Global Finance Journal 37 (2018) 39–56

Contents lists available at ScienceDirect

Global Finance Journal

journal homepage: www.elsevier.com/locate/gfj

Disentangling the impacts of industrial and global diversification on firm risk

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ARTICLE INFO

JEL classification:
G11
G12
G30
G32

Keywords:
Financial crisis
Global diversification
Industrial diversification
Idiosyncratic risk
Systematic risk

ABSTRACT

We examine the impact of corporate diversification on firm risk exposure from 1998 to 2016. We find that both global and industrial diversification mitigate idiosyncratic and world market risk while having a negligible impact on U.S. market risk, but the effects vary before, during, and after the financial crisis of 2007–2009. Before the crisis, only global diversification mitigates idiosyncratic risk, but it increases firms' exposure to world market risk. During the crisis, industrial diversification increases idiosyncratic risk, but both types of diversification increase exposure to U.S. market risk. After the crisis, both types of diversification increase firms' exposure to U.S. market risk but have negligible impact on idiosyncratic and world market risk. Our findings remain robust after we control for the potential endogeneity of the diversification decision through various self-selection models.

1. Introduction

Corporate diversification has been the subject of ongoing debate among investors and academics. Investors who wish to diversify their portfolios within a market or across markets can choose to diversify directly by creating a portfolio of firms from different industries or markets (homemade diversification) or diversify indirectly by investing instead in firms that are already diversified. Barriers to investment, including imperfectly integrated capital markets, transaction costs, and limited access to information, can impose impediments on homemade diversification, making it more efficient for investors to invest directly in diversified firms (Mathur & Hanagan, 1983). Studies suggest that corporate diversification should lower investment risk at a fraction of the cost incurred by individual investors (Agmon & Lessard, 1977; Doukas & Travlos, 1988; Harris & Ravenscraft, 1991; Sanders & Carpenter, 1998).

Scholars have investigated the impact of corporate diversification on various aspects of firm risk exposure. Rugman (1976), Brewer (1981), Fatemi (1984), Thompson (1984), Shaked (1986), Lubatkin and Chatterjee (1994), Goldberg and Heflin (1995), Reeb, Kwok, and Baek (1998), Stulz (1999), Olibe, Michello, and Thorne (2008), and Hann, Ogneva, and Ozbas (2013) measure the variance of stock returns and systematic risk (U.S. beta). Mitton and Vorkink (2010) measure the skewness of stock returns. Hund, Monk, and Tice (2010) and Lee and Li (2012) examine the volatility of firm profitability and ROE. While some studies document that corporate diversification reduces systematic risk (Fatemi, 1984; Hann et al., 2013; Lubatkin & Chatterjee, 1994; Shaked, 1986; Stulz, 1999), other studies show that diversified firms have a higher systematic risk (Krapl, 2015; Olibe et al., 2008; Reeb et al., 1998), a higher idiosyncratic risk, and a higher volatility of cash flows and earnings (Krapl, 2015).

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https://doi.org/10.1016/j.gfj.2018.04.006
Received 13 November 2017; Received in revised form 17 April 2018; Accepted 23 April 2018
Available online 27 April 2018

In this paper, we investigate the impact of corporate diversification on firms' risk exposure from 1998 to 2016. While previous studies either bundle industrial and global diversification or focus on only one of the two, this study disentangles the impacts of industrial and global diversification on firm risk exposure. In addition to systematic risk, we include idiosyncratic risk in our analysis to shed more light on various aspects of firm risk exposure. To estimate idiosyncratic and systematic risks of the sample firms, we employ a modified version of the Fama-French three-factor model instead of the one-factor market model and incorporate world returns (from the MSCI World Excluding U.S. index) as a fourth factor to circumvent the issue of incomplete modeling. We follow Heckman (1979) to address the potential endogeneity of the diversification decision (Campa & Kedia, 2002) through various self-selection models. Lastly, we check the results before, during, and after the financial crisis of 2007–2009.

The remainder of the paper is organized as follows. In Section 2, we summarize the existing literature on the effects of diversification on firm risk and develop our hypotheses. In Section 3, we describe the data and elaborate the methods. In Section 4, we report the empirical findings and their implications. In Section 5, we check the robustness of the results before, during, and after the financial crisis of 2007–2009. We conclude the paper in Section 6.

2. Literature review and hypotheses development

Firms benefit from two forms of diversification: industrial and global. Industrial diversification refers to involvement in different industries (business segments), and global diversification refers to operating in different countries (geographic segments). Corporations can lower their risk exposure by expanding their operations in industries or countries where they currently do little business, benefiting from the inverse relation between diversification and risk. To support this view, Fatemi (1984), Lubatkin and Chatterjee (1994), Shaked (1986), Stulz (1999), and recently Hann et al. (2013) show that diversification lowers firm systematic risks. Hann et al. (2013) argue that the imperfect correlation of cash flows (coinsurance) among diversified firms reduces countercyclical deadweight costs and ultimately systematic risk. In contrast, studies by Reeb et al. (1998), Olibe et al. (2008), and Krapl (2015) document higher systematic risks and more volatile cash flows and earnings for diversified firms.

In addition to systematic risk, a few studies provide insight into total risk and idiosyncratic risk exposure of diversified firms[1]. Goldberg and Helfin (1995) consider systematic risk and total risk simultaneously and suggest that a higher degree of global diversification reduces systematic risk but increases total risk. Krapl (2015) shows that global diversification increases idiosyncratic risk and consequently total risk.

In this study, to fill the gap in the literature, we focus simultaneously on both types of corporate diversification (industrial and global) as well as both types of firm risk (systematic and idiosyncratic). Considering the costs and benefits, we expect corporate diversification to have a significant impact on firm systematic and idiosyncratic risk.

Hypothesis 1. Diversification has a significant impact on firm systematic and idiosyncratic risk.

It is conceivable that industrial and global diversification may have different impacts on firms' systematic and/or idiosyncratic risk. In industrial diversification, firms expand their operations into various industries in their home country to diversify their income streams. From a portfolio theory perspective, firms with more diversified income streams are expected to have lower idiosyncratic risk. In addition, we argue that the more industrial segments the firm has, the more it resembles the market portfolio. In that way, industrial diversification enables firms to track the market portfolio closely, thus reducing firm systematic risk.

Hypothesis 2. Industrial diversification significantly reduces firm systematic and idiosyncratic risk.

As firms expand their operations into different countries, they face many opportunities and challenges. On one hand, globally diversified firms diversify their income streams in global markets, making it easier for investors to indirectly diversify their portfolio across imperfectly integrated capital markets (Agmon & Lessard, 1977; Hughes, Logue, & Sweeney, 1975). In addition, global diversification reduces risk by enhancing firms' debt capacity (Hughes et al., 1975; Logue & Merville, 1972) and diminishing the probability of bankruptcy (Michel & Shaked, 1986). On the other hand, globally diversified firms are exposed to various economic risks including political risks, foreign exchange risks, unfavorable taxation, agency problems, information asymmetry, and management self-fulfilling prophecies (Michel & Shaked, 1986; Reeb et al., 1998).

Accordingly, empirical studies document mixed findings on the impact of global diversification on firm systematic risk. Thompson (1984) examines a sample of large UK firms from 1966 to 1969, and reports no significant relationship between diversification and systematic risk. Fatemi (1984), Shaked (1986), Lubatkin and Chatterjee (1994), Stulz (1999), and Hann et al. (2013) show that diversification lowers firms' systematic risks. In contrast, Reeb et al. (1998), Olibe et al. (2008), and Krapl (2015) find higher systematic risks for globally diversified firms. Reeb et al. (1998) argue that globally diversified firms are exposed to various economic risks and hence experience higher systematic risk, and Olibe et al. (2008) support this argument for a sample of firms from 2000 to 2004. Krapl (2015) studies a large sample of firms from 1980 to 2011 and finds, in accord with previous studies, that global diversification increases systematic risk.

Globally diversified firms spread their investment and their income streams across multiple countries. From a portfolio theory

[1] Previous studies use other proxies to capture firm risk exposure. Mitton and Vorkink (2010) use the skewness of return distribution to proxy for risk and find that focused (single-segment) firms have greater skewness of returns than diversified firms. Hund et al. (2010) and Lee and Li (2012) use the volatility of profitability and return on equity (ROE), respectively, as proxies for risk and suggest that diversification reduces firm risk. However, they make no distinction between industrial and global diversification.

Table 1
Sample distribution.

Panel A: number of firm-year observations

Year	Domestic single-segment firms		Domestic multi-segment firms		Global single-segment firms		Global multi-segment firms		Total
1998	1232	(52.60%)	360	(15.37%)	461	(19.68%)	289	(12.34%)	2342
1999	955	(45.13%)	364	(17.20%)	448	(21.17%)	349	(16.49%)	2116
2000	894	(43.38%)	323	(15.67%)	461	(22.37%)	383	(18.58%)	2061
2001	775	(41.60%)	286	(15.35%)	431	(23.13%)	371	(19.91%)	1863
2002	707	(39.59%)	269	(15.06%)	446	(24.97%)	364	(20.38%)	1786
2003	673	(39.17%)	257	(14.96%)	430	(25.03%)	358	(20.84%)	1718
2004	664	(38.83%)	248	(14.50%)	443	(25.91%)	355	(20.76%)	1710
2005	605	(37.07%)	233	(14.28%)	435	(26.65%)	359	(22.00%)	1632
2006	594	(36.67%)	248	(15.31%)	437	(26.98%)	341	(21.05%)	1620
2007	588	(37.76%)	221	(14.19%)	396	(25.43%)	352	(22.61%)	1557
2008	606	(38.97%)	240	(15.43%)	338	(21.74%)	371	(23.86%)	1555
2009	541	(37.18%)	202	(13.88%)	392	(26.94%)	320	(21.99%)	1455
2010	498	(36.51%)	182	(13.34%)	362	(26.54%)	322	(23.61%)	1364
2011	447	(34.76%)	188	(14.62%)	329	(25.58%)	322	(25.04%)	1286
2012	416	(33.12%)	194	(15.45%)	330	(26.27%)	316	(25.16%)	1256
2013	367	(29.76%)	213	(17.27%)	334	(27.09%)	319	(25.87%)	1233
2014	342	(27.85%)	184	(14.98%)	352	(28.66%)	350	(28.50%)	1228
2015	305	(25.35%)	202	(16.79%)	343	(28.51%)	353	(29.34%)	1203
2016	221	(19.79%)	202	(18.08%)	327	(29.27%)	367	(32.86%)	1117
Total	11,430	(37.97%)	4616	(15.33%)	7495	(24.90%)	6561	(21.80%)	30,102

Panel B: number of unique firms

Period	Domestic single-segment firms		Domestic multi-segment firms		Global single-segment firms		Global multi-segment firms		Total
All	2424	38.13%	1066	16.77%	1686	26.52%	1181	18.58%	6357
Before 2007	2098	40.21%	904	17.33%	1213	23.25%	1002	19.21%	5217
2007–2009	518	23.78%	347	15.93%	758	34.80%	555	25.48%	2178
After 2009	654	26.88%	408	16.77%	735	30.21%	636	26.14%	2433

Notes: The sample period is 1998–2016. Domestic single-segment firms are firms that have only one business segment located in the United States. Domestic multi-segment firms are firms with more than one business segment located in the United States. Global single-segment firms are firms with a segment located globally. Global multi-segment firms are firms with more than one business segment and more than one geographic segment.

perspective, these firms are more diversified than their industrially diversified counterparts and should therefore have lower idiosyncratic risk. In addition, globally diversified firms have less resemblance to the U.S. market portfolio because they represent one or more segments of another market as well, and therefore should bear a higher U.S. market risk than industrially diversified firms.

Hypothesis 3. Globally diversified firms bear higher systematic risk than industrially diversified firms.

Hypothesis 4. Globally diversified firms have lower idiosyncratic risk than industrially diversified firms.

3. Data and methods

3.1. Data

We compile our sample from the COMPUSTAT Historical Segments database over the period 1998–2016[2]. Following Berger and Ofek (1995) and Denis, Denis, and Yost (2002), we exclude regulated financial and utility firms (primary SIC codes 6000–6999 and 4900–4999), foreign incorporated firms, and firm-year observations where the difference between the sum of the segment sales and total firm sales is greater than 1% and/or the total sales are less than $20 million.

3.2. Measure of firm diversification

We employ three alternative measures to capture and control for firms' degree of diversification. First, following Denis et al. (2002), we classify firms with more than one business segment as industrially diversified, and firms with more than one geographic

[2] Before 1998, firms reported their business segment information according to the Statement of Financial Accounting Standards (SFAS) No.131, in which business segments were classified by industry codes. Such classification might result in a firm with multiple related business lines being classified as a single-segment firm, which in turn distorts the impact of diversification on firm valuation documented in previous studies (He, 2009). SFAS 14 was introduced to overcome the weaknesses of SFAS 131 in that business segments are now classified according to their contributions to the firm's revenues and expenses. He (2009) compares pre-1998 and post-1998 data and suggests that the post-1998 data better capture the degree of corporate diversification and therefore its impact on firm.

segment as globally diversified. We report the sample distribution in Table 1. The sample includes 6357 firms and 30,102 firm-year observations. Firms that are diversified only across different industries are denoted domestic multi-segment (DM) and represent 15.33% of the sample (1066 firms and 4616 firm-year observations). Firms that are diversified only across different countries are designated global single-segment global (GS) and account for 24.90% of the sample (1686 firms and 7495 firm-year observations). Firms that are diversified across different industries and different countries are labeled global multi-segment (GM). There are a total of 1181 GM firms with 6561 firm-year observations, representing 21.80% of the sample. Domestic firms with only one business segment are designated domestic single-segment (DS); these firms serve as the benchmark. Our sample contains 2424 DS firms, representing 11,430 firm-year observations, or 37.97%. The decreasing trend in the number of domestic multi-segment (DM) firms and the increasing trends in both global single-segment (GS) and global multi-segment (GM) firms indicate that firms have become more globally diversified over our sample period (Panel A). Additionally, we report the number of unique firms before, during, and after the financial crisis of 2007–2009 (Panel B)[3].

Second, we use the number of business and geographic segments to quantify firm diversification.

Third, we calculate the sales-based Herfindahl index to proxy firm diversification. The Herfindahl index for the i^{th} firm in year t is computed as

$$HERF_{it} = \sum \left(\frac{SSales_{it}}{FSales_{it}} \right)^2, \tag{1}$$

where $SSales_{it}$ denotes the segment sales (which can be sales generated from an industrial segment or from a geographic segment) for firm i in year t. $FSales_{it}$ is firm i's total sales across all reported segments in that year. Accordingly, we report the industrial-segment-sales-based Herfindahl index (*I-HERF*) and the geographic-segment-sales-based Herfindahl index (*G-HERF*) separately. For domestic single-segment firms (DS), the Herfindahl index is equal to 1, and for multiple-segment firms (DM, GS, and GM) the Herfindahl index is less than 1; more diversified firms have a smaller index (closer to 0).

In Table 2, we report the descriptive statistics for both measures of firm diversification and other firm characteristics. On average, DM firms have 2.659 business segments, while GS firms have 3.464 geographic segments. GM firms have 2.938 business segments and 3.795 geographic segments. Domestic and global single-segment (DS and GS) firms have industrial-sales-based Herfindahl index equal to 1, since they are not industrially diversified. Similarly, geographic-sales-based Herfindahl index is equal to 1 for domestic single-segment and multi-segment (DS and DM) firms, which are not operating in foreign countries. DM and GM firms have average business-sales-based Herfindahl indexes of 0.633 and 0.531, respectively. GS and GM firms have geographic-sales-based Herfindahl indexes of 0.568 and 0.564, respectively. On average, GM firms have more business segments than DM firms (2.938 vs. 2.659 segments) and more geographic segments than GS firms (3.795 vs. 3.464 segments). Diversified firms tend to have greater assets and market capitalization than nondiversified firms. Globally diversified firms are larger, more leveraged, and more profitable than industrially diversified firms. They also have lower capital expenditure and higher advertising expenses.

3.3. Measure of risk

The three measures of risk that we are interested in are idiosyncratic risk (firm-specific risk), U.S. systematic risk (U.S. market beta), and world systematic risk (world market beta). We employ the following modified Fama-French 3-factor model to obtain the idiosyncratic risk, U.S. market risk, and world market risk of each firm in the sample as follows:

$$(R_{it} - R_{ft}) = \alpha + \beta_1 (R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WORLD_t + \varepsilon_{it}, \tag{2}$$

where $(R_{it} - R_{ft})$ is the excess return of firm i on day t; $(R_{mt} - R_{ft})$ is the market excess return on day t; SMB_t is the excess return of the small-stock portfolio over the big-stock portfolio on day t; HML_t is the excess return of the high-book-to-market portfolio over the low-book-to-market portfolio on day t; and $WORLD_t$ is the difference between the returns on the MSCI World Index excluding the U.S. on day t and the risk-free rate in the U.S. market[4]. The factors are obtained from Professor Kenneth French's website[5].

The above model is estimated cross-sectionally by firm and year. β_1 captures the exposure of the firm to the U.S. market. β_4 captures the exposure of the firm to the markets of 22 developed countries outside the United States. We calculate the standard deviation of residuals for each firm in each year and use it as the firm's idiosyncratic risk. We multiply the daily idiosyncratic risk by the square root of the number of trading days in a year ($\sqrt{250}$) to obtain the annualized idiosyncratic risk.

While Brewer (1981), Shaked (1986), Amit and Livnat (1988), Reeb et al. (1998), Kwok and Reeb (2000), and Best, Hodges, and Lin (2004) estimate diversified firms' risk using the one-factor market model (in which U.S. market return is the only explanatory variable), Stulz (1999) suggests that the global market factor (the excess returns of the world index over the U.S. domestic risk-free rate) should be included in the model to estimate the expected returns of globally diversified firms. Because markets have become increasingly integrated over time, even purely domestic firms are not immune to global market risks. Aggarwal and Harper (2010), for example, document significant exchange rate exposure borne by domestic firms; changes in exchange rate affect the cost structure

[3] Some firms may not exist in all three subperiods, so the sum of the numbers of unique firm observations in the subperiods does not match the total number of unique firms for the whole sample.

[4] The MSCI World Index is a broad global equity benchmark that represents large and mid-cap equity performance across 23 developed-country markets (Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Greece, Hong Kong, Ireland, Italy, Japan, Portugal, the Netherlands, New Zealand, Norway, Singapore, Spain, Sweden, Switzerland, and the United States). For more information please visit https://www.msci.com/world.

[5] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html.

Table 2
Descriptive statistics.

	Domestic single-segment firms		Domestic multi-segment firms		Global single-segment firms		Global multi-segment firms	
Variables	Mean	Median	Mean	Median	Mean	Median	Mean	Median
# of business segments	1.000	1.000	2.659	2.000	1.000	1.000	3.795	3.000
# of geographic segments	1.000	1.000	1.000	1.000	3.464	3.000	2.938	3.000
Industrial Herfindahl index	1.000	1.000	0.633	0.610	1.000	1.000	0.531	0.512
Global Herfindahl index	1.000	1.000	1.000	1.000	0.568	0.542	0.564	0.537
Market capitalization ($ million)	1660.490	209.146	2598.120	334.233	5692.060	640.066	7131.250	1118.460
Assets ($ million)	1519.910	229.431	2731.280	379.108	4497.790	516.034	5506.760	1148.300
Debt/asset	0.535	0.498	0.539	0.534	0.495	0.465	0.540	0.532
Capital expenditure/sales	0.117	0.034	0.075	0.033	0.072	0.035	0.052	0.032
EBIT/sales	−0.005	0.057	0.066	0.071	0.040	0.080	0.085	0.088
R&D/sales	0.120	0.001	0.048	0.010	0.115	0.057	0.058	0.028
Advertising/sales	0.037	0.016	0.028	0.012	0.032	0.013	0.027	0.011

Notes: This table provides the summary statistics of the characteristics of the 29,986 sample firm-year observations from 1998 to 2016. Market capitalization and assets are expressed in millions.

of global firms, which in turn affect the competition between these firms and domestic firms. To capture this trend, we incorporate the excess returns on the MSCI World Excluding U.S. index into the model.

3.4. Analyses of the relationship between diversification and firm risk

To test for the relationship between diversification and firms' risks, in Table 3 we compare and contrast risk levels between different types of firms (DS, DM, GS, or GM). In Table 4 we also compare risk levels between groups of firms with higher vs. lower numbers of business/geographic segments than the sample median, and between groups of firms with higher vs. lower Herfindahl indices than the sample median. We employ the traditional *t*-test and the nonparametric Wilcoxon rank sum to test whether differences between the groups are significant. We extend the univariate analyses to test whether the results hold in a multivariate framework that accounts for other factors (including unobservable ones), plus the potential endogeneity of the diversification decision. We regress the calculated measures of firms' risk on their diversification profiles and other control variables as follows:

$$Idiosyncratic\ Risk_{i,t} = \alpha_0 + \beta_1 DM_{i,t} + \beta_2 GS_{i,t} + \beta_3 GM_{i,t} + \beta_4 LNMKCAP_{i,t} + \beta_5 DEBT_{i,t} + \beta_6 INVERSEMILL_{i,t} + \varepsilon_{i,t}, \quad (5)$$

$$U.S.\ Market\ Risk_{i,t} = \alpha_0 + \beta_1 DM_{i,t} + \beta_2 GS_{i,t} + \beta_3 GM_{i,t} + \beta_4 LNMKCAP_{i,t} + \beta_5 DEBT_{i,t} + \beta_6 INVERSEMILL_{i,t} + \varepsilon_{i,t}, \quad (6)$$

and

$$World\ Market\ Risk_{i,t} = \alpha_0 + \beta_1 DM_{i,t} + \beta_2 GS_{i,t} + \beta_3 GM_{i,t} + \beta_4 LNMKCAP_{i,t} + \beta_5 DEBT_{i,t} + \beta_6 INVERSEMILL_{i,t} + \varepsilon_{i,t}, \quad (7)$$

where $DM_{i,t}$, $GS_{i,t}$, and $GM_{i,t}$ are dummy variables that take values equal to 1 if the firm is a domestic multi-segment firm, global single-segment firm, or global multi-segment firm, respectively. In addition, we also replace these three dummy variables with (1) a dummy variable for globally diversified firms (which can have one or many business segments), (2) number of business/geographic segments, and (3) business/geographic-sales-based Herfindahl indices.

The remaining control variables are selected following previous studies. The natural logarithm of market capitalization is used to control for firm size. The ratio of industry-adjusted total debt to total assets (*DEBT*) is included to control for relative financial leverage. Following Campa and Kedia (2002), several studies including those by Villalonga (2004), Ammann, Hoechle, and Schmid (2012), and He (2012) show that failure to address the endogeneity of firms' diversification decision can distort the empirical results. We address this issue with a two-step Heckman (1979) self-selection model. We first estimate the predicted probability of the firm's decision to diversify to calculate the inverse Mills ratio ($INVERSEMILL_{i,t}$) and include it in the regression models. The predicted probability of a firm's decision to diversify is estimated using the following regression:

$$DIVERSIFIED_{i,t} = \alpha_i + \beta_1 LNASSET_{i,t} + \beta_2 LAG1EBIT_{i,t} + \beta_3 LAG1CAPX_{i,t} + \beta_4 SP_{i,t} + \beta_5 NUMDIVFIRMS_{i,t} + \beta_6 SALEDIVFIRMS_{i,t} + \beta_7 MAVOL_{i,t} + \beta_8 MANUM_{i,t} + \beta_9 GDP_t + \beta_{10} MAJOREX_{i,t} + \beta_{11} DIVPAID_{i,t} + \varepsilon_{i,t} \quad (8)$$

We estimate Eq. (8) using a probit regression and an ordinal probit regression, alternatively. In the probit regression, DIVERSIFIED is a dummy variable set equal to 1 for industrially and/or globally diversified firms, and 0 for domestic single-segment firms, as in Campa and Kedia (2002). In the ordinal probit regression, DIVERSIFIED is coded to be 0 for domestic single-segment (DS) firms, 1 for domestic multi-segment (DM) firms, 2 for global single-segment (GS) firms, and 3 for global multi-segment (GM) firms. Following Campa and Kedia (2002) and Villalonga (2004), we include the following control variables. LNASSET is the natural logarithm of the firm's total assets. LAG1EBIT is the lag of EBIT-to-sales ratio. LAG1CAPX is the lag of capital-expenditure-to-sales ratio. SP is the dummy variable for firms included in the S&P indices. NUMDIVFIRMS is the number of diversified firms in the industry.

Table 3
Comparisons of risk measures among diversified firms.

Panel A: risk by diversification profile

	N	Idiosyncratic risk	U.S. market beta	World beta
Domestic single-segment firms (DS)	11,429	0.623	0.781	0.288
Domestic multi-segment firms (DM)	4414	0.539	0.781	0.245
Global single-segment firms (GS)	7893	0.511	0.972	0.291
Global multi-segment firms (GM)	6226	0.405	0.990	0.145

Panel B: comparison of risk by diversification profile

		Idiosyncratic risk	U.S. market beta	World beta
DM vs. DS	Mean diff	−0.084	0.000	−0.044
	t-stat	−12.37***	0.01	−1.48
	Wilcoxon stat	−16.53***	0.57	−1.43
GS vs. DS	Mean diff	−0.113	0.191	0.003
	t-stat	−22.15***	24.22***	0.12
	Wilcoxon stat	−20.15***	23.52***	0.38
GM vs. DS	Mean diff	−0.219	0.209	−0.144
	t-stat	−43.99***	26.88***	−6.15***
	Wilcoxon stat	−43.57***	26.04***	−4.13***
GS vs. DM	Mean diff	−0.028	0.191	0.046
	t-stat	−22.21***	2.21**	5.95***
	Wilcoxon stat	−24.12***	4.05***	4.38***
GM vs. DM	Mean diff	−0.134	0.209	−0.100
	t-stat	−20.4***	21.51***	−3.35***
	Wilcoxon stat	−20.76***	21.77***	−1.97**
GM vs. GS	Mean diff	−0.106	0.018	−0.146
	t-stat	−11.66***	21.91***	−3.55***
	Wilcoxon stat	−18.76***	21.84***	−2.13**

Notes: We compare and contrast the average (median) idiosyncratic risk, U.S. domestic market risk, and world market risk among the 29,986 sample firm-year observations from 1998 to 2016, grouped by their diversification profile. Domestic single-segment firms are firms that have only one business segment located in the United States. Domestic multi-segment firms are firms with more than one business segment located in the United States. Global single-segment firms are firms with a segment located globally. Global multi-segment firms are firms with more than one business segment and more than one geographic segment. We employ the following modified Fama-French 3-factor model to obtain the idiosyncratic risk, U.S. market risk, and world market risk of each firm in the sample:
$(R_{it} - R_{ft}) = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WORLD_t + \varepsilon_{it}$, where $(R_{it} - R_{ft})$ is the excess return of firm i on day t; $(R_{mt} - R_{ft})$ is the market excess return on day t; SMB_t is the excess return of the small-stock portfolio over the big-stock portfolio on day t; HML_t is the excess return of the high-book-to-market portfolio over the low-book-to-market portfolio on day t; and $WORLD_t$ is the difference between the returns on the MSCI World Excluding U.S. index on day t and the risk-free rate in the U.S. market. The factors are obtained from Professor Kenneth French's website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). The above model is estimated cross-sectionally by firm and year. β_1 captures the exposure of the firm to the U.S. market. β_4 captures the exposure of the firm to the world markets outside the U.S. We calculate the standard deviation of residuals for each firm in each year and use it as the idiosyncratic risk of the firm. We multiply the daily idiosyncratic risk by the square root of the number of trading days in a year to obtain the annualized idiosyncratic risk. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

SALEDIVFIRMS is the percentage of sales in the industry generated by diversified firms. MAVOL is the natural log of the values of all mergers and acquisitions in the industry. MANUM is the natural log of the total number of mergers and acquisitions in the industry. GDP is real GDP growth. MAJOREX is a dummy variable for firms listed on major exchanges including the NYSE, NASDAQ, and AMEX. DIVPAID is a dummy variable for firms that pay dividends in the preceding year.

Idiosyncratic risk is firm specific and time persistent. Therefore, we estimate Eq. (5) using a firm fixed-effect model. We conduct the Hausman test to make sure the fixed-effect model is more appropriate for our data than the random-effect model[6]. Unlike idiosyncratic risk, systematic risk is nondiversifiable; all firms are subject to U.S. market risk, and given the increasing integration of global markets, even domestic firms are not immune to world market risk. Since market risk exposure is common among all firms, cross-sectional dependence may become an issue. Therefore, we estimate Eqs. (6) and (7) with Driscoll-Kraay standard errors (Driscoll & Kraay, 1998) to account for heteroskedasticity, autocorrelation, and cross-sectional dependence between firms[7].

[6] Results from the Hausman test are not reported here to conserve space.

[7] Failing to account for cross-sectional (spatial) dependence will result in inconsistently estimated standard errors (Driscoll & Kraay, 1998). Driscoll and Kraay standard errors are well calibrated when cross-sectional dependence is present (Hoechle, 2007).

Table 4
Comparison of risk by diversification degree.

Panel A: comparison by number of business segments

	Low number of business segments (N = 19,323)		High number of business segments (N = 10,0640)		Difference			
	Mean	Median	Mean	Median	Mean diff	Median diff	t-stat	Wilcoxon stat
Idiosyncratic risk	0.577	0.468	0.460	0.357	−0.117	−0.111	−28.58***	−33.59***
U.S. market beta	0.859	0.855	0.904	0.923	0.044	0.068	7.12***	8.42***
World beta	0.290	0.145	0.186	0.075	−0.104	−0.069	−5.54***	−4.3***

Panel B: Comparison by number of geographic segments

	Low number of geographic segments (N = 15,844)		High number of geographic segments (N = 14,119)		Difference			
	Mean	Median	Mean	Median	Mean diff	Median diff	t-stat	Wilcoxon stat
Idiosyncratic risk	0.600	0.475	0.464	0.372	−0.136	−0.103	−34.1***	−33.59***
U.S. market beta	0.781	0.768	0.980	0.977	0.199	0.210	32.99***	32.51***
World beta	0.276	0.132	0.227	0.104	−0.050	−0.028	−1.67*	−1.57

Panel C: Comparison by business Herfindahl index

	Low Herfindahl (N = 10,627)		High Herfindahl (N = 19,336)		Difference			
	Mean	Median	Mean	Median	Mean diff	Median diff	t-stat	Wilcoxon stat
Idiosyncratic risk	0.460	0.357	0.577	0.468	0.117	0.111	28.53***	33.59***
U.S. market beta	0.904	0.923	0.859	0.855	−0.044	−0.068	−7.12***	−8.41***
World beta	0.185	0.075	0.290	0.145	0.105	0.070	5.6***	4.34***

Panel D: comparison by firm geographic Herfindahl index

	Low Herfindahl (N = 14,111)		High Herfindahl (N = 15,852)		Difference			
	Mean	Median	Mean	Median	Mean diff	Median diff	t-stat	Wilcoxon stat
Idiosyncratic risk	0.464	0.372	0.600	0.475	0.136	0.103	34.06***	33.54***
U.S. market beta	0.980	0.978	0.781	0.768	−0.199	−0.210	−32.99***	−32.5***
World beta	0.227	0.105	0.276	0.131	0.049	0.027	1.62	1.53

Notes: We compare and contrast idiosyncratic risk, U.S. domestic market risk, and world market risk among the 27,906 sample firm-year observations from 1998 to 2016. We break down the sample according to whether a firm-year observation has higher or lower value than the sample median value in terms of number of business segments (in Panel A), number of geographic segments (in Panel B), business-sales-based Herfindahl index (in Panel C), and geographic-sales-based Herfindahl index (in Panel D). Business/geographic-sales-based Herfindahl index is the sum of the squared ratios of each business/geographic segment of a firm to its total sales. We employ the following modified Fama-French 3-factor model to obtain the idiosyncratic risk, U.S. market risk, and world market risk of each firm in the sample:
$(R_{it} - R_{ft}) = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WORLD_t + \varepsilon_{it}$, where $(R_{it} - R_{ft})$ is the excess return of firm i on day t; $(R_{mt} - R_{ft})$ is the market excess return on day t; SMB_t is the excess return of the small-stock portfolio over the big-stock portfolio on day t; HML_t is the excess return of the high-book-to-market portfolio over the low-book-to-market portfolio on day t; and $WORLD_t$ is the difference between the returns on the MSCI World Excluding U.S. index on day t and the risk-free rate in the U.S. market. The factors are obtained from Professor Kenneth French's website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). The above model is estimated cross-sectionally by firm and year. β_1 captures the exposure of the firm to the U.S. market. β_4 captures the exposure of the firm to world markets outside the U.S. We calculate the standard deviation of residuals for each firm in each year and use it as the idiosyncratic risk of the firm. We multiply the daily idiosyncratic risk by the square root of the number of trading days in a year ($\sqrt{250}$) to obtain the annualized idiosyncratic risk. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Table 5
Correlation matrix.

	Idiosyncratic risk	U.S. beta	World beta	DS firms	DM firms	GS firms	GM firms	# of bus segments	# of geo segments	Industrial Herfindahl	Global Herfindahl
Idiosyncratic risk	1										
U.S. beta	0.002	1									
World beta	0.167***	−0.103***	1								
DS firms	0.193***	−0.138***	0.017***	1							
DM firms	0.00391	−0.073***	−0.002	−0.326***	1						
GS firms	−0.042***	0.109***	0.014***	−0.469***	−0.249***	1					
GM firms	−0.189***	0.111***	−0.034***	−0.402***	−0.213***	−0.307***	1				
# of bus segments	−0.176***	0.058***	−0.032***	−0.476***	0.394***	−0.363***	0.619***	1			
# of geo segments	−0.160***	0.177***	−0.012**	−0.514***	−0.273***	0.392***	0.426***	0.194***	1		
Industrial Herfindahl	0.168***	−0.055***	0.030***	0.506***	−0.380***	0.386***	−0.692***	−0.885***	−0.216***	1	
Global Herfindahl	0.186***	−0.209***	0.007	0.617***	0.327***	−0.524***	−0.456***	−0.175***	−0.797***	0.205***	1

Notes: We report the matrix of correlations between firm diversification variables and risk measures of the 27,906 sample firm-year observations from 1998 to 2016. We employ the following modified Fama-French 3-factor model to obtain the idiosyncratic risk, U.S. market risk, and world market risk of each firm in the sample:
$(R_{it} - R_{ft}) = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WORLD_t + \varepsilon_{it}$, where $(R_{it} - R_{ft})$ is the excess return of firm i on day t; $(R_{mt} - R_{ft})$ is the market excess return on day t; SMB_t is the excess return of the small-stock portfolio over the big-stock portfolio on day t; HML_t is the excess return of the high-book-to-market portfolio over the low-book-to-market portfolio on day t; and $WORLD_t$ is the difference between the returns on the MSCI World Excluding U.S. index on day t and the risk-free rate in the U.S. market. The factors are obtained from Professor Kenneth French's website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). The above model is estimated cross-sectionally by firm and year. β_1 captures the exposure of the firm to the U.S. market. β_4 captures the exposure of the firm to world markets outside the U.S. We calculate the standard deviation of residuals for each firm in each year and use it as the idiosyncratic risk of the firm. We multiply the daily idiosyncratic risk by the square root of the number of trading days in a year ($\sqrt{250}$) to obtain the annualized idiosyncratic risk. DS Firms, DM Firms, GS Firms, and GM Firms are the dummy variables for the types of diversification the firm is involved in. Domestic single-segment (DS) firms are firms that have only one business segment located in the United States. Domestic multi-segment (DM) firms are firms with more than one business segment located in the United States. Global single-segment (GS) firms are firms with a segment located globally. Global multi-segment (GM) firms are firms with more than one business segment and more than one geographic segment. Business/geographic-sales-based Herfindahl index is the sum of the squared ratios of each business/geographic segment of a firm to its total sales. * indicates a significance level of at least 5%.

Table 6
Probit regressions of diversification decision.

Panel A: summary statistics of the control variables employed in the probit regressions

	Domestic single-segment firms		Domestic multi-segment firms		Global single-segment firms		Global multi-segment firms	
Variables	Mean	Median	Mean	Median	Mean	Median	Mean	Median
% of diversified firms in the industry	13.014	12.195	17.604	15.213	17.620	16.124	19.492	18.103
% of sales in the industry generated by diversified firms	22.267	20.960	26.892	24.717	28.712	27.279	30.206	28.636
Volume of mergers and acquisitions in the industry	37,481.18	8771.92	39,801.81	8887.66	47,479.68	28,806.81	43,433.66	17,398.14
Number of mergers and acquisitions in the industry	79.283	29.000	75.623	27.000	108.161	64.000	79.291	47.000
Real GDP growth (%)	0.603	0.670	0.638	0.659	0.502	0.593	0.598	0.593

	Domestic single-segment firms		Domestic multi-segment firms		Global single-segment firms		Global multi-segment firms	
	N	% of the subsample	N	% of the subsample	N	% of the subsample	N	% of the subsample
Number of firms in S&P index	709	2.374	316	1.058	1407	4.711	1445	4.838
Firms listed on a major exchange	9119	30.533	3767	12.613	7238	24.235	5830	19.521
Firms that paid dividends last year	4664	15.616	2334	7.815	3452	11.558	3617	12.111

Panel B: probit regressions of the diversification decision

	Model 1—probit Dependent variable = dummy for diversified firms			Model 2—ordered probit Dependent variable = dummy for each diversification profile		
	Coef	t-stat	Marginal effect	Coef	t-stat	Marginal effect
Ln of total assets	0.664	29.347 ***	0.063	0.257	33.603 ***	−0.060
Lagged EBIT/sale	−0.010	−0.585	0.000	−0.005	−0.649	0.000
Lagged capital expenditure/sale	−0.030	−1.805 *	−0.002	−0.016	−2.262 **	0.002
Dummy for firms in S&P index	0.124	5.558 ***	0.067	0.045	6.551 ***	−0.060
% diversified firms in the industry	1.015	40.763 ***	2.122	0.289	38.625 ***	−1.484
% of sales in the industry generated by diversified firms	0.110	4.955 ***	0.144	0.061	8.268 ***	−0.195
Ln of volume of mergers and acquisitions in the industry	0.199	9.847 ***	0.000	0.069	10.342 ***	0.000
Ln of number of mergers and acquisitions in the industry	0.347	17.790 ***	0.001	0.122	18.349 ***	0.000
Real GDP growth	−0.462	−6.977 ***	−18.830	−0.133	−6.327 ***	13.274
Firms listed on a major exchange	0.192	11.671 ***	0.103	0.080	13.296 ***	−0.106

(*continued on next page*)

Table 6 (*continued*)

Panel B: probit regressions of the diversification decision

	Model 1—probit Dependent variable = dummy for diversified firms			Model 2—ordered probit Dependent variable = dummy for each diversification profile		
	Coef	t-stat	Marginal effect	Coef	t-stat	Marginal effect
Firms that paid dividends last year	0.033	1.902 *	0.012	0.008	1.302	−0.007
Constant	−1.728	−18.442 ***		1.606	22.348 ***	
Constant				2.038	28.270 ***	
Constant				2.884	39.664 ***	
Observations	29,616			29,616		
Pseudo R-squared	0.151			0.0829		
LR Chi-squared	5938			6520		

Notes: In Panel A, we report the summary statistics of control variables employed in the probit regressions in Panel B. The dependent variable is the dummy variable for whether the firm is diversified or not. In Panel B, the dependent variable is the dummy variable, coded 0 for DS firms, 1 for DM firms, 2 for GS firms, and 3 for GM firms. Domestic single-segment (DS) firms are firms that have only one business segment located in the United States. Domestic multi-segment (DM) firms are firms with more than one business segment located in the United States. Global single-segment (GS) firms are firms with a segment located globally. Global multi-segment (GM) firms are firms with more than one business segment and more than one geographic segment. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

Table 7
Fixed-effect regressions of idiosyncratic risk on firm diversification profile.

	Model 1	Model 2	Model 3	Model 4
Dummy for DM firms	−0.022			
	(−1.997**)			
Dummy for GS firms	−0.037			
	(−3.454***)			
Dummy for GM firms	−0.049			
	(−4.123***)			
Dummy for globally diversified firms		−0.034		
		(−3.569***)		
Industrial Herfindahl index			0.020	
			(1.459)	
Global Herfindahl index			0.086	
			(4.174***)	
# of bus segments				−0.007
				(−2.327**)
# of geo segments				−0.007
				(−3.599***)
Ln of asset	−0.075	−0.075	−0.074	−0.074
	(−12.269***)	(−12.397***)	(−12.254***)	(−12.269***)
Debt ratio	0.348	0.346	0.348	0.346
	(14.770***)	(14.710***)	(14.752***)	(14.673***)
Capital expenditure/sales	−0.038	−0.030	−0.037	−0.036
	(−0.577)	(−0.451)	(−0.564)	(−0.539)
R&D expenditure/sales	0.324	0.327	0.334	0.332
	(2.342**)	(2.368**)	(2.425**)	(2.407**)
Market-to-book ratio	−0.013	−0.012	−0.013	−0.013
	(−9.931***)	(−9.890***)	(−9.975***)	(−9.906***)
Inverse Mills ratio	0.123	0.137	0.148	0.141
	(1.956*)	(2.167**)	(2.344**)	(2.239**)
Constant	0.857	0.852	0.739	0.860
	(21.769***)	(21.822***)	(16.139***)	(22.108***)
F-statistics	142.300***	151.600***	147.600***	146.600***
Adj. R-squared	0.249	0.249	0.249	0.249
Year fixed effects	Yes	Yes	Yes	Yes
Number of firms	4234	4234	4234	4234
Number of observations	29,430	29,430	29,430	29,430
Rho	0.786	0.781	0.762	0.592

Notes: We employ the following modified Fama-French 3-factor model to obtain the idiosyncratic risk of each firm in the sample: $(R_{it} - R_{ft}) = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WORLD_t + \varepsilon_{it}$, where $(R_{it} - R_{ft})$ is the excess return of firm i on day t; $(R_{mt} - R_{ft})$ is the market excess return on day t; SMB_t is the excess return of the small-stock portfolio over the big-stock portfolio on day t; HML_t is the excess return of the high-book-to-market portfolio over the low-book-to-market portfolio on day t; and $WORLD_t$ is the difference between the returns on the MSCI World Excluding U.S. index on day t and the risk-free rate in the U.S. market. The factors are obtained from Professor Kenneth French's website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). The above model is estimated cross-sectionally by firm and year. β_1 captures the exposure of the firm to the U.S. market. β_4 captures the exposure of the firm to world markets outside the United States. We calculate the standard deviation of residuals for each firm in each year and use it as the idiosyncratic risk of the firm. We multiply the daily idiosyncratic risk by the square root of the number of trading days in a year ($\sqrt{250}$) to obtain the annualized idiosyncratic risk. Domestic single-segment (DS) firms are firms that have only one business segment located in the U.S. Domestic multi-segment (DM) firms are firms with more than one business segment located in the United States. Global single-segment (GS) firms are firms with a segment located globally. Global multi-segment (GM) firms are firms with more than one business segment and more than one geographic segment. The dummy for globally diversified firms captures global single-segment (GS) and global multi-segment (GM) firms. The inverse Mills ratio is obtained from the model in Panel B of Table 6. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

4. Results

4.1. Univariate results on the relationship between diversification and risk

In Table 3, Panel A, we report the mean (median) of the idiosyncratic risk, U.S. market risk, and world market risk for each of the four groups of firms. In Panel B, we compare and contrast the statistics between the groups. We notice that focused firms (DS) have the highest idiosyncratic risk. As firms diversify, idiosyncratic risk drops significantly. Interestingly, globally diversified firms have less idiosyncratic risk: while global single-segment firms and global multi-segment firms experience average idiosyncratic risks of 0.511 and 0.405, respectively, domestic multi-segment firms pose higher idiosyncratic risks (0.539). These results are consistent with those of Best et al. (2004).

In contrast to the findings for idiosyncratic risk, globally diversified firms have higher market risk. For U.S. market risk, while domestic single-segment and multi-segment firms have the same level of U.S. market beta (0.781), global single-segment firms and

Table 8
Driscoll-Kraay regressions of U.S. market risk on firm diversification profile.

	Model 1	Model 2	Model 3	Model 4
Dummy for DM firms	−0.016			
	(−2.033**)			
Dummy for GS firms	0.005			
	(0.624)			
Dummy for GM firms	0.009			
	(0.729)			
Dummy for globally diversified firms		0.013		
		(1.725*)		
Industrial Herfindahl index			0.002	
			(0.106)	
Global Herfindahl index			0.007	
			(0.260)	
# of bus segments				−0.005
				(−1.447)
# of geo segments				0.001
				(0.122)
Ln of asset	0.125	0.125	0.126	0.126
	(8.847***)	(8.996***)	(8.668***)	(8.866***)
Debt ratio	−0.123	−0.124	−0.123	−0.123
	(−4.270***)	(−4.270***)	(−4.271***)	(−4.217***)
Capital expenditure/sales	0.546	0.548	0.544	0.541
	(4.531***)	(4.499***)	(4.537***)	(4.494***)
R&D expenditure/sales	0.278	0.279	0.281	0.279
	(1.230)	(1.223)	(1.228)	(1.223)
Market-to-book ratio	0.024	0.024	0.024	0.024
	(5.861***)	(5.857***)	(5.830***)	(5.837***)
Inverse Mills ratio	−0.121	−0.107	−0.107	−0.109
	(−1.294)	(−1.129)	(−1.145)	(−1.162)
Constant	0.255	0.249	0.240	0.253
	(3.017***)	(2.941***)	(2.052**)	(3.058***)
F-statistics	6.54***	6.54***	6.54***	6.54***
Adj. R-squared	0.445	0.445	0.445	0.445
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Number of firms	4234	4234	4234	4234
Number of observations	29,430	29,430	29,430	29,430

Notes: In this table we report the results from the OLS regression with Driscoll-Kraay standard errors of firms' U.S. market risk. We employ the following modified Fama-French 3-factor model to obtain the U.S. market risk of each firm in the sample:
$(R_{it} - R_{ft}) = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WORLD_t + \varepsilon_{it}$, where $(R_{it} - R_{ft})$ is the excess return of firm i on day t; $(R_{mt} - R_{ft})$ is the market excess return on day t; SMB_t is the excess return of the small-stock portfolio over the big-stock portfolio on day t; HML_t is the excess return of the high-book-to-market portfolio over the low-book-to-market portfolio on day t; and $WORLD_t$ is the difference between the returns on the MSCI World Excluding U.S. index on day t and the risk-free rate in the U.S. market. The factors are obtained from Professor Kenneth French's website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). The above model is estimated cross-sectionally by firm and year. β_1 captures the exposure of the firm to the U.S. market. Domestic single-segment (DS) firms are firms that have only one business segment located in the United States. Domestic multi-segment (DM) firms are firms with more than one business segment located in the United States. Global single-segment (GS) firms are firms with a segment located globally. Global multi-segment (GM) firms are firms with more than one business segment and more than one geographic segment. The dummy for globally diversified firms captures global single-segment (GS) and global multi-segment (GM) firms. The inverse Mills ratio is obtained from the model in Panel B of Table 6. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

global multi-segment firms have significantly higher levels of U.S. market beta (0.972 and 0.990, respectively). Our results are consistent with findings by Reeb et al. (1998) and Olibe et al. (2008), who document a higher systematic risk for multinational firms. For world market risk, global single-segment firms experience the highest level (0.291) and global multi-segment firms have the lowest level (0.145) of world market beta. Global single-segment firms have significantly higher exposure to world market risk than domestic multi-segment firms. Surprisingly, global multi-segment firms have a significantly lower exposure to world market risk than do focused, domestic multi-segment and global single-segment firms. The results in Table 3 suggest that, compared to industrial diversification, global diversification brings lower idiosyncratic risk and higher U.S. market risk.

In Table 4, we employ alternative proxies of corporate diversification such as the number of business segments (in Panel A), the number of geographic segments (in Panel B), business Herfindahl index (in Panel C), and geographic Herfindahl index (in Panel D) to make sure that our results are not sensitive to the measure of corporate diversification. For each measure, we break the sample into two groups, above and below the median firm in the sample, and compare and contrast the risk measures between the high and low groups.

The results in Table 4 show that diversification brings about the expected risk reductions: idiosyncratic risk drops significantly as

Table 9
Driscoll-Kraay regressions of world market risk on firm diversification profile.

	Model 1	Model 2	Model 3	Model 4
Dummy for DM firms	−0.079			
	(−2.079**)			
Dummy for GS firms	−0.124			
	(−2.388**)			
Dummy for GM firms	−0.189			
	(−3.608***)			
Dummy for globally diversified firms		−0.123		
		(−2.850***)		
Industrial Herfindahl index			0.138	
			(3.353***)	
Global Herfindahl index			0.106	
			(0.882)	
# of bus segments				−0.027
				(−3.213***)
# of geo segments				−0.027
				(−2.069**)
Ln of asset	−0.111	−0.113	−0.112	−0.111
	(−2.718***)	(−2.802***)	(−2.699***)	(−2.736***)
Debt ratio	0.548	0.542	0.546	0.540
	(4.997***)	(4.925***)	(4.871***)	(4.824***)
Capital expenditure / sales	−0.038	0.000	−0.014	−0.023
	(−0.076)	(0.001)	(−0.028)	(−0.046)
R&D expenditure / sales	1.261	1.275	1.269	1.293
	(1.404)	(1.423)	(1.416)	(1.450)
Market-to-book ratio	−0.038	−0.038	−0.038	−0.038
	(−3.007***)	(−2.977***)	(−2.999***)	(−2.993***)
Inverse Mills ratio	−0.611	−0.574	−0.548	−0.554
	(−1.845*)	(−1.640)	(−1.521)	(−1.544)
Constant	0.639	0.627	0.361	0.656
	(2.610***)	(2.588***)	(1.015)	(2.694***)
F-statistics	1.59***	1.55***	1.54***	1.55***
Adj. R-squared	0.0728	0.0728	0.0727	0.0728
Year fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Number of firms	4234	4234	4234	4234
Number of observations	29,430	29,430	29,430	29,430

Notes: We employ the following modified Fama-French 3-factor model to obtain the world market risk of each firm in the sample: $(R_{it} - R_{ft}) = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WORLD_t + \varepsilon_{it}$, where $(R_{it} - R_{ft})$ is the excess return of firm i on day t; $(R_{mt} - R_{ft})$ is the market excess return on day t; SMB_t is the excess return of the small-stock portfolio over the big-stock portfolio on day t; HML_t is the excess return of the high-book-to-market portfolio over the low-book-to-market portfolio on day t; and $WORLD_t$ is the difference between the returns on the MSCI World Excluding U.S. index on day t and the risk-free rate in the U.S. market. The factors are obtained from Professor Kenneth French's website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). The above model is estimated cross-sectionally by firm and year. β_4 captures the exposure of the firm to the world markets outside the United States. Domestic single-segment (DS) firms are firms that have only one business segment located in the United States. Domestic multi-segment (DM) firms are firms with more than one business segment located in the United States. Global single-segment (GS) firms are firms with a segment located globally. Global multi-segment (GM) firms are firms with more than one business segment and more than one geographic segment. The dummy for globally diversified firms captures global single-segment (GS) and global multi-segment (GM) firms. The inverse Mills ratio is obtained from the model in Panel B of Table 6. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

the number of business/geographic segments increases and the business/geographic-sales-based Herfindahl index decreases. On the other hand, U.S. market risk increases significantly with a higher number of business/geographic segments and a lower business/geographic-sales-based Herfindahl index. World market risk is not statistically different between the two groups for any measure of diversification.

4.2. Multivariate results on the relationship between diversification and idiosyncratic risk

In Table 5, we report the matrix of correlations between the diversification measures and idiosyncratic, U.S. market, and world market risk. The correlations among the variables are consistent with the univariate results in Tables 3 and 4.

In Panel B of Table 6 we report the results from the probit regressions of the diversification decision, from which we obtain the inverse Mills ratio. The summary statistics of the control variables in these regressions are reported in Panel A. The results are consistent with those of the ordinal probit regression, and qualitatively similar to the results reported by Campa and Kedia (2002). We incorporate the inverse Mills ratio calculated from the ordinal probit regression into later regressions of idiosyncratic and systematic risks.

Table 10
Fixed-effect regressions of idiosyncratic risk on firm diversification profile before, during, and after the financial crisis of 2007–2009.

	Before 2007			2007–2009			After 2009		
Independent variables	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Dummy for DM firms	−0.004			0.028			−0.008		
	(−0.326)			(1.233)			(−0.295)		
Dummy for GS firms	−0.033			−0.054			−0.005		
	(−3.132***)			(−1.487)			(−0.225)		
Dummy for GM firms	−0.045			−0.031			−0.028		
	(−3.547***)			(−0.804)			(−1.143)		
Dummy for globally diversified firms		−0.037			−0.057			−0.011	
		(−3.900***)			(−1.657*)			(−0.649)	
Industrial Herfindahl index			0.011			−0.045			−0.010
			(0.505)			(−2.061**)			(−0.310)
Global Herfindahl index			0.085			0.070			0.008
			(3.507***)			(0.924)			(0.215)
Ln of asset	−0.060	−0.060	−0.060	−0.213	−0.213	−0.214	−0.062	−0.063	−0.063
	(−7.916***)	(−7.946***)	(−7.880***)	(−6.502***)	(−6.514***)	(−6.571***)	(−4.312***)	(−4.374***)	(−4.393***)
Debt ratio	0.338	0.337	0.338	0.385	0.384	0.385	0.298	0.298	0.298
	(12.14***)	(12.14***)	(12.12***)	(4.851***)	(4.845***)	(4.856***)	(7.604***)	(7.573***)	(7.564***)
Capital expenditure/sales	−0.079	−0.076	−0.082	−0.514	−0.525	−0.516	−0.240	−0.237	−0.237
	(−1.023)	(−0.981)	(−1.053)	(−2.050**)	(−2.106**)	(−2.059**)	(−1.846*)	(−1.820*)	(−1.818*)
R&D expenditure/sales	0.252	0.253	0.265	−0.278	−0.274	−0.283	0.074	0.087	0.092
	(1.787*)	(1.800*)	(1.871*)	(−0.538)	(−0.532)	(−0.546)	(0.380)	(0.450)	(0.474)
Market-to-book ratio	−0.012	−0.012	−0.012	−0.007	−0.007	−0.007	−0.010	−0.010	−0.010
	(−7.397***)	(−7.380***)	(−7.421***)	(−1.389)	(−1.413)	(−1.404)	(−4.873***)	(−4.862***)	(−4.845***)
Inverse Mills ratio	0.076	0.077	0.084	0.266	0.270	0.252	0.198	0.200	0.203
	(0.936)	(0.950)	(1.040)	(2.511**)	(2.657***)	(2.465**)	(1.688*)	(1.699*)	(1.720*)
Constant	0.807	0.807	0.707	1.641	1.655	1.619	0.700	0.701	0.698
	(16.78***)	(16.88***)	(12.47***)	(7.416***)	(7.478***)	(6.977***)	(7.183***)	(7.217***)	(6.780***)
F-statistics	118.40***	133.40***	124.70***	114.70***	134.50***	121.50***	18.86***	21.66***	19.92***
Adj. R-squared	0.248	0.248	0.248	0.411	0.410	0.410	0.0624	0.0621	0.0621
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of firms	3715	3715	3715	1911	1911	1911	1903	1903	1903
Number of observations	16,398	16,398	16,398	4368	4368	4368	8664	8664	8664

Notes: We employ the following modified Fama-French 3-factor model to obtain the idiosyncratic risk of each firm in the sample: $(R_{it} - R_{ft}) = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WORLD_t + \varepsilon_{it}$(2), where $(R_{it} - R_{ft})$ is the excess return of firm i on day t; $(R_{mt} - R_{ft})$ is the market excess return on day t; SMB_t is the excess return of the small-stock portfolio over the big-stock portfolio on day t; HML_t is the excess return of the high-book-to-market portfolio over the low-book-to-market portfolio on day t; and $WORLD_t$ is the difference between the returns on the MSCI World Excluding U.S. index on day t and the risk-free rate in the U.S. market. The factors are obtained from Professor Kenneth French's website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). The above model is estimated cross-sectionally by firm and year. β_1 captures the exposure of the firm to the U.S. market. β_1 captures the exposure of the firm to the world markets outside the United States. We calculate the standard deviation of residuals for each firm in each year and use it as the idiosyncratic risk of the firm. We multiply the daily idiosyncratic risk by the square root of the number of trading days in a year ($\sqrt{250}$) to obtain the annualized idiosyncratic risk. Domestic single-segment (DS) firms are firms that have only one business segment located in the United States. Domestic multi-segment (DM) firms are firms with more than one business segment located in the United States. Global single-segment (GS) firms are firms with a segment located globally. Global multi-segment (GM) firms are firms with more than one business segment and more than one geographic segment. The dummy for globally diversified firms captures global single-segment (GS) and global multi-segment (GM) firms. The inverse Mills ratio is obtained from the model in Panel B of Table 6. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

In Table 7, we report the results from the fixed-effect regressions of idiosyncratic risks on firm diversification profile. The Hausman test (not reported here) shows that fixed-effect regression is more appropriate for our data than random-effect regression. In Model 1, the coefficients of the dummy variables for domestic multi-segment (−0.022), global single-segment (−0.037), and global multi-segment (−0.049) firms are negative and significant, suggesting that corporate diversification significantly reduces the firm's idiosyncratic risk. However, the magnitude of risk reduction is greater for globally diversified firms. In Model 2, the coefficient of the dummy variable for globally diversified firms (GS and GM firms) is negative and significant at the 1% level, confirming that global diversification significantly reduces the firm's idiosyncratic risk. In Model 3, we use the Herfindahl index to capture firms' degree of diversification. The coefficient of the global Herfindahl index is positive and significant; firms with a higher global Herfindahl index have a lower level of global diversification and hence a higher idiosyncratic risk. In short, geographic diversification mitigates firm idiosyncratic risk. Globally diversified firms generate uncorrelated cash flows from different markets with different systematic risks. In contrast, industrially diversified firms receive cash flows from different industries in the same market, which are exposed to the same systematic risk. Therefore, global diversification exerts a stronger impact on firm-specific risk than industrial diversification does.

Table 11
Driscoll-Kraay regressions of U.S. market risk on firm diversification profile before, during, and after the financial crisis of 2007–2009.

	Before 2007			2007–2009			After 2009		
Independent variables	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Dummy for DM firms	−0.014			0.035			0.034		
	(−0.960)			(1.685)			(3.828***)		
Dummy for GS firms	−0.012			−0.008			0.037		
	(−1.525)			(−0.668)			(2.908**)		
Dummy for GM firms	−0.016			0.008			0.030		
	(−2.057*)			(0.618)			(2.122*)		
Dummy for globally diversified firms		−0.009			−0.018			0.022	
		(−1.052)			(−1.025)			(1.818)	
Industrial Herfindahl index			−0.002			−0.068			−0.062
			(−0.071)			(−7.250***)			(−1.870*)
Global Herfindahl index			0.032			−0.082			−0.043
			(1.437)			(−4.417***)			(−0.925)
Ln of asset	0.169	0.169	0.169	0.092	0.031	0.090	0.071	0.072	0.070
	(15.071***)	(15.130***)	(14.790***)	(2.235)	(5.325**)	(2.813***)	(2.651**)	(2.690**)	(2.756***)
Debt ratio	−0.206	−0.206	−0.206	0.337	0.006	0.337	0.029	0.031	0.029
	(−5.016***)	(−5.000***)	(−5.409***)	(6.436**)	(0.742)	(7.761***)	(0.417)	(0.446)	(0.459)
Capital expenditure/sales	0.442	0.445	0.443	−0.557	−0.036	−0.548	0.024	0.022	0.021
	(2.005*)	(2.006*)	(2.161**)	(−2.248)	(−1.207)	(−2.709***)	(0.170)	(0.154)	(0.159)
R&D expenditure/sales	0.164	0.168	0.172	0.568	0.260	0.550	−0.887	−0.880	−0.864
	(0.648)	(0.655)	(0.716)	(2.779)	(3.669*)	(3.343***)	(−2.536**)	(−2.484**)	(−2.622***)
Market-to-book ratio	0.027	0.027	0.027	−0.006	0.002	−0.006	0.006	0.006	0.006
	(4.651***)	(4.668***)	(4.982***)	(−1.470)	(5.132**)	(−1.754*)	(0.897)	(0.898)	(1.007)
Inverse Mills ratio	0.069	0.080	0.083	0.163	0.014	0.125	−0.102	−0.112	−0.108
	(0.660)	(0.739)	(0.816)	(1.573)	(1.399)	(2.112**)	(−0.498)	(−0.552)	(−0.577)
Constant	0.044	0.039	0.008	0.105	0.291	0.241	0.411	0.417	0.525
	(0.531)	(0.449)	(0.069)	(0.375)	(7.673**)	(1.080)	(2.094*)	(2.127*)	(2.737***)
F-statistics	4.61***	4.34***	4.34***	4.97***	4.96***	43.65***	6.75***	6.75***	6.75***
Adj. R-squared	0.450	0.429	0.429	0.636	0.635	0.949	0.559	0.559	0.559
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of firms	3715	3715	3715	1911	1911	1911	1903	1903	1903
Observations	16,398	16,398	16,398	4368	4368	4368	8664	8664	8664

Notes: We employ the following modified Fama-French 3-factor model to obtain the U.S. market risk of each firm in the sample: $(R_{it} - R_{ft}) = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WORLD_t + \varepsilon_{it}$(2), where $(R_{it} - R_{ft})$ is the excess return of firm i on day t; $(R_{mt} - R_{ft})$ is the market excess return on day t; SMB_t is the excess return of the small-stock portfolio over the big-stock portfolio on day t; HML_t is the excess return of the high-book-to-market portfolio over the low-book-to-market portfolio on day t; and $WORLD_t$ is the difference between the returns on the MSCI World Excluding U.S. index on day t and the risk-free rate in the U.S. market. The factors are obtained from Professor Kenneth French's website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). The above model is estimated cross-sectionally by firm and year. β_1 captures the exposure of the firm to the U.S. market. Domestic single-segment (DS) firms are firms that have only one business segment located in the United States. Domestic multi-segment (DM) firms are firms with more than one business segment located in the United States. Global single-segment (GS) firms are firms with a segment located globally. Global multi-segment (GM) firms are firms with more than one business segment and more than one geographic segment. The dummy for globally diversified firms captures global single-segment (GS) and global multi-segment (GM) firms. The inverse Mills ratio is obtained from the model in Panel B of Table 6. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

4.3. Multivariate results on the relationship between diversification and market risk

In Tables 8 and 9, we report the results from Driscoll-Kraay regressions of U.S. and world market risks, respectively, on firms' diversification profile. All specifications control for firm and year fixed effects. In Table 8, the coefficient of the dummy variable for domestic multi-segment firms (−0.016) is negative and significant at the 5% level, implying that industrially diversified firms have a lower exposure to U.S. market risk (Model 1). The dummy variable for globally diversified firms (0.013) is positive and significant at the 10% level, indicating that globally diversified firms have a higher exposure to U.S. market risk (Model 2). However, the coefficients on the dummy variables for global single-segment and global multi-segment firms (Model 1), as well as alternative proxies for firm diversification such as the Herfindahl indices (Model 3) and the number of diversified segments (Model 4), are not significant. These results do not provide strong evidence on the impact of corporate diversification on firms' exposure to U.S. market risk.

In Table 9, the coefficients of the dummy variables for domestic multi-segment (−0.079), global single-segment (−0.124), and global multi-segment (−0.189) firms are all negative and significant, suggesting that both types of diversification lower firms' exposure to world market risk but global diversification does so more strongly (Model 1). The coefficient on the dummy variable for globally diversified firms (−0.123) is negative and significant, confirming that global diversification reduces firms' world market risk exposure (Model 2). The coefficient of the industrial Herfindahl index (0.138) is positive and significant, indicating that higher industrial diversification mitigates the firm's exposure to world market risk (Model 3). The coefficients of the variables for number of

Table 12
Driscoll-Kraay regressions of world market risk on firm diversification profile before, during, and after the financial crisis of 2007–2009.

	Before 2007			2007–2009			After 2009		
Independent variables	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Dummy for DM firms	−0.045			−0.022			−0.169		
	(−1.902*)			(−0.338)			(−1.292)		
Dummy for GS firms	−0.035			−0.039			−0.166		
	(−0.616)			(−0.437)			(−1.241)		
Dummy for GM firms	−0.063			−0.192			−0.134		
	(−1.566)			(−2.345**)			(−0.854)		
Dummy for globally diversified firms		−0.031			−0.016			−0.089	
		(−0.643)			(−0.714)			(−0.815)	
Industrial Herfindahl index			0.103			0.281			0.037
			(2.628***)			(5.821***)			(0.245)
Global Herfindahl index			−0.266			0.799			0.331
			(−2.576**)			(3.299***)			(1.260)
Ln of asset	−0.215	−0.216	−0.222	−0.211	0.031	−0.218	0.061	0.057	0.059
	(−5.874***)	(−5.859***)	(−6.21***)	(−1.987)	(5.325**)	(−2.58***)	(0.956)	(0.864)	(1.018)
Debt ratio	0.538	0.537	0.529	1.071	0.006	1.077	−0.013	−0.024	−0.025
	(3.478***)	(3.478***)	(3.606***)	(4.986**)	(0.742)	(6.093***)	(−0.075)	(−0.149)	(−0.161)
Capital expenditure/sales	−0.250	−0.237	−0.204	0.104	−0.036	0.106	−0.141	−0.132	−0.132
	(−0.348)	(−0.331)	(−0.301)	(0.147)	(−1.207)	(0.190)	(−0.171)	(−0.158)	(−0.171)
R&D expenditure/sales	3.039	3.050	3.012	2.168	0.260	2.220	−1.582	−1.617	−1.639
	(2.162*)	(2.163*)	(2.267**)	(1.080)	(3.669*)	(1.312)	(−1.570)	(−1.649)	(−1.769*)
Market-to-book ratio	−0.036	−0.036	−0.036	−0.030	0.002	−0.031	−0.020	−0.020	−0.021
	(−1.925*)	(−1.899*)	(−1.992**)	(−1.626)	(5.132**)	(−2.020**)	(−1.803)	(−1.800)	(−1.949*)
Inverse Mills ratio	−1.265	−1.235	−1.278	−1.308	0.014	−1.415	0.287	0.336	0.348
	(−3.180**)	(−3.191**)	(−3.50***)	(−2.147)	(1.399)	(−2.441**)	(0.433)	(0.492)	(0.555)
Constant	1.244	1.232	1.403	1.259	0.291	0.394	−0.085	−0.119	−0.458
	(4.888***)	(4.988***)	(4.848***)	(2.007)	(7.673**)	(1.315)	(−0.188)	(−0.273)	(−1.337)
F-statistics	1.41***	1.41***	1.41***	1.38***	1.38***	44.51***	1.37***	1.37***	1.37***
Adj. R-squared	0.0844	0.0841	0.0843	0.143	0.142	0.951	0.0762	0.0762	0.0762
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of firms	3715	3715	3715	1911	1911	1911	1903	1903	1903
Number of observations	16,398	16,398	16,398	4368	4368	4368	8664	8664	8664

Notes: We employ the following modified Fama-French 3-factor model to obtain the world market risk of each firm in the sample: $(R_{it} - R_{ft}) = \alpha + \beta_1(R_{mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 WORLD_t + \varepsilon_{it}$, where $(R_{it} - R_{ft})$ is the excess return of firm i on day t; $(R_{mt} - R_{ft})$ is the market excess return on day t; SMB_t is the excess return of the small-stock portfolio over the big-stock portfolio on day t; HML_t is the excess return of the high-book-to-market portfolio over the low-book-to-market portfolio on day t; and $WORLD_t$ is the difference between the returns on the MSCI World Excluding U.S. index on day t and the risk-free rate in the U.S. market. The factors are obtained from Professor Kenneth French's website (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html). The above model is estimated cross-sectionally by firm and year. β_4 captures the exposure of the firm to the world markets outside of the U.S. Domestic single-segment (DS) firms are firms that have only one business segment located in the United States. Domestic multi-segment (DM) firms are firms with more than one business segment located in the United States. Global single-segment (GS) firms are firms with a segment located globally. Global multi-segment (GM) firms are firms with more than one business segment and more than one geographic segment. The dummy for globally diversified firms captures global single-segment (GS) and global multi-segment (GM) firms. The inverse Mills ratio is obtained from the model in Panel B of Table 6. *, **, and *** indicate significance levels of 10%, 5%, and 1%, respectively.

business and geographic segments are both negative and significant, indicating that both types of diversification mitigate the firm's exposure to world market risk (Model 4).

In sum, we find evidence that both types of diversification mitigate idiosyncratic and world market risk but have a negligible impact on U.S. market risk. These results are consistent with the view that diversification provides operational flexibility that reduces idiosyncratic risk (Dixit & Pindyck, 1994; Markowitz, 1959) but could expose firms to a new set of risks, such as political/regulatory risk (Shaked, 1986) and foreign exchange risk (Bartov, Bodnar, & Kaul, 1996), increasing systematic risk.

5. The role of the financial crisis of 2007–2009

Studies document that financial crises can change the costs and benefits associated with diversification. While Meyer and Rose (2003) find evidence that global diversification reduced the impact of the Asian financial crisis, Schwebach, Olienyk, and Zumwalt (2002) argue that global diversification had less value in the highly correlated markets of their sample countries following the Asian financial crisis.

In this section, we examine the impact of the financial crisis of 2007–2009 on the relations between corporate diversification and firm risk exposure. We divide our sample into three subperiods: before 2007, during 2007–2009, and after 2009. All specifications control for firm and year fixed effects. Table 10 reports the results for idiosyncratic risk. Before 2007, the coefficients of global single-

segment (−0.033), global multi-segment (−0.045), and globally diversified firms (−0.037) and the global Herfindahl index (0.085) are significant at the 1% level, providing strong evidence that global diversification significantly reduces idiosyncratic risk before the crisis. Between 2007 and 2009, the coefficient of the industrial Herfindahl index (−0.045) is significant at the 5% level, suggesting that firms with less industrial diversification have less idiosyncratic risk during the crisis. After 2009, none of these coefficients are significant. That is, before the crisis, global diversification significantly mitigated firm idiosyncratic risk; during the crisis, industrial diversification significantly contributed to firm idiosyncratic risk; and after the crisis, corporate diversification did not play a significant role.

Table 11 reports the results for U.S. market risk. Before 2007, neither industrial nor global diversification has a significant impact on U.S. market risk. However, between 2007 and 2009, the coefficients of the industrial (−0.068) and global (−0.082) Herfindahl indexes are negative and significant at the 1% level, providing evidence that lower degrees of both industrial and global diversification significantly lessen U.S. market risk. After 2009, the coefficients of domestic multi-segment (0.034) and global single-segment (0.037) firms are positive and significant, suggesting that both industrial and global diversification significantly increase U.S. market risk. Overall, the results in Table 11 suggest that during and after the financial crisis of 2007–2009, both industrial and global diversification significantly increase firms' exposure to U.S. systematic risk.

Table 12 reports the results for world market risk. Before 2007, the significant coefficients of industrial Herfindahl index (0.103) and global Herfindahl index (−0.266) suggest that firms' exposure to world market risk increases with a lower degree of industrial diversification and decreases with a lower degree of global diversification. Between 2007 and 2009, the coefficients of global multi-segment firms (−0.192), the industrial Herfindahl index (0.281), and the global Herfindahl index (0.799) are significant, indicating that industrial and global diversification reduces the firm's exposure to world market risk. After 2009, none of the coefficients are significant. Overall, results in Table 12 provide strong evidence that before the financial crisis of 2007–2009, industrial and global diversification have opposite impacts on world market risk: firms' exposure to world market risk decreases with industrial diversification but increases with global diversification. In contrast, during the crisis, both industrial and global diversification reduce firms' exposure to world market risk.

To summarize, we find evidence that the impact of corporate diversification on firm risk is not homogenous before, during, and after the financial crisis of 2007–2009. Before the crisis, global diversification mitigates idiosyncratic risk but increases firms' exposure to world market risk. During the crisis, industrial diversification increases idiosyncratic risk, while both types of diversification increase U.S. market risk but decrease world market risk. After the crisis, both types of diversification increase firms' exposure to U.S market risk, but their impact on idiosyncratic and world market risk is negligible. These results support the view that global diversification is more desirable before the crisis because it reduces idiosyncratic risk. However, both types of diversification are less desirable during and after the crisis because they enhance firm's exposure to U.S. market risk (Raffestin, 2014; Schwebach et al., 2002).

6. Conclusion

Studies document mixed evidence on the impact of corporate diversification on firm risk exposure. In theory, diversified firms' operational flexibility coupled with access to various industries and countries should reduce their risk exposure (Dixit & Pindyck, 1994; Markowitz, 1959). However, globally diversified firms' operations in various countries expose them to a new set of risks such as political/regulatory risk (Shaked, 1986) and foreign exchange risk (Bartov et al., 1996). Among empirical studies, some document a lower systematic risk (Fatemi, 1984; Hann et al., 2013; Lubatkin & Chatterjee, 1994; Shaked, 1986; Stulz, 1999), while others find a higher systematic risk (Krapl, 2015; Olibe et al., 2008; Reeb et al., 1998), a higher idiosyncratic risk, and a higher volatility of cash flows and earnings (Krapl, 2015) for diversified firms.

We find evidence that both industrial and global diversification mitigate idiosyncratic and world market risk but have a negligible impact on U.S. market risk. These results are consistent with the view that diversification provides operational flexibility that reduces idiosyncratic risk (Dixit & Pindyck, 1994; Markowitz, 1959). Our results remain robust after we control for the potential endogeneity of the diversification decision through various self-selection models.

In addition, we find evidence that the impact of corporate diversification on firm risk is not homogenous before, during, and after the financial crisis of 2007–2009. Our results support the view that global diversification is more desirable before the crisis because it reduces idiosyncratic risk. However, given today's highly integrated global capital markets, common asset holding between industrially and globally diversified firms increases systematic U.S. market risk exposure during and after the crisis, making corporate diversification less desirable when it is needed most (Raffestin, 2014; Schwebach et al., 2002).

Acknowledgements

We are grateful to Ali Fatemi (the editor), our anonymous reviewer, and participants of the 2014 Financial Management Association and 2015 Academy of Economics and Finance annual meetings for their valuable comments and suggestions. All errors remain our own. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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