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# Corporate diversification strategies and capital structure

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## Abstract

Research shows that corporate leverage is positively related to diversification across product lines but negatively related to geographic diversification. Why this difference occurs is an important empirical question since diversification appears to be value destroying. After controlling for geographic diversification, asset turnover, and firm size as well as other variables, we find that diversification across product lines is at best unrelated to debt usage; it may be negatively related to debt usage in some instances.

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## 1. Introduction

Since the early work of [Modigliani and Miller \(1958\)](#) on capital structure irrelevance, there has been considerable study of capital structure and its impact on firm value. [Harris and Raviv \(1991\)](#) in a review of the general capital structure literature report that the consensus is that leverage is positively related to fixed assets, non-debt tax shields, investment opportunities, and firm size; and is negatively related to volatility, advertising expenditure, the probability of bankruptcy, profitability, and the uniqueness of the product. [Li and Li \(1996\)](#) argue that diversified firms need to carry greater leverage to maximize firm value, and they cite the evidence in [Kaplan and Weisbach \(1992\)](#) as supporting their theory.

A substantial body of literature, however, shows that corporate leverage is negatively related to geographic diversification. Multinational corporations, MNCs, tend to carry less debt in their

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capital structure than domestic firms (Shapiro, 1978; Senbet, 1979; Michel & Shaked, 1986; Lee & Kwok, 1988; Burgman, 1996; Chen, Cheng, He, & Kim, 1997; Fatemi, 1988).

Why should the two types of diversification, product and geographic, have different effects on corporate leverage? Product diversification has been shown to be value destroying, but product diversification appears from the theoretical literature to create debt capacity. If increased debt capacity is present, it could be that it offsets some of the loss in value from diversification.

We investigate the relation between the two dimensions of corporate scope, geographic and product diversification, and their impact on corporate leverage. After controlling for geographic diversity, asset turnover, firm size, and other factors, we find that product diversification is possibly unrelated to debt usage, and it may be either negatively related to debt usage or related in a non-linear manner. Thus, product diversification does not appear to create debt capacity, and therefore would not offset the value loss from diversification. Our analysis of the interactive effects of product and geographic diversification on corporate leverage indicates that they are complementary in generating usage, which may explain the previously observed asymmetric impacts.

## 2. Diversification and capital structure

### 2.1. *Diversification*

Whether diversification benefits a corporation and its shareholders has been the subject of considerable research. Early studies often argued that diversification was valuable. For example, Weston (1970) proposes that resources could be allocated more efficiently within an organization than in capital markets, so diversified firms would be more efficient than non-diversified firms.

Since then, researchers have found that conglomerate firms have significantly lower profitability (Rumelt, 1982; Varadarajan & Ramanujam, 1987; Davis, Robinon, Pearce, & Park, 1992), although this effect could be due to differences in industry (Christiansen & Montgomery, 1981; Bettis & Hall, 1982; Stimpert & Duhaime, 1997). It has also been shown that highly diversified firms have less market power in their respective markets than more focused firms (Montgomery, 1985). Product diversification has also been found to be negatively related to firm value (Lang & Stulz, 1994; Servaes, 1996) and to occur in firms with less managerial and blockholder equity ownership (Denis, Denis, & Sarin, 1997). Berger and Ofek (1995) compare estimates for the stand-alone values of business segments and find a 13–15% value loss from diversification. This loss in value is less when firms diversify within closely related industries.

More recent evidence suggests that the reported diversification discount may in fact be an artifact of data selection and methodological approaches adopted to analyze the issue. For example, Villalonga (2000), using inputs from a probit model, shows that either there is no diversification discount, or there exists a diversification premium. Graham, Lemmon, and Wolf (1999) show that when firms add business segments due to reporting changes, there are no changes in the diversification discount. However, some of the discount manifests itself when firms acquire units that are already discounted. Campa and Kedia (2000) show that the diversification discount may be related to firm characteristics that lead them to diversify. Whited (2001) argues that the diversification discount may be an artifact of measurement errors, while Fee

and Thomas (1999) state that this discount may be related to greater information asymmetries associated with diversified firms.

## 2.2. *Capital structure*

Lewellen (1971) argues that combining businesses with imperfectly correlated cashflow streams provides a coinsurance effect that creates more capacity for debt. While diversification may destroy value and profitability, its effect may be partially offset by an increased debt capacity and resulting tax shields. Li and Li (1996) argue “the combination of diversification with low leverage leads to over investment” (p. 704). Thus, to maximize shareholder wealth, diversified firms may have greater debt capacity than non-diversified firms. The increased capacity for debt may or may not result in increased debt usage. Whether or not it does is an empirical question. Results of empirical research are generally consistent with this proposition, since product-diversified firms have chosen to carry relatively more debt than non-diversified firms (Riahi-Belkaoui & Bannister, 1994). Comment and Jarrell (1995) find that leverage ratios average 33–34% in their sample, but increase to 38–40% for the firms with the largest number of business segments. They, however, question the robustness of this finding because the relation between leverage and diversification does not appear to be as consistent when they measure diversification with the Herfindahl index. Cross border diversification appears to improve shareholder wealth (Eun, Koloday, & Scheraga, 1996), and the coinsurance effect may be a partial explanation for this improvement.

If this coinsurance effect enhances debt capacity and results in increased debt usage for product-diversified firms, it would be reasonable to expect a similar impact for geographically diversified firms, when geographic diversification occurs across political boundaries with imperfectly correlated cashflow streams. There is also evidence that diversification across political boundaries reduces risk more than diversifying across industries within one country (Heston & Rouwenhorst, 1994). At the same time, the empirical evidence suggests that MNCs have lower debt ratios than domestic corporations (Shapiro, 1978; Senbet, 1979; Michel & Shaked, 1986; Lee & Kwok, 1988; Burgman, 1996; Chen et al., 1997).

There are several possible explanations for this inconsistency. Some risks are unique to globally active firms, and these risks may influence capital structure decisions. For example, MNCs have country-specific political risks and also face exchange rate risks. Domestic firms that diversify across product and industry lines do not face these risks.

There may also be information asymmetries involved in international diversification, as information may not flow as easily or in the same form across political boundaries. Information releases may also be influenced by cultural norms. Burgman (1996) finds a positive relationship between political and exchange rate risk and leverage. He explains his findings by companies using leverage to hedge away these risks.

If it is not exchange rate risk or political risk, other explanations are needed. Ethier (1996) and Ethier and Horn (1990) argue that internationalization is a way to internalize intangible assets. MNCs would have lower leverage because they carry proportionately more intangible assets in their asset base.

Chen et al. (1997) argue that MNCs have higher bankruptcy costs and agency costs of debt. These higher costs would reduce the optimal amount of debt for MNCs. Kim and Lyn

(1986) suggest that MNCs often outperform local companies in host countries and have more growth opportunities. Since Stulz (1990) finds that leverage is negatively related to growth opportunities, one would expect that leverage would be lower for MNCs than for domestic companies.

The idea that growth and leverage would be inversely related is not new. Myers (1977) argues that growth opportunities can be viewed as call options, and he shows that issuing risky debt reduces the present value of a firm holding these options. Thus, he predicts that corporate borrowing will be inversely related to these options for growth.

### 2.3. *Research questions*

While the results are somewhat mixed most recent research documents that product diversification is negatively related to firm value. If product diversification theoretically creates the potential for increased debt capacity (Lewellen, 1971), and increased debt usage is documented in results of empirical studies as well, it could be that the increased debt capacity combined with the corporate choice to utilize the increased capacity for debt offsets the value loss from diversification.

To understand why product diversification seemingly increases debt capacity and possibly increases debt usage while geographic diversification does not, we address several specific questions. First, we reexamine the impact of product and geographic diversification on leverage. We then focus our attention on the determinants of leverage identified in prior research and measure these variables across both product- and geographic-diversified and focused firms.

There is no published research dealing with the impact on leverage of the interrelationship between product and geographic diversification. We test this interrelationship by subdividing a sample across both measures of diversification and comparing the leverage-determining variables. We also test whether one type of diversification moderates the relationship between firm leverage and the other type of diversification.

Finally, we directly measure the impact of diversification on leverage while controlling for the other leverage-determining variables. Here, we propose that it may not be diversification per se that impacts the choice to use leverage, but that diversification may proxy for some excluded determinants of leverage and only appears to influence leverage usage.

## 3. Method

### 3.1. *Sample selection*

We derive the sample from the Compustat active firms library for the years 1994–1996. The initial sample consists of all NYSE, AMEX, and Nasdaq listed U.S. firms that have annual sales volume higher than US\$ 100 million. We exclude firms belonging to the financial services industry (SIC 6000–6999) and regulated utilities (SIC 4900–4999). In addition, to be included in the sample, firms must have business segments and international operations data available on Compustat.

There are 1,528 firms in the initial sample. We classify firms as domestic or multinational depending upon the ratio of foreign sales to total sales (FSTS). If this ratio is 0, we classify the firm as domestic. If the ratio is positive, we classify the firm as multinational. In multivariate tests we use the value of this ratio as an independent variable. We define a firm as product-focused if it operates in a single business segment or product-diversified if it operates in multiple business segments. In our statistical tests, we use panel data since we have both time series and cross-sectional data. When using panel data a missing variable in 1 year requires the elimination of the firm for the entire period. As a result, we have a sample of 1,127 firms that meet our complete data criteria. For 1-year cross-sectional tests, we use the entire sample.

Following is a breakdown of the sample into various categories according to type of diversification strategy.

Year	Product		Geographic		Total
	Diversified	Focused	MNC	Domestic	
1994	370	757	568	559	1,127
1995	383	744	560	567	1,127
1996	399	728	544	583	1,127

### 3.2. Variables

We measure firm leverage as the ratio of total debt to total assets of the firm. In the univariate tests (either product-focused or diversified firms), we use the number of business segments to define diversity. In the multivariate tests, we use the entropy measure of total product diversification (Jacquemin & Berry, 1979). The ratio of FSTS is our measure of international diversification.<sup>1</sup>

We use several control variables to clearly delineate the effect of diversification strategies on capital structure by isolating other influences on firm leverage. Our choice of control variables is guided by two distinct but related theories developed to explain corporate capital structure. According to the Pecking–Order theory (Myers and Majluf, 1984), informational asymmetries lead high-quality firms to avoid external financing. In this framework, the choice of leverage will be a function of investment opportunities and its profitability. More profitable firms may finance their growth by utilizing internally generated retained earnings. In contrast, firms with lower profitability may need more leverage. Thus, we may see a negative relation between firm performance and degree of financial leverage. Rajan and Zingales (1995), and Booth, Aivazian, Demircug–Kunt, and Maksimoric (2001) use firm performance as a control variable. Asset turnover ratio is introduced to capture managerial efficiency in utilization of corporate assets. This variable is also interpreted as indicator of reduced agency costs of managerial discretion (Ang, Cole, & Lin, 2000).

Agency-cost-of-debt model suggests that as a firm's growth opportunities increase, agency-cost of debt in terms of profitable projects foregone (Myers, 1977). Firms with profitable growth opportunities may, therefore, use less debt financing. Smith and Watts (1992) provide empirical evidence of the existence of negative relation between growth opportunities and leverage. Rajan and Zingales (1995) use the market to book ratio as proxy for growth opportunities.

We include size as a control variable following Booth et al. (2001) and Rajan and Zingales (1995) since it captures informational asymmetries as well as financial strength of firms. According to Booth et al. (2001), in general, highly profitable slow-growing firms should generate the most cash, but less profitable fast-growing firms will need significant external financing. Thus, realized growth may influence degree of leverage levels.

### 3.3. Data analysis

The data analysis involves identification and quantification of corporate capital structure differentials across the product and internationally diversified firms on the one hand, and the domestic and product-focused firms on the other, using parametric test statistics. We also use a multivariate regression analysis to investigate capital structure differentials across firm groups using diversification strategy indicator variables. This facilitates isolation and control of other firm-specific influences on the choice of capital structure. Since we have both time series and cross-sectional data, we use the Fuller and Battese panel data regression procedure. We also test for non-linearity in relationship between each type of diversification and the degree of debt financing.

## 4. Results

### 4.1. Univariate results

In Table 1, we first compare sample firms across levels of product diversification. Panel A of Table 1 provides the comparisons for 1996, while Panels B and C are for 1995 and 1994. While there are some differences across time, the signs of the differences and significance levels generally remain the same. We therefore focus discussion on the 1996 results as shown in Panel A.

Product-diversified firms have significantly higher sales than product-focused firms ( $t = 5.36$ ) and also have a higher ratio of FSTS ( $t = 2.29$ ). Thus, product-diversified firms tend to be also more diversified internationally. Product-diversified firms carry significantly more intangibles ( $t = 4.24$ ) as a percent of assets.

Product-focused firms have a significantly ( $t = -4.60$ ) higher average turnover ratio (asset turnover = 1.50 times) than product-diversified firms (asset turnover = 1.28). They also have a significantly ( $t = -4.01$ ) higher average 5-year sales growth rate (growth = 14.68%) than diversified firms (growth = 11.02%). The expected future growth rate of product-focused firms, as proxied by the market to book ratio, is nominally larger than for diversified firms, but the difference is not statistically significant in 1996 (it is significant in 1994).

Despite the higher asset turnover ratios and sales growth rates, product-focused firms have significantly ( $t = 2.52$ ) smaller ROEs (ROE = 9.49%) than diversified firms (ROE = 11.83%). Consistent with prior research, their debt to asset ratio (24.41) is significantly ( $t = 2.72$ ) smaller than for diversified firms (debt to assets = 27.39%).

There is not a significant difference in the ROAs of the two groups, which leads us to believe that the difference in the ROEs that we observe is due to the higher debt ratios and the equity

Table 1

Mean comparison across firms for product diversification and geographic diversification

	Product diversification			Geographic diversification		
	Diversified ( <i>n</i> = 577)	Focused ( <i>n</i> = 888)	<i>t</i> -statistic	Diversified ( <i>n</i> = 647)	Domestic ( <i>n</i> = 714)	<i>t</i> -statistic
Panel A: 1996						
Sales (US\$ millions)	4565.84	1940.26	5.36***	4158.28	1804.56	4.75***
Foreign sales/total sales	16.45	13.76	2.29*	–	–	–
Intangibles/assets	0.12	0.08	4.24***	0.11	0.09	2.0*
Sales/assets	1.28	1.50	–4.60***	1.23	1.60	–7.58***
5-Year sales growth	11.02	14.68	–4.01***	11.69	13.71	–2.32*
Market to book ratio	2.53	3.37	–0.90	2.63	3.36	–0.74
ROE	11.83	9.49	2.52*	12.18	8.58	3.90***
ROA	4.33	3.92	0.72	4.64	3.52	1.99*
Debt to assets ratio	27.39	24.41	2.72**	23.75	27.66	–3.90***
Altman Z-score	3.48	4.62	–5.36***	3.98	4.27	–1.35
Number of business segments	2.93	1.0	–	1.92	1.59	5.40***
	<i>n</i> = 593	<i>n</i> = 935	<i>t</i> -statistic	<i>n</i> = 663	<i>n</i> = 758	<i>t</i> -statistic
Panel B: 1995						
Sales (US\$ millions)	4383.62	1695.67	5.78***	4074.09	1571.50	(5.27)***
Foreign sales/total sales	15.94	13.37	2.24*	30.880	–	–
Intangibles/assets	0.11	0.08	4.51***	0.10	0.09	1.68 <sup>†</sup>
Sales/assets	1.31	1.53	–4.68***	1.26	1.63	–7.82***
5-Year sales growth	10.71	14.94	–4.67***	11.54	14.07	–2.75**
Market to book ratio	2.45	2.65	–0.96	2.66	2.36	1.50
ROE	11.99	9.97	2.12*	12.07	9.39	2.78**
ROA	4.77	4.53	0.52	4.80	4.20	1.29
Debt to assets ratio	27.63	24.66	2.76**	24.22	27.90	–3.33***
Altman Z-score	3.43	4.75	–5.83***	3.97	4.33	–1.55
Number of business segments	2.93	1.0	–	2.0	1.64	5.50***
	<i>n</i> = 610	<i>n</i> = 918	<i>t</i> -statistic	<i>n</i> = 657	<i>n</i> = 773	<i>t</i> -statistic
Panel C: 1994						
Sales (US\$ millions)	4180.43	1384.06	6.54***	3807.13	1406.0	5.45***
Foreign sales/total sales	15.08	12.08	2.77**	29.07	0.0	–
Intangibles/assets	0.10	0.07	4.13***	0.09	0.07	1.75 <sup>†</sup>
Sales/assets	1.28	1.52	–5.38***	1.23	1.617	–8.05***
5-Year sales growth	9.98	15.49	–6.14***	11.34	14.39	–3.31***
Market to book ratio	1.93	2.82	–2.20*	2.53	2.33	0.48
ROE	11.36	10.34	1.17	11.62	10.07	1.79 <sup>†</sup>
ROA	4.33	5.08	–1.76 <sup>†</sup>	4.80	4.68	0.28
Debt to assets ratio	27.51	23.92	3.25**	23.98	27.21	–2.82**
Altman Z-score	3.22	4.58	–6.64***	3.76	4.25	–2.31*
Number of business segments	3.07	1.0	–	2.04	1.66	5.88***

For individual year tests, we start with 1,528 firms. For all firms we have data on product diversification, but for geographic diversification we do not always know the ratio of foreign sales. The geographically diversified and domestic subsamples therefore do not sum to 1,528.

<sup>†</sup> Significant at 0.10 or better.

\* Significant at 0.05 or better.

\*\* Significant at 0.01 or better.

\*\*\* Significant at 0.001 or better.

multiplier. Interestingly, product-focused firms have higher average Altman Z-scores than the diversified firms.

In the second set of columns in [Table 1](#), we compare the multinational diversified companies to domestic companies. We again focus our discussion on the 1996 results in Panel A. The comparisons of the variables across multinational diversified companies are somewhat similar as those for product diversification. The multinational diversified companies have significantly higher sales, intangibles, ROEs, and ROAs than those of domestic companies.<sup>2</sup> Domestic companies have significantly higher asset turnover ratios and 5-year sales growth rates.

The biggest difference between the product diversification results and the geographic diversification results is seen in the debt to asset ratios. Product diversified firms have larger debt ratios (27.39%) than product focused firms (24.41%), but geographic diversified firms have smaller debt ratios (23.75%) on average than domestic firms (27.66%). Thus, the two types of diversification appear to impact debt ratios in the opposite direction. Multinational diversified companies have an average debt to asset ratio of 23.75%, while the ratio for domestic companies is 27.66%. This difference is significant at better than 0.001.

As we noted earlier, the product-diversified firms appear to carry more debt than product-focused firms. This difference in debt ratios across the two types of diversification cannot be explained by bankruptcy probability since the average Z-scores are lower for both product-diversified and geographic-diversified firms.<sup>3</sup>

#### *4.2. Interaction between product and geographic diversification*

Since many of the geographically diversified companies are also product-diversified, we must determine if there is interaction between the two types of diversification in their impact on capital structure. There have so far been no tests of the interrelation between geographic and product diversification.

[Table 2](#) shows the interactive results between the two types of diversification. There are separate panels for each year. The results are generally similar in sign and significance in each year, so again our discussion focuses on 1996. Column 1 contains the results for multinational product-diversified (MPD) firms. These are the 309 firms in 1996 that diversify across both dimensions. Column 2 shows results for multinational product-focused (MPF) firms, column 3 for domestic product-diversified firms (DPD), and column 4 for domestic product-focused firms (DPF), companies that do not diversify in either category. The six remaining columns show the comparisons of the variables across the four groups.

The comparisons provide interesting results. Firm size, as measured by sales (in all 3 years), and profitability, as measured by ROE (in 1996), are highest for firms that diversify across both product lines and geography and lowest for those that does not diversify in either manner. However, when we examine the ratio of sales to assets, the firms that are both product and geographically focused have the largest ratio (in all 3 years). The 5-year sales growth rates are the highest for multinational product-focused firms in 1996, followed by domestic product-focused firms, but this result varies from year to year. Product focus is therefore associated with sales growth since the two product-focused categories have the highest rates of sales growth in each year. The higher growth rates could be the result of growth from a much smaller base.



Table 2  
Mean comparison across firm groups based upon combinations of geographic and product diversification

	MPD multinational and product-diversified firms (n = 309)	MPF multinational product focus firms (n = 362)	DPD domestic firms with product diversity (n = 245)	DPF domestic firms with product focus (n = 502)	MPD vs. MPF	MPD vs. DPD	MPD vs. DPF	MPF vs. DPD	MPF vs. DPF	DPD vs. DPF
Panel A: 1996										
Sales (US\$ millions)	6321.25	2313.0	2077.63	1671.29	4008.25 (4.26)***	4243.62 (3.88)***	4649.95 (5.79)***	235.37 (0.48)	641.70 (1.57)	406.33 (0.96)
Sales/assets	1.173	1.288	1.447	1.690	-0.115 (-2.53)*	-0.271 (-3.51)**	-0.514 (-7.71)**	0.160 (2.09)*	-0.399 (-6.24)**	-0.240 (-2.69)**
5-Year sales growth	8.55	14.39	12.76	14.18	-5.84 (-5.21)***	-4.21 (-3.17)**	-5.63 (-5.29)***	1.63 (-1.09)	0.21 (0.18)	-1.42 (-1.03)
ROE	14.10	10.49	8.61	8.57	3.61 (2.82)**	5.49 (3.65)***	5.53 (4.28)***	1.88 (1.37)	1.92 (1.62)	-0.05 (-0.02)
Market to book ratio	2.462	2.777	2.557	3.761	-0.315 (-0.79)	-0.095 (-0.23)	-1.299 (-0.74)	0.220 (-0.54)	-0.984 (-0.61)	-1.204 (-0.61)
Debt to assets	26.34	21.55	28.26	27.63	4.80 (3.22)**	-1.92 (-1.14)	-1.02 (-0.63)	-6.72 (-4.29)***	-5.81 (-3.91)***	0.91 (0.52)
Foreign sales/total sales	29.49	32.85	0.0	0.0	-3.36 (-2.02)*	-	-	-	-	-
Altman Z-score	3.391	4.489	3.652	4.561	-1.098 (-4.48)**	-0.260 (-1.14)	-1.173 (-3.90)**	-0.836 (-2.71)**	-0.075 (-0.24)	-0.911 (-2.52)*
Entropy index	0.796	0.0	0.631	0.0	-	0.165 (4.64)***	-	-	-	-
Intangibles/assets	0.118	0.098	0.114	0.080	0.020 (1.84)†	0.003 (0.27)	0.038 (3.54)***	0.016 (1.42)	0.018 (1.80)†	0.035 (2.99)**
	n = 313	n = 350	n = 257	n = 501						
Panel B: 1995										
Sales (US\$ millions)	6346.89	2041.55	1749.90	1479.99	4305.34 (4.64)***	4596.99 (4.43)***	4866.90 (6.22)***	-291.65 (-0.73)	561.57 (1.53)	269.91 (0.77)
Sales/assets	1.184	1.317	1.487	1.701	-0.133 (-2.83)**	-0.302 (-4.35)***	-0.517 (-7.82)***	0.169 (2.37)*	-0.385 (-5.86)***	-0.215 (-2.57)*
5-Year sales growth	8.443	14.325	13.181	14.531	-5.881 (-5.20)***	-4.737 (-3.10)***	-6.088 (-5.61)***	-1.144 (-0.71)	-0.207 (-0.17)	-1.351 (-0.91)
ROE	13.936	10.378	9.348	9.416	3.558 (2.50)**	4.588 (3.21)**	4.521 (3.39)***	-1.030 (-0.71)	0.962 (0.73)	-0.068 (-0.04)
Market to book ratio	2.618	2.701	2.165	2.455	-0.082 (-0.22)	0.454 (1.38)	0.164 (0.60)	-0.536 (-1.69)†	0.246 (0.93)	-0.290 (-1.27)
Debt to assets	26.628	22.057	28.995	27.331	4.570 (3.22)**	-2.367 (-1.46)	-0.703 (-0.47)	6.938 (4.03)***	-5.273 (-3.50)***	1.664 (0.96)
Foreign sales/total sales	29.035	32.520	0.0	0.0	-3.485 (-2.12)*	-	-	-	-	-
Altman Z-score	3.238	4.622	3.683	4.656	-1.384 (-5.29)***	-0.445 (-2.20)*	-1.418 (-4.23)***	-0.939 (-3.01)**	-0.034 (-0.09)	-0.974 (-2.52)*
Entropy index	0.809	0.0	0.609	0.0	-	0.20 (5.36)***	-	-	-	-
Intangibles/assets	0.111	0.086	0.106	0.074	0.025 (2.40)*	0.005 (0.43)	0.037 (3.56)***	0.019 (1.75)†	0.011 (1.20)	0.032 (2.82)**
	n = 313	n = 339	n = 265	n = 508						
Panel C: 1994										
Sales (US\$ millions)	6153.91	1640.33	1709.76	1247.55	4513.58 (5.14)***	4444.16 (4.60)***	4906.36 (6.74)***	69.426 (0.20)	392.78 (1.24)	462.21 (1.48)
Sales/assets	1.145	1.319	1.469	1.693	-0.175 (-3.79)***	-0.324 (-4.71)***	-0.549 (-8.52)***	0.149 (2.09)*	-0.374 (-5.76)***	-0.225 (-2.75)**
5-Year sales growth	7.797	14.625	12.593	15.333	-6.827 (-6.06)***	-4.795 (-3.18)**	-7.535 (-6.90)***	-2.032 (-1.27)	-0.708 (-0.61)	-2.740 (-1.87)†
ROE	3.345	10.004	9.107	10.576	3.341 (2.69)**	4.237 (3.46)***	2.769 (2.41)*	-0.897 (-0.66)	-0.572 (-0.47)	-1.468 (-1.16)
Market to book ratio	1.863	3.166	1.934	2.539	-1.303 (-1.79)†	-0.071 (-0.14)	-0.676 (-1.20)	-1.232 (-1.82)†	0.627 (0.99)	-0.605 (-1.17)
Debt to assets	27.071	21.142	28.489	26.547	5.930 (3.98)***	-1.418 (-0.86)	0.525 (0.33)	7.348 (4.31)***	-5.405 (-3.41)***	1.943 (1.10)
Foreign sales/total sales	27.861	30.197	0.0	0.0	-2.336 (-1.43)	-	-	-	-	-
Altman Z-score	3.001	4.443	3.521	4.623	-1.442 (-6.28)***	-0.520 (-2.70)**	-1.622 (-5.21)***	-0.922 (-3.28)***	-0.180 (-0.54)	-1.102 (-3.08)**
Entropy index	0.809	0.0	0.592	0.0	-	0.217 (5.59)***	-	-	-	-
Intangibles/assets	0.104	0.079	0.100	0.067	0.025 (2.38)*	0.004 (0.36)	0.037 (3.82)***	0.021 (1.87)†	0.012 (1.31)	0.033 (3.19)**

† Significant at 0.10 or better.

\* Significant at 0.05 or better.

\*\* Significant at 0.01 or better.

\*\*\* Significant at 0.001 or better.

Table 3  
Comparisons of debt ratios across product and geographic diversification for 1996<sup>a</sup>

	MNC <sup>a</sup>	Domestic <sup>b</sup>	<i>t</i> -statistic <sup>c</sup>
Product-diversified	26.34%	28.26%	-1.92 <sup>†</sup>
Product-focused	21.55%	27.63%	-3.91 <sup>***</sup>
<i>t</i> -statistic <sup>d</sup>	3.22 <sup>**</sup>	0.52	

<sup>a</sup> The average debt ratio (26.34%) of firms that are both a MNC and product diversified.

<sup>b</sup> The average debt ratio (28.26%) of firms that are domestic companies and product diversified, etc.

<sup>c</sup> The *t*-statistic compares the average debt ratios of product-diversified MNCs vs. product diversified domestic companies.

<sup>d</sup> The *t*-statistics compares average debt ratios for the cells above.

<sup>†</sup> Significant at 0.10 or better.

\*\* Significant at 0.01 or better.

\*\*\* Significant at 0.001 or better.

The comparisons of the debt ratios also yield interesting results. Only the three comparisons of the multinational product-focused group with the other three groups show significant differences. This same result occurs in all 3 years. The multinational product-focused firms have debt to asset ratios that average 21.55%. This average is significantly lower than the debt ratios for all of the other groups.

To highlight these differences, Table 3 compares the two diversity dimensions. The highest debt ratios are for domestic product-diversified firms, 28.26%. For domestic firms, there is no significant difference in debt ratios across product diversity. For domestic firms, product diversification does not boost debt usage. The lowest debt ratios, 21.55%, occur for multinational product-focused firms. This cell is significantly different from its two adjacent cells.

There does appear to be interaction between the two types of diversification; geographic diversification is negatively related to debt ratios, while product diversification is positively related to debt ratios. Combining these findings shows that DPD firms have the highest debt ratios, while MPF firms have the lowest. Comparison of domestic product-diversified and domestic product-focused firms suggests that product diversification does not really help to boost debt usage in the case of domestic firms, but it seems to counter the negative relation between multinational diversification and leverage. We argue this because we find no significant leverage differences between MNCs that are product-diversified (MPD) and either category of domestic firms (DPD and DPF).

MNCs that are product-focused have the lowest leverage. This finding is important since it shows that the negative impact of geographic diversification on leverage documented in prior research is present only in MNCs that are not product-diversified.

Furthermore, our findings suggest that the positive relation between product diversification and leverage documented in the literature appears to hold only for MNCs. We say this because we do not find any leverage difference between DPD and DPF firms. Overall, our results suggest some interplay between the two types of diversification and leverage.

With regard to the other variables for DPD and DPF firms, the averages for the two groups are insignificantly different in size (sales), sales growth rates, ROEs, market to book ratios, and ratios of intangible assets to assets in 1996. There are, however, differences. The asset turnover

is 1.447 for DPD firms and only 1.288 for MPF firms. This difference is significant at 0.05 ( $t = 2.09$ ). The  $Z$ -scores average 4.489 for MPF firms but only 3.652 for DPD firms; but recall, it is the DPD firms that carry the most debt. In 1995, the MPF firms have marginally higher market to book ratios ( $t = -1.69$ ) and marginally lower ratios of intangible assets to assets ( $t = 1.75$ ).

### 4.3. Multivariate results

To examine these findings more closely, to control for other differences between the groups, and to examine all 3 years simultaneously, we regress the debt to asset ratios against a set of independent variables using the Fuller Battese panel data regression.<sup>4</sup> The test variables are the entropy index of product diversification and the ratio of foreign sales to domestic sales. We control for asset turnover, firm size (log of sales), 5-year sales growth rate, ROA, and the expected future growth potential (market to book ratio). The results appear in [Table 4](#).

Regression 1 is the full sample results. Regressions 2–4 divide the sample according to a single dimension of product or geographic diversity, and regressions 6–9 divide it according to the two types of diversity.

In these regressions the debt ratios are negatively related to the asset turnover ratios, and the coefficients are all significant at better than 0.001. We also find that larger firms carry more debt because the coefficients in all nine regressions for log of sales are positive. Further, and consistent with previous findings, the ROA is significantly and negatively related to the debt ratios in all nine regressions.

The 5-year sales growth rate has significantly positive coefficients for domestic firms, product-diverse firms, and domestic product-diverse firms. This variable is not related to debt ratios for either MNCs or for product-focused firms or the subsamples in either category. It can be argued that domestic firms may be able to finance their growth scale and scope expansion through debt-generated funds, since they do not suffer from the information asymmetries that handicap an MNC's growth through debt financing. Therefore, we find a positive association between growth and leverage for domestic firms only, while MNC growth is not related to leverage.

It should be recognized that growth itself causes uncertainty of future cash flows. Such uncertainty would be more severe in the case of growth in multinational operations. In this scenario, one should expect the relation between future growth opportunities and leverage to be negative for MNCs and positive for domestic firms.

Interestingly, the coefficient for the market to book ratio (our proxy for anticipated growth) is positive for product-focused and for domestic firms (and for the subgroup DPF). While the positive sign may be expected for domestic firms, it is surprising to find the relation between the market to book ratio and leverage for product-focused firms, as we found earlier that domestic firms are also relatively more product-focused than MNCs. As argued, the leverage-growth opportunities link is negative for MNCs and for product-diversified firms (as well as subgroup MPD). Note that the negative relation between leverage and the market to book ratio for product-diversified firms may be driven by MNCs that, as we reported in our bivariate analysis, are relatively more product-diversified.

To test the impact of diversification on the debt ratios, we must examine the coefficients for the last two variables. In our univariate tests and in prior research, product diversification

Table 4

Multiple regressions: dependent variable equals debt to asset ratio sample includes 1,127 firms across 3 years using Fuller and Battese panel data estimation method

Regression number	Regression description	Intercept	Sales/assets	Log of sales	5-Year sales growth rate	ROA	Market to book ratio	Entropy index of product diversification	Ratio of foreign sales to domestic sales <sup>a</sup>	Adjusted R <sup>2</sup> (Hausan M.)
1	Full sample	19.0300 (8.96)***	-4.0476 (-9.92)***	2.2055 (7.06)***	0.0210 (0.72)	-0.5116 (-17.40)***	-0.0345 (-0.37)	-0.2883 (-0.29)	-0.0946 (-5.06)***	12.9% (151.31)***
2	MNC	17.5629 (5.98)***	-4.6556 (-5.79)***	2.1564 (5.22)***	-0.0483 (-1.17)	-0.4441 (-11.68)***	-0.2640 (-2.28)*	1.3764 (1.24)	-0.0439 (-1.98)*	14.1% (80.56)***
3	Domestic firms	17.7614 (5.37)***	-4.423 (-8.62)***	2.4391 (4.87)***	0.0964 (2.20)*	-0.5652 (-12.51)***	0.3827 (2.71)**	-2.5537 (-1.27)	-	14.8% (83.93)***
4	Product-diversified firms	20.3956 (5.26)***	-4.3594 (-6.27)***	2.4661 (4.62)***	0.1785 (2.78)**	-0.5485 (-10.90)***	-0.4659 (-3.61)***	-3.4318 (-2.46)*	-0.0609 (-1.94) <sup>†</sup>	16.8% (42.88)***
5	Product-focused firms	18.1655 (6.98)***	-4.1614 (-8.21)***	2.1493 (5.38)***	-0.0035 (-0.10)	-0.5090 (-14.44)***	0.4626 (3.75)***	-	-0.1231 (-5.35)***	13.1% (131.40)***
6	Product-diversified MNCs—MPD	24.3903 (5.03)***	-5.9065 (-4.63)***	2.1360 (3.48)***	-0.0244 (-0.29)	-0.4984 (-8.88)***	-0.5014 (-3.73)***	-2.2667 (-1.43)	-0.0501 (-1.43)	16.6% (33.41)***
7	Product-diversified domestic firms—DPD	11.1708 (1.39)	-3.9757 (-4.23)	3.7689 (3.32)***	0.3850 (3.39)***	-0.7254 (-5.89)***	-0.3686 (-0.95)	-5.2907 (-1.71) <sup>†</sup>	-	20.5% (13.31)*
8	Product-focused MNC firms—MPF	16.6685 (4.53)***	-3.3909 (-3.32)***	1.5663 (2.77)**	-0.0661 (-1.43)	-0.4240 (-8.28)***	0.3406 (1.58)	-	-0.0345 (-1.22)	10.9% (54.60)***
9	Product-focused domestic firms—DPF	19.4962 (5.44)***	-4.9055 (-7.98)***	2.2887 (4.13)***	0.0335 (0.71)	-0.5407 (-11.16)***	0.5064 (3.36)***	-	-	14.9% (69.50)***

<sup>a</sup> We also create a dummy variable where  $D = 1$  for MNCs and 0 for domestic companies and achieve qualitatively similar results when the dummy variable appears in place of the continuous variable ratio of foreign to domestic sales.

<sup>†</sup> Significant at 0.10 or better.

\* Significant at 0.05 or better.

\*\* Significant at 0.01 or better.

\*\*\* Significant at 0.001 or better.

is positively related to leverage. For the total sample, the coefficient for the entropy index of product diversification is statistically insignificant.

Since size and product diversity are positively related, previous studies have interpreted the positive relation between size and leverage as capturing the positive impact of diversity on leverage (Rajan & Zingales, 1995). Once we isolate individual effects of size and diversity on leverage of product diversified firms, however, a higher degree of product diversity reduces debt ratios instead of increasing them. For the product-diversified firms, a higher degree of product diversity reduces debt ratios instead of increasing them.<sup>5</sup>

One could argue that firms diversify to generate growth opportunities in new business lines. If this is true, diversified firms would have higher growth potential and hence—in terms of the agency-cost-of-debt hypothesis—higher diversification would be negatively related to leverage. Product diversified firms, however, have the lowest market to book ratios in 1996 (second-smallest in 1995 and 1994), and the smallest 5-year average sales growth rate in all 3 years.<sup>6</sup> The market to book ratio measures the stock market's estimate of future growth potential and the 5-year sales growth measures the history of sales growth. Product diversified firms appear to be below average for both growth statistics.

Even after controlling for the market to book ratio, the relation between degree of diversification and leverage is negative. For this subsample, the coefficient for the market to book ratio is also negative, so for the product diversified firms, debt is negatively related to diversification and to growth opportunities.

An alternative explanation for a negative relation between degree of diversification and leverage may be that greater product diversity could create agency costs through suboptimal investments. Hence, the debt market may be less willing to lend to firms that engage in value-destroying diversification. In addition, the product-diverse subsample has the highest ratio of intangible assets to total assets. It is generally accepted that leverage is negatively related to the degree of intangibles in the total asset base of firms.

The coefficient for the ratio of foreign sales to domestic sales has a negative coefficient and is highly significant in regression 1. The sign of this coefficient is consistent with prior research. The coefficient is also nominally negative for all subsamples (MPD, MPF, DPD and DPF) but is statistically insignificant in regressions 6 and 8 (MPD and MPF).

#### 4.4. *Interactive effects*

The univariate results suggest that product and geographic diversification may interact. The multiple regression analysis also indicates some interaction. If we compare the coefficients for FSTS for product-diversified firms (from regression 4) with product-focused firms (from regression 5), we find that the negative impact of the degree of international diversification on leverage is economically and statistically much lower for product-focused firms.

The implications from these regressions are consistent with the univariate framework findings, where we report that the debt ratios of MNCs that are product-diversified (MPD) are indistinguishable from those of domestic firms (both DPD and DPF).

Also, if, as argued, product diversification helps only in the case of MNCs and may reduce leverage in domestic firms for agency reasons, we should find a positive coefficient for the entropy measure for MNCs and a negative coefficient for domestic firms in the regressions

relating diversification to leverage. Although we do find the correct signs for MNCs in regression 2 and for domestic firms in regression 3, the coefficients are statistically insignificant.

To directly test the interactive effects of the two types of diversification on leverage, we run interactive variable regressions allowing for interaction between product and geographic diversification. If, as argued, product diversification helps leverage by mitigating the negative impact of geographic diversification, we should find interactive variables to have positive and significant coefficients.

We use both binary and continuous measures of diversification, and we report the results in Table 5. Regression 10 shows the interactive dummy ( $D = 1$  for firms that are both product-diversified and internationally diversified, and 0 otherwise) is positive and significant at 0.10, indicating that firms that are diversified in both dimensions can support higher debt to asset ratios.

In regression 11, we define the interaction dummy variable as a multiple of the ratio of foreign to total sales (FSTS) and the product diversification dummy ( $D = 1$  for product-diversified firms, and 0 for single-segment firms). The coefficient is positive and significant at 0.10.

In regression 12, the interactive variable (multiple of entropy measure and international diversification dummy variable) is also positive and significant. Finally, in regression 13, we introduce the continuous interactive variable (a multiple of the entropy measure and the ratio of foreign to total sales), which produces a positive although statistically insignificant coefficient.

Overall, results in Table 5 suggest that firms following a strategy of dual diversification—product as well as international—are able to support higher leverage. Thus, the two diversification types seem to complement each other in generating debt capacity and usage, while individually, they each may be negatively related to firm leverage.

Further, it is plausible to argue that the relation between the degree of diversification and leverage may be conditional upon existing debt levels. The debt market may perhaps welcome some degree of product diversification as a hedging instrument against the unique risks that MNCs face due to their international operations.

If this is so, we may find a positive relation between degree of product diversification and leverage for MNCs, at least at the initial stages of product diversification. At higher levels of diversification, if product diversification is perceived as agency-driven, there may be a negative relation between leverage and entropy measures. Thus, we would see an inverted U-shaped relation between leverage and degree of product diversification.

#### 4.5. *Nonlinear relations*

We test the full sample and subsamples by diversification strategy for non-linearity. In Table 6, we examine the test variables by adding two variables: a squared term of the entropy index, and a squared term for foreign sales to domestic sales. Regression 14 is performed for the full sample. The entropy index has a positive coefficient (significant at 0.10), while its square term has a negative coefficient (significant at 0.10). This implies an inverted U-shape for its relation with the debt ratio. An examination of the subsample tests in regressions 15–18 indicates that this non-linear relation is present only for MNCs. These results suggest that the positive relation of product diversification with debt usage occurs only for MNCs.

Table 5  
Multiple regressions: dependent variable equals debt to asset ratio<sup>a</sup>

Regression number	Regression description	Intercept	Sales/assets	Log of sales	5-Year sales growth rate	ROA	Market to book ratio	Diversification team	International diversification	Product diversification	Adjusted R <sup>2</sup> (Hausan M.)
10	Interactive effects <sup>b</sup>	20.3629 (9.49)***	-4.0108 (-9.90)***	2.0805 (6.72)***	0.0202 (0.70)	-0.5115 (-17.38)***	-0.0374 (-0.40)	2.5585 (1.84) <sup>†</sup>	-4.7075 (-5.41)***	-0.8842 (-0.83)	13.0% (164.77)***
11	Interactive effects <sup>c</sup>	19.4680 (9.15)***	-4.0254 (-9.92)***	2.1485 (6.92)***	0.0257 (0.89)	-0.5150 (-17.49)***	-0.0361 (-0.39)	0.0677 (1.92) <sup>†</sup>	-0.1188 (-5.31)***	-0.9090 (-0.96)	13.0% (168.79)***
12	Interactive effects <sup>d</sup>	20.3692 (9.47)***	-4.0588 (-9.96)***	2.1134 (6.81)***	0.0177 (0.61)	-0.5107 (-17.36)***	-0.0399 (-0.43)	2.9354 (1.67) <sup>†</sup>	-4.5175 (-5.36)***	-1.8563 (-1.77) <sup>†</sup>	13.0% (156.48)***
13	Interactive effects <sup>e</sup>	19.3605 (9.06)***	-4.0721 (-9.97)***	2.1861 (7.0)***	0.0224 (0.77)	-0.5137 (-17.45)***	-0.0358 (-0.39)	0.0539 (1.29)	-0.1082 (-5.05)	-1.3168 (-1.04)	12.9% (157.13)***

<sup>a</sup> Testing for interactive effects of product and geographic diversification with a sample of 1,127 firms across 3 years using the Fuller and Battese Panel data estimation method.

<sup>b</sup> In regression 10, we use a binary variable for international diversification and product diversification.

<sup>c</sup> In regression 11, we use the ratio of foreign to total sales (a continuous variable) to measure international business and the binary variable for product diversification.

<sup>d</sup> In regression 12, we use the entropy index (a continuous variable) for diversification and binary variable for international diversification.

<sup>e</sup> In regression 13, we use the ratio of foreign to total sales and entropy index as measures of diversification.

<sup>†</sup> Significant at 0.10 or better.

\*\*\* Significant at 0.001 or better.

Table 6

Multiple regressions: dependent variable equals debt to asset ratio sample includes 1,127 firms across 3 years using Fuller and Battese panel data estimation method testing for non-linear relationships

Regression number	Regression description	Intercept	Sales/assets	Log of rate	5-Year sales growth rate	ROA	Market to book ratio	Entropy index of product diversification	Square of the entropy index	Ratio of foreign sales to domestic sales	Square of ratio of foreign sales to domestic sales	Adjusted $R^2$ (Hausan M.)
14	Full sample	18.7187 (8.78)***	-4.0324 (-9.86)***	2.2591 (7.22)***	0.0203 (0.70)	-0.5121 (-17.42)***	-0.0229 (-0.25)	4.3188 (1.75) <sup>†</sup>	-3.5637 (-1.93) <sup>†</sup>	-0.1731 (-3.84)***	0.0012 (1.86) <sup>†</sup>	13.1% (148.89)***
15	MNCs	16.8592 (5.57)***	-4.4968 (-5.57)***	2.1285 (5.14)***	-0.0397 (-0.96)	-0.4453 (-11.73)***	-0.2528 (-2.18)*	7.1876 (2.58)**	-4.3261 (-2.27)*	-0.0494 (-0.78)	0.0001 (0.11)	14.4% (75.48)***
16	Domestic firms	17.3024 (5.22)***	-4.3993 (-8.59)***	2.4698 (4.94)***	0.0967 (2.21)*	-0.5680 (-12.56)***	0.3950 (2.79)**	5.1340 (0.92)	-7.5383 (-1.48)	-	-	14.9% (85.27)***
17	Product-focused firms	18.7465 (7.20)***	-4.2549 (-8.40)***	2.1772 (5.47)***	-0.0093 (-0.28)	-0.5077 (-14.42)***	0.4645 (3.77)***	-	-	-0.2649 (-4.76)***	0.0022 (2.79)**	13.4% (125.79)***
18	Product-diversified firms	21.7548 (4.96)***	-4.3964 (-6.29)***	2.3326 (4.27)***	0.1802 (2.79)**	-0.5470 (-10.85)***	-0.4743 (-3.68)***	-5.9973 (-1.44)	1.5039 (0.63)	0.0110 (0.15)	-0.0011 (-1.04)	16.9% (53.26)***

<sup>†</sup> Significant at 0.10 or better.

\* Significant at 0.05 or better.

\*\* Significant at 0.01 or better.

\*\*\* Significant at 0.001 or better.



As MNCs initially adopt product diversification, they may be able to support higher debt. The debt market may see product diversification as a stabilizing instrument. At higher degrees of product diversity, however, further diversification may be perceived as agency-driven, and hence produce a negative relation between leverage and entropy.

Similarly for the full sample, the non-linear relationship suggests that the positive impact of product diversity on leverage is limited. Beyond a point, the debt market may perceive further product diversification as agency-driven and value destroying, and it may avoid lending to these corporations. Alternatively, the negative relation beyond a point may occur because managers are avoiding higher debt/an or agency costs of debt between shareholders and debtholders.

For geographic diversification, the ratio of foreign sales to domestic sales has a negative coefficient as before (significant at 0.001), but its square term is positive (significant at 0.10). This relation is present only in the product-focused firms.

Recall that we found multinational product-focused firms to have the lowest debt ratios, while debt ratios for the other three groups are indistinguishable. We first argued that product diversification helps MNCs to boost their leverage. The results here support only the converse of that argument: having foreign operations actually reduces leverage in product-focused firms, especially in initial stages of their operations abroad. As they increase their degree of international diversification, they send signals to the market about the sustainability of their global operations. Further, they may be able to raise debt in foreign destination markets as they grow and become significant and visible players in those markets, thereby increasing their leverage. Note, however, that while there is a U-shape in this relation, the coefficient for the squared term is considerably smaller than the non-squared term.

At the same time, for firms that are diversified in both dimensions (MPD), there is no negative influence of degree of either product or international diversification. Thus, complementing international diversification with product diversification may help to mitigate the negative influence of each diversification type on leverage.

## 5. Conclusions

The published theoretical research has found product diversity leads to greater debt capacity and empirical research has found that product diversity leads to higher debt ratios.

Geographic diversity, on the other hand, is associated with lower debt ratios. If diversification is value destroying, this increased capacity for debt and decision to utilize the increased capacity could partially offset the value loss from diversification. Our exploration of this difference reveals that the two types of diversity interact.

Once we control for geographic diversification, asset turnover, firm size, past firm growth, expected firm growth, and profitability, we find that product diversity individually is on average unrelated to debt ratios. Interactively, however, it may help alleviate the negative influence of international diversification on leverage, as we find that MNCs that are product-diversified do not have leverage ratios lower than domestic firms. Further, a negative relation between degree of international diversification and leverage does not characterize the product-diversified MNCs.

The implications of our interactive analysis suggest that firms following a strategy of dual diversification—product as well as international—appear to use more debt. This increased debt

usage may come from the choice to utilize the increased debt capacity created through diversification. Accordingly, our results suggest that the coinsurance effect of diversification exists and may, therefore, create debt capacity. The two types of diversification seem to complement one another in generating debt usage, although individually each one may be negatively related to firm leverage. Further, product diversification per se does not lead to increased debt usage, and does not appear to offset any loss in value caused by diversification.

## Notes

1. The entropy measure is calculated as

$$\text{Total product diversification} = \sum_{i=1}^n P_i \ln \left( \frac{1}{P_i} \right),$$

where  $P_i$  is share of the  $i$ th business segment's sales as a percent of total firm sales, and  $n$  is the number of the firm's business segments.

2. One interesting result is that the significance levels for intangible assets/assets across product diversification is larger than the significance level across geographic diversification despite the differences in means being very similar in size. Similarly, the ROE differences across geographic diversification subsamples have a larger significance level than the comparison across product diversity. The reason lies with variability. There is much greater variability for the sample comparisons when the test statistics are smaller.
3. [Chen et al. \(1997\)](#) suggest that higher agency costs of debt (in terms of [Myers' \(1977\)](#) underinvestment hypothesis) may explain lower leverage for MNCs. This does not seem to be the case, as MNCs as a group appear to have relatively low market to book ratios compared to domestic firms. [Li and Li \(1996\)](#) argue that in the management-shareholders agency framework, debt can be a bonding device, forcing managers to act in a wealth-maximizing manner. In addition, [Harris and Raviv \(1990\)](#) emphasize the information role of debt in which equityholders opt for higher leverage. Consequently, MNCs facing higher information asymmetry may have higher levels of debt.

Furthermore, if debt is used as a source of financing diversification across businesses and across geographies, then MNCs should have a higher level of debt compared to domestic firms.

If MNCs are able to reduce business risk due to international diversification, they should be able to support a higher level of leverage, given the negative relation between optimal debt and business risk ([Castanias, 1983](#); [Bradley, Jarrell & Kim, 1984](#)). Thus, lower leverage in the case of MNCs seems to contradict a number of theories.

4. We run the regressions separately for each year and find generally consistent results.
5. We tested for multicollinearity in our data because the negative entropy coefficient that is positive in the simple regressions could be explained by this econometric problem. All the coefficients are significant relative to the overall  $R^2$ . The VIF estimates do not indicate multicollinearity for product-diversified firms or for DPD firms. The correlation coefficient between entropy and size is only 0.26 for product-diversified firms and only 0.07 for DPD firms. In both subgroups, the eigenvalues are close to 0. Therefore, we reject multicollinearity as the cause for the reversal in sign for the entropy coefficient.

6. Our findings on the impact of product diversification on leverage are contrary to results in other research. We examine this issue more completely in [Appendix A](#) table. Here, we find the entropy index to have a significantly positive coefficient when no other variables appear in the regression. We then regress it separately with each variable and find that it loses its significance when regressed with asset turnover and log of sales. Product-diversified firms are larger and have lower asset turnover ratios than focused firms. When we control for these variables, the impact of product diversification on debt ratios changes and become insignificant.

### Appendix A. Multiple regressions: dependent variable equals debt to asset ratio sample includes 1,127 firms across 3 years using Fuller and Battese panel data estimation method

Intercept	Entropy index product diversification	Ratio of foreign sales to domestic	Sales/assets	Log of sales	5-Year sales growth rate	ROA	Market to book ratio	Adjusted R <sup>2</sup> (Hausan M.)
Full sample								
23.0339 (42.27)***	1.9621 (1.97)*							0.1% (14.69)***
23.4704 (38.97)***	2.1713 (2.17)*	-0.0331 (-1.70) <sup>†</sup>						0.2% (19.73)***
29.7704 (35.59)***	0.8244 (0.84)	-	-4.4899 (-10.58)***					3.3% (26.88)***
14.3058 (6.80)***	0.7995 (0.78)	-	-	1.3910 (4.30)***				0.7% (13.72)**
23.6522 (33.21)***	1.7447 (1.73) <sup>†</sup>	-	-	-	-0.0426 (-1.35)			0.2% (13.82)***
25.8979 (48.75)***	1.9663 (2.10)*	-	-	-	-	-0.5399 (-18.50)***		9.3% (114.01)***
23.7235 (40.42)***	2.0662 (2.09)*	-	-	-	-	-	-0.2957 (-3.08)***	0.4% (24.81)***
18.7839 (8.64)***	-0.8202 (-0.80)	-	-4.7625 (-11.19)***	1.8183 (5.57)***	-	-	-	4.2% (46.54)***
18.6294 (8.64)***	-0.5531 (-0.54)	-0.0886 (-4.47)***	-5.0413 (-11.77)***	2.0954 (6.35)***	-	-	-	4.7% (51.50)***

<sup>†</sup> Significant at 0.10 or better.

\* Significant at 0.05 or better.

\*\* Significant at 0.01 or better.

\*\*\* Significant at 0.001 or better.

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