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Diversification and Efficiency of Investment by East Asian Corporations

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Firms in industrial countries are more likely to benefit from vertical integration and corporate diversification — learning faster and hence improving performance. Corporate diversification in less developed countries is more likely to lead to misallocation of capital.

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Summary findings

The East Asian financial crisis has been attributed in part to the corporate diversification associated with the misallocation of capital investment toward less profitable and more risky business segments. Much anecdotal evidence to support this view has surfaced since the crisis but there was little discussion of it before the crisis. Quite the contrary: The rapid expansion of East Asian firms by entering new business segments was viewed as contributing to the East Asian miracle.

Claessens, Djankov, Fan, and Lang examine the efficiency of investment by diversified corporations in nine East Asian countries, using unique panel data from more than 10,000 corporations for the pre-crisis period, 1991–96. They:

- Document the degree of diversification in the corporate sector in Hong Kong, Indonesia, Japan, the Republic of Korea, Malaysia, the Philippines, Singapore, Taiwan (China), and Thailand, countries that have achieved enviable rates of economic growth over the past three decades.
- Distinguish between vertical and complementary diversification and study the differences across nine countries.
- Investigate whether diversification in East Asia has hurt economic efficiency.

Their study tests the learning-by-doing and misallocation-of-capital hypotheses related to the types and degrees of diversification in East Asian countries. Firms in Indonesia, Korea, Taiwan, and Thailand appear to have suffered significant negative effects of vertical integration on short-term performance; the same countries gained significant short-term benefits from complementary expansion. The results suggest that the misallocation-of-capital hypothesis is appropriate for Korea and Malaysia; the learning-by-doing hypothesis for Indonesia, Taiwan, and Thailand.

Firms in more developed countries succeed in vertically integrating and improve both short-term profitability and market valuation. Firms in more developed countries are ultimately more likely to benefit from such diversification (learn faster, to improve their performance). And diversification by firms in less developed countries is subject to more misallocation of capital.

This paper — a product of the Economic Policy Unit, Finance, Private Sector, and Infrastructure Network — is part of a larger effort in the department to. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Rose Vo, room MC10-628, telephone 202-473-3722, fax 202-522-2031, Internet address hvo1@worldbank.org. The authors may be contacted at cclaessens@worldbank.org or sdjankov@worldbank.org. December 1998. (30 pages).

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Diversification and Efficiency of Investment By East Asian Corporations

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1. Introduction

The East Asian financial crisis has at least in part been attributed to the extensive diversification of corporates, which is associated with misallocation of capital investment towards less profitable and more risky business segments. While a plethora of anecdotal evidence to support this argument has surfaced in the aftermath of the crisis, there was little discussion preceding the crisis. Quite the opposite, the rapid expansion of East Asian corporations through entry into new business segments was seen as an important contributing factor to the East Asian Miracle (World Bank (1994)). In this paper, we examine the efficiency of investment by diversified corporations in nine East Asian countries, using unique panel data of more than 10,000 firms over the 1991-96 pre-crisis period. We offer three contributions to the literature. First, we document the degree of diversification on the corporate sector in Hong Kong, Indonesia, Japan, Korea, Malaysia, the Philippines, Singapore, Taiwan, and Thailand, countries which have achieved enviable rates of economic growth over the last three decades. Second, we distinguish between vertical and complementary diversification and study the differences across the nine countries. Finally, we investigate whether diversification in East Asia has hurt economic efficiency.

To accomplish the first two contributions, we use the inter-industry commodity flow data in the US input-output table as a common benchmark to construct vertical relatedness and complementarity indices between the primary and the secondary businesses of all sample firms in the nine countries (see Fan, Lang and Stulz (1998)). These measures allow us to describe, for any pairs of businesses, the possibility of vertical integration, joint procurement, and/or sharing marketing and distribution in each firm. We document the degree of diversification in the corporate sector, distinguish between vertical and complementary diversification, and study the differences across the nine countries.

We use two competing hypotheses to help answer the third question. The misallocation-of-capital hypothesis states that diversified firms allocate capital to less profitable segments. The more diverse and complex the investment opportunities available, the more pronounced this misallocation is.[1] Such misallocation of capital should be associated with a reduction of short-term profitability and a pronounced diversification discount. In contrast, the learning-by-doing hypothesis argues that when firms diversify into new lines of business, there is an initial period during which labor is learning how to use the new technology, and a reduction in short-term profitability should be observed.[2] This learning-by-doing should not be associated, however, with a diversification discount since the forward-looking capital market fairly assesses the increase in profitability over time as the learning-by-doing pays off. We test these hypotheses by separating vertical and complementary diversification. Since vertical diversification is more complex in technology, management, and capital investment than complementary diversification (and thus involves more possibilities for misallocation of capital and learning-by-doing), we should observe a more pronounced effect on short-term profitability and diversification discount in vertical diversification than in complementary diversification.[3]

Our East Asian sample allows us to effectively test these two competing hypotheses. First, some governments in the region have encouraged corporations to engage in vertical expansion to upgrade technology and general level of development (see World Bank (1998)). Since this is not a pure market-outcome, it may be more likely to find a differential effect of vertical integration and complementary diversification for countries with heavy intervention such as South Korea than for countries undertaking a natural transition into diversified businesses. Second, the nine East Asian countries are at different levels of development, which provides insights into the link between diversification patterns and outcomes and the general level of economic development.[4] This diversity

[1] See Shin and Stulz (1996), Scharfstein (1997), and Rajan, Servaes, and Zingales (1997).
[2] See Stockey (1991) and Young (1993).
[3] See discussion of vertical integration in Williamson (1971) and Klein, Crawford and Alchian (1978).
[4] In particular, the nine countries can be thought of as a V-formation with Japan at the lead, flanked by Hong Kong, Singapore and Taiwan, then South Korea, Malaysia and finally Thailand, Indonesia and the Philippines.

allows us to test the differential effect of vertical integration and complementary diversification by level of development.[5]

We find that Indonesia, South Korea, Taiwan and Thailand have suffered significant negative impact of vertical integration on profit margins, while the same four countries have seen significant benefits from complementary expansion on profit margins. In contrast, the diversification discount results suggest that the negative impact of vertical diversification only remains for South Korea and Malaysia. It suggests that the misallocation of capital is more pronounced in South Korea and possibly Malaysia than in Indonesia, Taiwan and Thailand, while the learning hypothesis is more pronounced for these three countries.

The diversity of economic development in our East Asian samples allows us to further examine these two hypotheses by investigating the link between diversification effects and the level of economic development of a country. We would expect that the learning and capital misallocation problems are sensitive to the degree of economic development of the country to which a firm belongs. Consistent with the learning-by-doing hypothesis, firms in more developed countries are successful in vertically integrating with lower costs to both short-term profitability and market valuation since they already make use of sophisticated technologies and may have peer firms to learn from. In contrast, firms in less developed countries benefit more from complementary diversification, but firms in more developed countries are more likely to ultimately benefit from such diversification. This is also consistent with the learning-by-doing hypothesis where firms in more developed countries go faster up their learning curves and improve their performance. We also find evidence consistent with the misallocation-of-capital hypothesis, as diversification by firms in less developed countries is subject to more misallocation of capital. Our evidence supports the finding in Shin and Stulz (1996) that internal capital markets play a more important role in less developed countries, however the internal capital markets misallocate capital. On the other hand, capital misallocation is less relevant to firms in more developed countries, as there is no evidence of a pronounced diversification discount for firms in more developed countries.

[5] For example, Japan is the most developed country, for example, vertical integration should involve less costs of misallocation of capital and learning-by-doing than the other countries.

The paper is organized as follows. Section 2 discusses the main findings of the recent literature on diversification and provides motivation for our hypotheses. Section 3 describes the data sample. Section 4 provides some simple comparisons between single-segment and multi-segment firms. Section 5 details the construction of the main variables in testing the misallocation-of-capital and the learning-by-doing hypotheses. Section 6 studies the links between the general level of economic development of a country and the effect of diversification on the performance. Section 7 concludes.

2. The Literature on Diversification and Efficiency of Investment

There is a growing body of literature, which investigates the impact of diversification on the market valuation of firms. Lang and Stulz (1994), Berger and Ofek (1995), Comment and Jarrell (1995), and Servaes (1996), among others, document that diversified US firms trade at discounts relative to single-segment firms. Similar studies are also conducted by Khanna and Palepu (1996), Lins and Servaes (1998), Fauver, Houston, and Naranjo (1998) and Doukas and Lang (1998) for diversified firms in a cross-section of developed and developing countries.

In examining the efficiency of investment by diversified firms, several authors argue that diversified firms allocate their capital to less profitable segments. The more diverse investment opportunities available, the more pronounced this misallocation. Shin and Stulz (1996) argue that non-core segments of diversified firms invest more than specialized firms in the same industry when other segments do well and invest less when they do poorly. Their evidence is consistent with the view that the investment policy of segments within firms differs from that of similar specialized firms. Scharfstein (1997) examines investment patterns across segments in diversified firms and concludes that diversified firms appear to practice some form of suboptimal "socialist" reallocation of resources across divisions, moving funds from profitable firms in high Q industries to support investment in lower Q sectors. Rajan, Servaes, and Zingales (1997) find that diversified firms misallocate investment funds. The extent of misallocation is positively related to the diversity of investment opportunities across divisions; and the discount at which these diversified firms trade is positively related to the extent of the investment misallocation and the diversity of the investment opportunities across divisions. Denis,

Denis and Sarin (1997) argue that these value-reducing investment strategies are sustained over time because they benefit management, but a competitive corporate control market may act as a disciplining tool. The ineffective corporate control market in the mid-1980s has exacerbated this inefficiency (Jensen (1986, 1989)).

The misallocation-of-capital argument is complementary to the observation by Stockey (1991) and Young (1993) who argue that when firms diversify into new businesses, the diversification is associated with a temporarily lower level of profitability as the firm is learning to use the new technology. If the capital is used for advantageous economic activity, however, profitability should recover over time. Young (1992, 1995) has applied the learning-by-doing hypothesis in the diversification context of East Asia, examining the patterns of corporate growth in Hong Kong and Singapore. He finds that as firms diversify into less related businesses, they require more time to adapt to the new technology (see also Kim and Lau (1994) and Krugman (1994)). Since corporations in Singapore are given incentives by the government to rapidly move into more technology-intensive sectors, they can seldom reach a sufficient level of learning before embarking on a new venture.

A third literature is related to the internal capital market of diversified firms. When external capital markets are more costly to use, firms allocate their capital internally through diversification (Williamson (1971), Gertner, Scharfstein and Stein (1994), Lamont (1997), Stein (1997), Scharfstein and Stein (1997) and Scharfstein (1998)). Fauver, Houston, and Naranjo (1998) find that diversified firms perform better when the capital markets and the legal systems of their country are less developed. Following the internal capital market hypothesis, diversification within firms is an efficient response to the distortions in the external environments or weak external financial markets. However, as argued by Shin and Stulz (1996), internal capital markets may lead to misallocation of capital due to the heterogeneous and complex investment opportunities across the segments of the firms.

3. The Data

We study corporate diversification in nine countries: Hong Kong, Indonesia, South Korea, Japan, Malaysia, Philippines, Singapore, Taiwan and Thailand.[6] Our primary data source is the Worldscope database. Worldscope contains financial and segment information on companies from 49 countries. The database has been used in several international studies of corporate diversification (Lins and Servaes (1997) and Fauver, Houston, and Naranjo (1998)).

We initially selected all companies from the nine countries covered by the June 1991-1998 CD-Rom version of annual Worldscope database. In each of the annual database, Worldscope provides historical financial data. We are able to assemble several years of financial data for most of the companies. Historical segment data for many of the companies are missing, however, since Worldscope reports only the latest available segment data. To increase sample size, we collected additional segment data for Worldscope companies from the autumn edition of the 1994-*1998 Asian Company Handbook* and *Japan Company Handbook.* All financial data were converted to US dollars using fiscal year end foreign exchange rate for each firm.

In order to determine the types of the companies' businesses, we group the companies' segments according to the two-digit Standard Industry Classification (SIC) system. This procedure involves two steps. In the first step, we assign the four-digit SIC codes reported by Worldscope to appropriate segments. In many cases we are able to obtain one-to-one matches between SIC codes and segments. For some companies, the number of reported SIC codes is not the same as the number of reported segments. If a segment can not be associated with a reported SIC code, we determine the segment's SIC code according to its business description. If a segment is associated with multiple SIC codes, it is broken down equally so that each segment is associated with one SIC code. In the second step, we redefine segments at the two-digit SIC level and aggregate segment sales to that level.

We classify firms as single-segment if at least 90 percent of their total sales are derived from one two-digit SIC segment. Firms are classified as multi-segment if they

[6] Although China is also an interesting case, we can locate only a handful public firms from Worldscope. The dominant corporate units in China are state-owned enterprises. The few publicly traded firms are far from representative of the census of firms in China.

operate in more than one two-digit SIC code industries and none of their two-digit SIC code segments accounts for more than 90 percent of total firm sales.[7] This classification scheme is the same as in Lins and Servaes (1996, 1997) and Fauver, Houston, and Naranjo (1998). We further define the primary segment of a multi-segment firm as the largest segment by sales. The remaining segment(s) are defined as secondary segments. In a small number of cases two largest segments have identical sales. In such cases we select the segment with the lower two-digit SIC code as the primary segment. Note that our empirical results generally hold if the alternative is chosen as the primary segment.

Following Lins and Servaes (1997, 1998) and Fauver, Houston, and Naranjo (1998), we exclude multi-segment firms from the sample when they do not report segment sales. We also exclude firms whose primary business segment is financial services (SIC 6000-6999). This selection results in a sample described in Table 1.

[Table 1 here]

There are 8,450 (65%) multi-segment firms and 4,625 (35%) single-segment firms in the sample. Japanese firms comprise the majority of the sample, as they account for 75 percent of the multi-segment firms and 68 percent of the single-segment firms. Across the nine countries, Singapore and Malaysia rank high in the percentage of multi-segment firms (72 and 70 percent, respectively), while Thailand and the Philippines have the lowest percentage (27 and 33 percent, respectively).

The average size of multi-segment firms is US$2,371 million in total assets and US$1,776 million in total assets for single-segment firms. Across the nine countries, the average assets of multi-segment firms are mostly larger than those of single-segment firms, with the exception of South Korea and Singapore. Of the multi-segment firms, Japanese firms have the largest average assets (US$2,850 million), followed by Korean and Hong Kong firms. Of the single-segment firms, Korean firms have the largest average assets (US$2,250 million), followed by Japanese and Hong Kong firms.

[7] We also use 80% cut-off as a robustness check. The qualitative results do not change.

4. Construction of the Main Variables

4.1 Short-term Performance

To examine the hypothesis by Shin and Stulz (1996) that investment policy of segments in diversified firms differs from that of similar specialized firms, we employ the "chop-shop" procedure of Lang and Stulz (1996) to construct our short-term and long-term performance measures. In addition to adjust for sectoral differences in performance, the measures can be interpreted as the performance of a multi-segment firm relative to single-segment firms in its industries. These measures allow us to compare the performance differences between multi-segment (diversified) and single-segment (focused) firms and associate the performance differences with their different investment strategies.

We measure a firm's short-term performance by its profit margin, calculated as one minus the costs of goods sold over sales. We first use the sub-sample of single-segment firms in each country to compute the median profit margin for each two-digit SIC code industry. We then multiply the sales share in each segment of a firm by the corresponding industry median profit margin. We sum the sales-weighted profit margin across segments to obtain the imputed profit margin of the firm. Lastly, we subtract the imputed profit margin from the actual profit margin to obtain the industry-adjusted excess profit margin (EPM).[8]

In the computation of industry median profit margin, we restrict the number of single-segment firms to be at least three. In some cases, we do not have sufficient number of firms to compute the median profit margin. In these cases, we use the median profit margin of broader industry groups as defined by Campbell (1996). This procedure avoids the loss of observations. Table 2 compares the differences in the excess profit margin measures between single- and multi-segment firms. Overall, multi-segment firms are less profitable than single-segment firms. The difference in mean and median EPM between the multi- and single-segment firms is negative and statistically significant at the 1-percent level.

[Table 2 here]

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[8] The excess profit margin is more appropriate than other accounting income variables for the purposes of this study, since it is perfectly correlated with average variable cost (defined as 1 – profit margin) which is widely used by micro economists to proxy factor productivity changes (see, for example, Young (1992) and Clerides, Lach and Tybout (1998)).

In most of the nine countries, multi-segment firms are less profitable than their single-segment counterparts. As in Table 2, multi-segment firms in seven of the nine countries exhibit lower mean (median) EPM and the differences in means (medians) are statistically significant in four (seven) countries. Multi-segment firms in Indonesia and the Philippines appear to have higher EPM, but the mean difference is not statistically significant, while the median difference is only significant for the Philippines.

4.2 Relatedness

We use two variables to capture the degree of relatedness (vertical and complementary) between the primary and secondary segments of a firm. The vertical relatedness variable measures the degree to which a firm integrates forward and/or backward into its secondary segment(s), given its primary segment. For example, if a car manufacturer takes over a car upholstery business, this would reflect a high backward vertical relatedness. If, in contrast, an electricity generation company takes over an electricity distribution business, this would reflect a high forward vertical relatedness. The complementarity variable measure the degree to which the primary and the secondary segments complement each other (forward) in marketing and distribution and/or (backward) in procurement. An example of forward complementarity is a peanut butter producer taking over (or expanding into) strawberry jelly production – the two products do not use the same inputs, and are not vertically related, but that use the same distributors and marketing agents. An example of backward complementarity would be merging together a gin producer and an aspirin producer, as they both use glass containers for their products. To ensure consistency across countries and to provide a common benchmark, the two variables are constructed from information in the US input-output tables.[9]

The procedure for constructing the variables is detailed in Fan, Lang and Stulz (1998). It entails three steps. First, we create four matrices of inter-industry relatedness coefficients. This involves computing the coefficients between each pair of over 400 industries defined in the input-output tables. We follow an approach similar to Lemelin (1982) in measuring inter-industry relatedness. The building block of this approach is the *Use Table of the 1992 Benchmark U.S. Input-Output Accounts*.[10] The *Use Table* reports

[9] We are unable to obtain input-output tables for individual Asian countries.

[10] The Accounts reports commodity flows between pairs of over 400 non-government and non-household industries. See Lawson (1997) for details.

for each pair of industries i and j the dollar value of i's output required to produce industry j's total output, denoted as V_{ij}. We divide V_{ij} by the dollar value of industry j's total output to get v_{ij}, representing the dollar value of i's output required to produce one dollar worth of industry j's output. When v_{ij} is large, it suggests a high degree of forward integration of i into j. Conversely, v_{ji} measures the dollar value of j's product required by industry i to produce one dollar worth of its output. When v_{ji} is large, it suggests an opportunity for i to backward integrate into j. We therefore define two vertical relatedness coefficients, $FVR_{ij}=v_{ij}$ and $BVR_{ij}=v_{ji}$, to proxy for the opportunity for industry i to forward and backward integrate into industry j, respectively.

From the *Use Table*, we compute for each industry i the percentage of its output supplied to each industry k, denoted as c_{ik}. For each pair of industry i and j, we compute the simple correlation coefficient between c_{ik} and c_{jk} across all k. A large correlation coefficient in the percentage output flows suggests a significant overlap in markets to which industry i and j sell their products.[11] For each pair of industry i and j, we also compute a simple correlation coefficient across industry input structures between the input requirement coefficients v_{ik} and v_{jk} of the two industries. A large correlation coefficient suggests a significant overlap in inputs required by industries i and j. We hence define two complementarity coefficients, $FCOM_{ij} = corr(c_{ik}, c_{jk})$ and $BCOM_{ij} = corr(v_{ik}, v_{jk})$, to proxy for the degree of forward and backward complementarity between industries i and j, respectively. Trade between I and j is excluded from the correlations. In step one, the subscripts for FVR, BVR, FCOM, and BCOM are small i and j which denote 400x400 industries.

In the second step, we condense the relatedness coefficient matrices to accommodate the widely used SIC codes and reduce 400 industries to a manageable number. This involves classifying the industries into 34 industry groups and computing mean relatedness coefficients by pairs of industry groups. For each pair of the 34 industry groups, we compute mean relatedness coefficients across pairs of industries that are classified into the same 34 pairs of industry groups. This results in four 34x34 matrices of mean relatedness coefficients.

[11] This coefficient is not used in the Lemelin (1982) study.

In the third step, we construct the relatedness variables for each multiple-segment firms in our sample based on the mean relatedness coefficients from the condensed matrices. We define the vertical relatedness and the complementarity variables as follows.

$$V = \Sigma_k(w^k * FVR^k{}_{IJ}) + \Sigma_k(w^k * BVR^k{}_{IJ}), \quad \text{and}$$

$$C = \Sigma_k(w^k * FCOM^k{}_{IJ}) + \Sigma_k(w^k * BCOM^k{}_{IJ}),$$

where w^k is the sales weight equal to the ratio of the k^{th} secondary segment assets to the total assets of all secondary segments; $FVR^k{}_{IJ}$, $BVR^k{}_{IJ}$, $FCOM^k{}_{IJ}$, and $BCOM^k{}_{IJ}$ are the four mean related coefficients associated with industry group I and J to which the primary and the secondary segments belong.

[Table 3 here]

In Table 3, we rank multi-segment firms by their relatedness levels, group the firms into ten percentiles, and compute mean relatedness measures for each of the ten percentiles. We focus on the 50^{th} (median) percentile. The mean vertical relatedness is 0.0049 (Table 3, Panel A). This implies that for every dollar worth of production by the firm, only 0.49 cent is potentially transacted in-house between the primary and secondary segments. The maximum in-house transaction is 10 cent per dollar worth of output, while the minimum is zero. Across the nine countries, the mean vertical relatedness of the 50 percentile is highest for Thailand (0.0096), followed by Indonesia, Singapore, Hong Kong, Malaysia, the Philippines, Japan, Korea, and Taiwan (0.0031). This order does not correlate with the degree of economic development.

Panel B of Table 3 reports mean complementarity measures by percentile. The mean complementarity of the 50^{th} percentile is 0.3413. The maximum is 2 while the minimum is close to zero. Comparing the levels of the two relatedness measures, these numbers suggest that the across-industry diversification by the Asian companies generate more opportunities of sharing procurement and/or sales activities relative to the opportunity of transacting input internally through vertical integration. Across the nine countries, the mean complementarity of the 50^{th} percentile is the highest for Singapore (0.3991), followed by Hong Kong, Thailand, Japan, South Korea, Indonesia, Taiwan, the Philippines, and Malaysia (0.2091). This order does not appear to correlate with the across-country order of the vertical relatedness measure or the degree of economic development.

To further examine the patterns of diversification by the firms, we report in Panel A and B of Table 4 the distribution of firms by number and by cumulative percentage across ten different levels of the vertical relatedness measure V. As in Panel A and B, the majority of the multi-segment firms falls into the category of V<0.01. For the sample as a whole, 5,298 (70%) of firms have their vertical relatedness measure below that level. The number of firms decreases as V increases. The pattern suggests that, for most of the firms, there exist a small amount of transactions (less than 1 cent per dollar of output) between the firms' primary and secondary segments.

[Table 4 here]

Across the nine countries, Thailand has the lowest percentage (50%) of firms falling into the first category where V<0.01, followed in ascending order by Hong Kong, Singapore, Indonesia, Philippines, Malaysia, Japan, South Korea, and Taiwan (86%). The order is almost identical to the results presented in Table 3. The order suggests that Thai-firms have more vertically-related segments than firms in the eight other countries. On the other hand, Taiwanese multi-segment firms are the least vertically related.

Panel C and D of Table 4 present the distribution of firms across ten levels of the complementarity measure C which indicates the possibility of sharing procurement or sales activities. In the sample as a whole, the majority (62%) of the multi-segment firms falls into the first four categories where C<0.4. Using 0.4 as the cutoff level, the countries in ascending order of the cumulative percentage are Singapore (50%), Hong Kong (52%), Indonesia (59%), Thailand (60%), Japan (61%), Taiwan (73%), Philippines (75%), Korea (76%), and Malaysia (77%). The order is comparable to the results in Table 3, with Singaporean firms having the highest segmental complementarity, and Malaysian firms having the least segmental complementarity.

4.3 Diversification Discount

In calculating the diversification discount, we adopt the approach of Berger and Ofek (1995) and extended by Lins and Servaes (1997, 1998) and Fauver, Houston, and Naranjo (1998) to the international context. This approach defines the excess value of the diversification discount (EXV) as the ratio of the firm's actual value to its imputed value. Market capitalization is used as the measure of actual firm value. It is the market value of common equity plus the book value of debt. The imputed value is computed following the industry-matching scheme described in Section 4.1. We first compute median market-to-sales ratio for each industry in each country using only single-segment firms. The market-to-sales ratio is the market capitalization divided by firm sales. We then multiply the level of sales in each segment of a firm by its corresponding industry median market-to-sales ratio. The imputed value of the firm can be obtained by summing the multiples across all segments. We also restrict the number of single-segment firms to at least three when computing the median market-to-sales ratio of an industry. When an industry has fewer than three single-segment firms even defined broadly as Campbell (1996), we use the median of all firms in the country.

5. Regression analysis

5.1 Relatedness and short-term performance

To be consistent with both hypotheses, we should observe a differential effect between vertical and complementary diversification on EPM. We test this proposition by performing the following estimation:

$$EPM = a + b_1 * V + b_2 * C + b_3 * SEGN + b_4 * Log(ASSETS) + (Fixed\ effects) + u$$

where EPM is the industry-adjusted excess profit margin, V is the vertical relatedness measure, and C is the complementarity measure. The explanatory variables also include the number of firm segments (SEGN) and the natural logarithm of firm assets in thousands of US dollars (Log(ASSETS)) to control for segment and size effects.[12] Lastly, we include country and year dummy variables to control for any fixed effects that may exist. The regression is performed on the pooled sample of multi-segment firms as well as on country-by-country samples.

[Table 5 here]

Table 5 presents the regression results. In the pooled regression, the estimated coefficients of the two relatedness variables V and C are both positive but only the latter is statistically significant. The result is largely driven by Japanese firms, which account for

[12] Morck, Shleifer and Vishny (1988) argue that firm size should be included as a control variable since the size may be correlated with value. In this study, we control for the size effect because the diversification strategy would increase the size of a firm, which increases the inefficiency of running a bigger corporation.

more than two third of the sample. In the country-by-country regressions, the estimated coefficient of V is negative in all countries but Japan. The negative coefficients are significant for Indonesia (significant at the 10% level), Korea (1%), Taiwan (5%), and Thailand (5%). Vertical relatedness seems to hurt performance in these countries. Japan is the only country whose profitability has benefited from vertical relatedness, as the estimated coefficient of V is positive and significant at the 1-percent level.

In contrast, the estimated coefficient of C is positive in all but two countries, Hong Kong and Japan. The positive coefficients are significant for Indonesia (5%), Korea (1%), Taiwan (1%), and Thailand (1%). Firm profitability in these countries has thus benefited from complementary diversification. Although the coefficients of C in the cases of Hong Kong and Japan are negative, they are not statistically significant.

We next examine the effects of multiple segments on EPM. The coefficient of SEGN is negative and significant, suggesting that more segments hurt firm profitability. Across the nine countries, six countries exhibit negative segment effects and five of the coefficient estimates are statistically significant. The Philippines is the only country exhibiting significantly positive segment effect. This result may be driven by the small sample size (35 firms). Lastly, there exist significant positive size effects on profitability except for Taiwan. Large firms are on average more profitable than small firms, as indicated by the positive and highly significant coefficient of Log(ASSETS) in the pooled regression. The country-by-country evidence is consistent with the pooled result.

To provide the statistical significance of the difference of impact between vertical and complementary diversification on profit margin, we test whether the estimated coefficients of V and C from the regressions are equal. As reported in Table 5, the F-value is not significant for the pooled sample. Across the nine countries, we find that the F-value is significant in five countries: Indonesia, Japan, Korea, Taiwan, and Thailand. The evidence for these four countries except for Japan is consistent with both hypotheses. Note that Japan is the only country whose profitability has benefited from vertical relatedness and the estimated coefficient of V is significantly higher than that of C. This evidence indicates that Japan as the most developed country in East Asia may already utilize sophisticated technologies and may also have peer firms to learn from. Hence they have benefited from vertical diversification more than from complementary diversification whose degree of required learning is low. We are unable to test this proposition in this section, however it clearly indicates that the degree of economic development matters in testing these two competing hypotheses. We will examine this issue in Section 6.

Note that if both vertical and complementary diversification have positive impact on profitability, then it demonstrates that conglomerate diversification hurts profitability more than related diversification. However, the impact between vertical and complementary diversification on EPM should still be significantly different since vertical diversification is more complex than complementary diversification. As we can see from previous tables, vertical integration has a negative impact on most countries, while complementary expansion has a positive impact on almost all countries. This evidence suggests that vertical integration is indeed associated with a more complex structure in technology, management and capital investment than complementary or possibly conglomerate diversification.

5.2 Relatedness and diversification discount

The results in Section 5.1 show a significant differential effect for four countries between vertical and complementary diversification. To be consistent with the learning hypothesis, the diversification discount should not be affected by the degree of vertical diversification. In contrast, to be consistent with the misallocation-of-capital hypothesis, the diversification discount should be negatively significant for vertical diversification. To test these two hypotheses, we perform the following estimation:

$$EXV = a + b_1*V + b_2*C + b_3*SEGN + b_4*Log(ASSETS) + (\text{Fixed effects}) + u$$

where EXV is the excess value of diversification discount, V is the vertical relatedness measure, and C is the complementarity measure. The explanatory variables also include the number of firm segments (SEGN) and the natural logarithm of firm assets in thousands of US dollar (Log(ASSETS)) to control for segment and size effects. Lastly, we include country and year dummy variables to control for any fixed effects that may exist. The regression is performed on the pooled sample of multi-segment firms as well as on country-by-country samples.

Table 6 presents the regression results. In the pooled regression, the estimated coefficients of the two relatedness variables V and C are both positive and statistically significant. In the country-by-country regressions, the estimated coefficient of V is negative for only five countries. The negative coefficients are significant only for Korea (5%) and Malaysia (5%). Japan is the only country whose EXV benefits from vertical relatedness, as the estimated coefficient of V is positive and significant at the 1-percent level. In contrast, the estimated coefficient of C is positive only for four countries, and significant only for Japan (1%), South Korea (5%) and Singapore (5%).

[Table 6 here]

We next examine the effects of multiple segments on EPM. The coefficient of SEGN is mixed. Only Japan exhibits a positive and significant effect, while Malaysia experiences a negative and significant effect. Lastly, there exist significant positive size effects on EXV except for Taiwan. Large firms are on average more profitable than small firms. Note that these two variables have little relevance with the test of the two hypotheses.

We study separately the significance levels of V on EXV for Indonesia, Korea, Taiwan and Thailand since the results for EPM for these four countries are consistent with both hypotheses. To be consistent with the learning hypothesis, the significant differential effect between V and C should reduce or disappear. As documented in Table 6, the statistical significance of the difference of impact between vertical and complementary diversification on EXV is insignificant for three countries, Indonesia, Taiwan and Thailand. In contrast, to be consistent with the misallocation-of-capital hypothesis, the significant differential effect between V and C should remain, as is the case for South Korea. As documented in Table 6, the statistical significance of the difference of impact between vertical and complementary diversification on EXV is significant at the 5 % level for South Korea.

The results for Malaysia are interesting. In the EPM regression, the effect of vertical diversification on EPM is negative but insignificant, while this variable becomes significantly negative and significantly different from the effect of complementary diversification in the EXV regression. We may argue that Malaysia is a relatively less developed country in East Asia. Its vertical integration may involve less complex layer of technology, management and capital investment than in Korea or Taiwan, hence it may impose less strain on short-term performance. However, Malaysia may have a more serious misallocation of capital problem, which is reflected in the EXV regression. We hence argue that the evidence is more consistent with the misallocation-of-capital hypothesis.

6. Diversification Effects and Economic Development

In this section, we study the two competing hypotheses by examining the link between diversification effects and the level of economic development of a country. We investigate whether the learning and capital misallocation problems are sensitive to the degree of economic development of the country to which a firm belongs.

6.1 The learning-by-doing hypothesis

In previous section, using Japan as an example, we argued that learning-by-doing is less costly for firms in more developed countries. Since vertical integration involves more learning than complementary diversification, we should observe that firms in more developed countries benefit more from vertical integration, because they already utilize sophisticated technologies and may have peer firms to learn from. On the other hand, we should not observe such performance difference for complementary diversification, because the degree of required learning is low.

We regress EPM and EXV on diversification variables as well as variables proxying the level of economic development of each of the nine countries. In the first model specification, we use the average per-capita GNP[13] during 1991-96 (World Bank (1996)) as the proxy for economic development. In an alternative specification, we proxy the level of economic development by using the World Bank classification of countries by income level groups. This income grouping has been used in the studies of La Porta et al (1998) and Fauver et al (1998). As reported by the World Bank, the lower-middle income dummy equals one if the firm is from Indonesia, the Philippines, or Thailand. The high income Dummy equals one if the firm is from Hong Kong, Japan, Singapore or Taiwan. The numeraire is higher-middle income countries (Korea and Malaysia). The results are reported in Table 7.

[Table 7 here]

[13] We divide the per-capita GNP by 1,000,000 in the regressions.

Initially focus on the interactive effects of vertical relatedness and economic development. From columns (2) and (4), the interaction term between Per-Capita GNP and vertical relatedness is positive and significant for both EPM and EXV. From columns (1) and (3), EPM and EXV are positively related to vertical relatedness in high-income countries while negatively (or insignificantly in the case of EXV) related to it in lower-middle income countries. These results suggest that firms in more developed countries are successful in vertically integrating with lower costs to both short-term profitability and market valuation, while this is not the case for firms in less-developed countries. We have found support for the learning-by-doing hypothesis.

From Table 7, we observe differential short- and long-term interactive effects of complementary diversification and economic development. From column (2) and (4), the coefficient of (Per-Capita GNP)xC is significantly negative for the EPM regression but significantly positive for the EXV regression. Using the alternative specification, the coefficients of (Lower-income dummy)xC and (High-income dummy)xC in the EPM regression are significantly positive and negative, respectively (column (1)). But the reverse is true in the EXV regression (column (4)). From these results, it appears that in the short run firms in less developed countries benefit more from complementary diversification relative to those from more developed countries. It is consistent with the view that, relative to more developed countries, the less developed countries are less open and less competitive, they have more opportunities for short-term profits. But the firms in more developed countries are more likely to ultimately benefit from such diversification. This long-run result is consistent with the learning-by-doing hypothesis where firms in the relatively more developed countries go faster up their learning curves and improve their performance.

6.2 The misallocation-of-capital hypothesis

We next examine whether the firms' diversification performance can be attributed to misallocation of capital. We focus on the effects of vertical diversification on both the short-term and long-term performance. From column (1) to column (4) of Table 7, the estimated coefficients of V are negative and mostly significant, indicating the possibility of misallocation of capital. The coefficients of Per-Capita GNPxV in column (2) and (4) are positive and significant, suggesting that diversification by firms in less developed countries are more subject to misallocation of capital. This evidence supports the finding by Shin and Stulz (1996) that internal capital markets play a more significant role in less developed countries, however internal capital markets misallocate capital. To assess the role of capital misallocation on high-income and low-income countries, we jointly examine the estimated coefficients of V and those of the interaction terms in the EXV regressions. The sum of the estimated coefficient of V and that of (High income dummy)xV is positive in column (3). On the other hand, the sum of the coefficient of V and that of (Lower-middle income dummy)xV is negative in colume (3). We do not find evidence of a pronounced diversification discount for firms in more developed countries, in support of the hypothesis that capital misallocation is less relevant to such firms.

It is also interesting to report the direct effects of the degree of economic development on diversification performance. For both measures (EPM and EXV), the coefficient estimate on Per-Capita GNP is negative (columns (2) and (4)). The dummy variables for income (columns (1) and (3)) tell a similar story: the lower-middle income group dummy has a positive (and significant in column (1)) coefficient, while the high-income group dummy is negative in both specifications, and significant in explaining EXV. Diversified firms in less developed countries perform better relative to those in more developed countries. The evidence is consistent with the view that external markets in less developed countries are more subject to distortions, hence it is relatively more cost effective for firms to allocate resources internally through diversification. At the opposite, more developed countries are typically more open and have a higher degree of market competition. That suggests less opportunity for excess profit margins and stock market valuation.

7. Conclusions

This study tests the learning-by-doing and the misallocation-of-capital hypotheses related to the types and degree of diversification in East Asian countries. Firms in Indonesia, Korea, Taiwan and Thailand appear to have suffered a significant negative impact of vertical integration on short-term performance, while the same four countries have gained significant short-term benefits from complementary expansion. This evidence is consistent with both hypotheses. However, diversification discounts of vertical diversification remain for Korean and Malaysian firms. This result suggests that the misallocation-of-capital hypothesis is appropriate for Korea and Malaysia, while the learning-by-doing hypothesis is more appropriate for Indonesia, Taiwan, and Thailand.

We further examine these two hypotheses by examining the relation between diversification effects and the level of economic development of a country. We document that firms in more developed countries are successful in vertically integrating with lower costs to both short-term profitability and market valuation. We also document that firms in more developed countries are more likely to ultimately benefit from such diversification. This evidence is consistent with the learning-by-doing hypothesis that firms in more developed countries learn faster to improve their performance. Consistent with the misallocation-of-capital hypothesis, we document that diversification by firms in less developed countries are more subject to misallocation of capital.

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Table 1: Summary Statistics of Multi- and Single-Segmented Firms

The primary data source is Worldscope, amended by Asian/Japan Company Handbook. The sample spans the period of 1991-1997. Firms with missing segment sales data are excluded. Firms with their primary businesses in financial services (SIC 6000-6999) are also excluded. Company segments are defined at the two-digit SIC code level. Firms are classified as single-segment if at least 90 percent of their total sales are derived from one two-digit SIC code segment. The remaining firms are classified as multi-segment firms.

		Multi-segment firms			Single-segment firms	
	Number	Percentage	Average assets	Number	Percentage	Average assets
		of total firms	(Millions of US$)		of total firms	(Millions of US$)
Hong Kong	488	65	1199	256	34	974
Indonesia	117	47	670	133	53	391
Japan	6407	67	2850	3153	33	2250
Korea (South)	270	64	1556	152	36	2502
Malaysia	531	70	612	230	30	499
Philippines	38	33	489	76	67	455
Singapore	357	72	526	137	28	721
Taiwan	111	46	768	128	54	766
Thailand	131	27	578	360	73	261
All countries	8450	65	2371	4625	35	1776

Table 2: Summary Statistics of Excess Profitability for Multi- and Single-Segment Firms

EPM is the excess profit margin defined as PM - IPM, where PM = 1- (Costs of goods sold)/Sales. IPM is the imputed profit margin. Using only single-segment firms, we compute the median profit margin in each two-digit SIC code industry. The median profit margin of each segment of a diversified firm is multiplied by the sales weight of the segment. The imputed profit margin is the sum of the sales-weighted medians across all segments. We subtract IMP from PM to obtain the industry-adjusted profit margin EPM.

	Mean EPM Multi-segment firms	Mean EPM Single-segment firms	T-statistics for Difference in means	Median EPM Multi-segment firms	Median EPM Single-segment firms	Z-statistics for Difference in medians
Hong Kong	-0.0246	-0.0046	-1.52	-0.0269	-0.0030	-3.34
Indonesia	0.0433	0.0207	1.02	0.0151	0.0000	0.95
Japan	-0.0131	0.0093	-8.27	-0.0233	-0.0045	-8.58
Korea (South)	-0.0432	-0.0031	-3.27	-0.0460	-0.0063	-3.85
Malaysia	-0.0082	-0.0047	-0.26	-0.0208	0.0000	-2.54
Philippines	0.0898	0.0409	1.10	0.1526	0.0000	2.20
Singapore	-0.0625	0.0090	-4.19	-0.0653	0.0000	-5.37
Taiwan	-0.0109	0.0057	-0.87	-0.0316	-0.0012	-2.72
Thailand	-0.0275	0.0157	-2.42	-0.0330	0.0000	-1.68
All countries	-0.0153	0.0008	-9.61	-0.0251	-0.0021	-12.25

Table 3: Summary Statistics of Vertical Relatedness and Complementarity of Multi-Segment Firms

We rank multi-segment firms by their relatedness levels, group the firms into ten percentiles, and compute mean relatedness measures for each of the ten percentiles. The vertical relatedness and complementarity variables are constructed from the commodity flows data in the Use Table of the 1992 Benchmark U.S. Input-Output Accounts. The details of the variable definitions are described in the text.

Panel A: Vertical relatedness

Percentile	Hong Kong	Indonesia	Japan	Korea (South)	Malaysia	Philippines	Singapore	Taiwan	Thailand	All countries
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10	0.0010	0.0004	0.0007	0.0006	0.0010	0.0006	0.0013	0.0003	0.0010	0.0007
20	0.0019	0.0021	0.0014	0.0013	0.0016	0.0019	0.0024	0.0007	0.0023	0.0014
30	0.0034	0.0046	0.0020	0.0018	0.0024	0.0024	0.0033	0.0013	0.0062	0.0022
40	0.0055	0.0052	0.0030	0.0023	0.0035	0.0037	0.0061	0.0020	0.0079	0.0033
50	0.0078	0.0082	0.0044	0.0037	0.0052	0.0046	0.0079	0.0031	0.0096	0.0049
60	0.0117	0.0097	0.0065	0.0051	0.0076	0.0088	0.0102	0.0053	0.0131	0.0071
70	0.0175	0.0151	0.0090	0.0069	0.0111	0.0106	0.0172	0.0076	0.0276	0.0099
80	0.0302	0.0350	0.0148	0.0137	0.0168	0.0144	0.0301	0.0090	0.0357	0.0163
90	0.0486	0.0529	0.0326	0.0301	0.0400	0.0170	0.0493	0.0125	0.0697	0.0377
100	0.0824	0.0825	0.0977	0.0879	0.0851	0.0825	0.0925	0.0746	0.0811	0.0977

Panel B: Complementarity

Percentile	Hong Kong	Indonesia	Japan	Korea (South)	Malaysia	Philippines	Singapore	Taiwan	Thailand	All countries
0	0.0117	0.0129	0.0148	0.0248	-0.0005	0.0017	0.0637	0.0393	0.0716	-0.0005
10	0.1175	0.0865	0.1482	0.0922	0.0760	0.1057	0.1298	0.0950	0.0997	0.1306
20	0.1860	0.1565	0.1947	0.1489	0.1031	0.1151	0.2099	0.1294	0.1706	0.1851
30	0.2570	0.2205	0.2584	0.1868	0.1264	0.1522	0.2720	0.1516	0.2533	0.2416
40	0.3299	0.2355	0.3103	0.2429	0.1523	0.1776	0.3302	0.2057	0.3275	0.2946
50	0.3915	0.2722	0.3485	0.3009	0.2091	0.2121	0.3991	0.2649	0.3560	0.3413
60	0.4357	0.4145	0.3919	0.3341	0.2616	0.2551	0.5119	0.3546	0.3988	0.3919
70	0.5751	0.6420	0.4271	0.3825	0.3276	0.2994	0.6318	0.3904	0.4520	0.4283
80	0.6457	0.9489	0.5311	0.4095	0.4254	0.5626	0.7391	0.4276	0.6420	0.5375
90	0.9720	1.3655	0.7539	0.4330	0.6287	0.8951	1.0070	1.2886	0.9082	0.7908
100	2.0000	2.0000	2.0000	2.0000	2.0000	1.2744	2.0000	2.0000	1.4190	2.0000

Table 4: Distribution of Multi-Segment Firms by Relatedness and Complementarity

The table reports for each country the distribution of firms in number and in cumulative percentage across ten relatedness levels. Panel A and B report numbers and cumulative percentages by vertical relatedness (V). Panel C and D report numbers and cumulative percentages by complementarity (C). The vertical relatedness and complementarity variables are constructed from the commodity flows data in the Use Table of the 1992 Benchmark U.S. Input-Output Accounts. The details of the variable definition are described in the text.

	All countries	Hong Kong	Indonesia	Korea (South)	Japan	Malaysia	Philippines	Singapore	Taiwan	Thailand
Panel A: Number of firms by vertical relatedness										
V < 0.01	5298	260	65	122	4170	336	23	208	58	56
0.01 <= V < 0.02	1068	87	14	14	789	78	11	51	8	16
0.02 <= V < 0.03	271	32	4	8	175	22	0	21	0	9
0.03 <= V < 0.04	226	27	5	5	136	20	0	19	0	14
0.04 <= V < 0.05	174	24	5	0	110	16	0	17	0	2
0.05 <= V < 0.06	229	16	6	3	173	24	0	7	0	0
0.06 <= V < 0.07	110	9	1	2	85	1	0	9	0	3
0.07 <= V < 0.08	154	20	5	5	94	7	0	13	1	9
0.08 <= V < 0.09	32	1	1	1	19	3	2	4	0	1
0.09 <= V	5	0	0	0	4	0	0	1	0	0
Panel B: Cumulative percentage of firms by vertical relatedness										
V < 0.01	0.70	0.54	0.61	0.76	0.72	0.66	0.63	0.59	0.86	0.50
0.01 <= V < 0.02	0.84	0.72	0.74	0.85	0.86	0.81	0.94	0.74	0.98	0.65
0.02 <= V < 0.03	0.87	0.79	0.78	0.90	0.89	0.85	0.94	0.80	0.98	0.73
0.03 <= V < 0.04	0.90	0.85	0.83	0.93	0.91	0.89	0.94	0.85	0.98	0.86
0.04 <= V < 0.05	0.92	0.90	0.87	0.93	0.93	0.93	0.94	0.90	0.98	0.88
0.05 <= V < 0.06	0.96	0.93	0.93	0.95	0.96	0.97	0.94	0.92	0.98	0.88
0.06 <= V < 0.07	0.97	0.95	0.94	0.96	0.97	0.98	0.94	0.94	0.98	0.90
0.07 <= V < 0.08	0.99	0.99	0.99	0.99	0.99	0.99	0.94	0.98	1.00	0.99
0.08 <= V < 0.09	0.99	1.00	1.00	1.00	0.99	1.00	1.00	0.99	1.00	1.00
0.09 <= V	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Panel C: Number of firms by complementarity										
C < 0.1	404	28	13	17	217	93	2	15	8	11
0.1 <= C < 0.2	1356	75	11	37	982	152	16	52	18	13
0.2 <= C < 0.3	1312	73	34	24	1013	80	8	54	10	16
0.3 <= C < 0.4	1624	73	5	45	1338	67	1	55	13	27
0.4 <= C < 0.5	1150	64	5	26	970	37	1	26	8	13
0.5 <= C < 0.6	412	36	2	1	312	22	2	32	1	4
0.6 <= C < 0.7	384	50	7	3	257	20	1	37	1	8
0.7 <= C < 0.8	184	10	3	1	137	10	0	19	0	4
0.8 <= C < 0.9	99	11	3	3	63	7	2	7	1	2
0.9 <= C	642	56	23	3	466	19	3	53	7	12
Panel D: Cumulative percentage of firms by complementarity										
C < 0.1	0.05	0.05	0.12	0.10	0.03	0.18	0.05	0.04	0.11	0.10
0.1 <= C < 0.2	0.23	0.21	0.22	0.33	0.20	0.48	0.50	0.19	0.38	0.21
0.2 <= C < 0.3	0.40	0.36	0.54	0.48	0.38	0.64	0.72	0.34	0.53	0.36
0.3 <= C < 0.4	0.62	0.52	0.59	0.76	0.61	0.77	0.75	0.50	0.73	0.60
0.4 <= C < 0.5	0.77	0.65	0.64	0.93	0.78	0.84	0.77	0.57	0.85	0.72
0.5 <= C < 0.6	0.82	0.73	0.66	0.93	0.83	0.88	0.83	0.66	0.86	0.76
0.6 <= C < 0.7	0.87	0.83	0.72	0.95	0.88	0.92	0.86	0.77	0.88	0.83
0.7 <= C < 0.8	0.90	0.85	0.75	0.96	0.90	0.94	0.86	0.82	0.88	0.87
0.8 <= C < 0.9	0.91	0.88	0.78	0.98	0.91	0.96	0.91	0.84	0.89	0.89
0.9 <= C	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 5: OLS Regressions of Excess Profitability on Relatedness and Complementarity

This table reports the OLS regression results of the following regression model: EPM = a + b_1*V + b_2*C + b_3*SEGN + b_4*Log(ASSETS) + (Fixed effects) + u, where EPM is the excess profitability measure, V is the vertical relatedness measure, C is the complementarity measure, SEGN is the number of segments, and Log(ASSETS) is the natural logarithm of firm assets in thousands of US dollar. The polled regression controls for fixed effects by including country and year dummy variables (not reported). EPM = PM - IPM, where PM = 1 - (Costs of goods sold)/Sales. IPM is the imputed profitability measure. Using only single-segment firms, we compute the median profitability measure in each two-digit SIC code industry. The median profitability measure of each segment of a diversified firm is multiplied by the sales weight of the segment. The imputed profitability measure is the sum of the sales-weighted medians across all segments. The vertical relatedness and complementarity variables are constructed from the commodity flows data in the Use Table of the 1992 U.S. Input-Output Accounts.

Dependent variable: EPM

	All countries	Hong Kong	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand
Intercept	-0.5135	-0.3751***	-0.1398	-0.0599***	0.0187	-0.2657***	0.2119	-0.3323***	0.6943***	-0.2661
	(-0.830)	(-5.375)	(-0.695)	(-3.979)	(0.165)	(-3.642)	(0.577)	(-3.554)	(2.675)	(-1.332)
Vertical relatedness	0.1154	-0.2470	-1.8746*	0.4788***	-1.4989***	-0.4626	-1.7029	-0.2253	-4.8110**	-2.0914**
(V)	(1.228)	(-0.644)	(-1.974)	(4.739)	(-2.820)	(-0.958)	(-0.903)	(-0.489)	(-2.362)	(-2.369)
Complementarity	0.0087*	-0.0177	0.0789**	-0.0066	0.1291***	0.0432	0.1349	0.0302	0.1947***	0.1791***
(C)	(1.949)	(-0.886)	(1.984)	(-1.447)	(2.901)	(1.604)	(1.272)	(1.080)	(4.242)	(2.754)
Number of segments	-0.0176***	-0.0374***	0.0190	-0.0173***	-0.0120	-0.0289***	0.0530**	-0.0250***	-0.0384*	0.0321
(SEGN)	(-12.900)	(-6.057)	(1.025)	(-11.864)	(-0.968)	(-5.388)	(2.177)	(-3.096)	(-1.708)	(1.564)
Log(ASSETS)	0.0103***	0.0395***	0.0092	0.0075***	-0.0041	0.0293***	-0.0260	0.0285***	-0.0494**	0.0102
	(9.554)	(6.914)	(0.619)	(7.131)	(-0.565)	(4.567)	(-0.885)	(3.606)	(-2.437)	(0.619)
Adjusted R-square	0.0471	0.1177	0.0432	0.0311	0.0583	0.0657	0.1295	0.0398	0.3366	0.1365
Observations	7489	466	106	5726	147	492	35	342	67	108
F value for V=C	1.2497	0.3478	4.1741	22.3926	8.8410	1.0599	0.9314	0.2975	5.9752	6.4084
Probability>F	0.2637	0.5556	0.0437	0.0001	0.0035	0.3037	0.3422	0.5858	0.0174	0.0129

Table 6: OLS Regressions of Excess Value on Relatedness

This table reports the OLS regression results of the following regression model: $EXV = a + b_1 * V + b_2 * C + b_3 * SEGN + b_4 * Log(ASSETS) + (Fixed\ effects) + u$. The dependent variable, EXV, is the excess value defined as the ratio of a firm's actual value to its imputed value. Details of the variable construction can be found in the text and also in Berger and Ofek (1995) and Lins and Servaes (1996, 1997). Among the independent variables, V is the vertical relatedness measure, C is the complementarity measure, SEGN is the number of segments, and Log(ASSETS) is the natural logarithm of firm assets in thousands of US dollar. The polled regression controls for fixed effects by including country and year dummy variables (not reported). The vertical relatedness and complementarity variables are constructed from the commodity flows data in the Use Table of the 1992 Benchmark U.S. Input-Output Accounts. The details of the variable definition are described in the text.

Dependent variable: EXV	All countries	Hong Kong	Indonesia	Japan	Korea	Malaysia	Philippines	Singapore	Taiwan	Thailand
Intercept	1.1088***	-0.2893	-1.0173	0.7555***	1.5531**	1.5347***	-1.4029	1.1905***	3.1165***	1.9956**
	(3.311)	(-0.796)	(-1.101)	(9.582)	(2.362)	(3.749)	(-1.106)	(3.538)	(2.773)	(2.341)
Vertical relatedness	1.2863***	2.0361	-3.0572	2.1913***	-7.2571**	-6.8400***	7.9937	-0.3712	1.3894	-4.9497
(V)	(2.685)	(1.033)	(-0.594)	(4.108)	(-2.356)	(-2.615)	(1.307)	(-0.217)	(0.074)	(-1.188)
Complementarity	0.0715***	-0.0559	-0.1563	0.0896***	0.7830**	-0.1372	0.7112	0.2217**	-0.0221	-0.3463
(C)	(3.182)	(-0.573)	(-0.866)	(3.749)	(2.332)	(-0.944)	(1.563)	(2.227)	(-0.109)	(-1.198)
Number of segments	0.0174**	-0.0445	-0.0354	0.0357***	0.0014	-0.0652**	0.0533	-0.0262	-0.0388	-0.0364
(SEGN)	(2.548)	(-1.419)	(-0.401)	(4.682)	(0.020)	(-2.238)	(0.647)	(-0.895)	(-0.445)	(-0.345)
Log(ASSETS)	0.0135**	0.1340***	0.2028***	0.0118**	-0.0486	0.0097	0.1689	-0.0158	-0.1488*	-0.0318
	(2.501)	(4.471)	(2.929)	(2.139)	(-1.150)	(0.273)	(1.634)	(-0.550)	(-1.697)	(-0.450)
Adjusted R-square	0.0136	0.0397	0.0788	0.0128	0.0434	0.0182	0.1187	0.0092	-0.0026	-0.0011
Observations	7127	402	93	5550	133	455	30	315	57	92
F value for V=C	6.2388	1.0958	0.3127	15.0572	6.3856	6.3498	1.3705	0.1170	0.0057	1.1915
Probability>F	0.0125	0.2958	0.5775	0.0001	0.0127	0.0121	0.2528	0.7325	0.9403	0.2781

Note: t-statistics in parentheses; Asterisks denote the level of significance: *** 1%, ** 5%, * 10%.

Table 7: Diversification Effects and Economic Development

Excess profit margin (EPM) and excess value (EXV) are employed as the dependent variable in Equations (1) and (2), and (3) and (4), respectively. GNP is the annual per-capita GNP in US dollars divided by 1,000,000. The Lower-Middle Income Dummy equals one if the firm is from Indonesia, Philippines, or Thailand. The High Income Dummy equals one if the firm is from Hong Kong, Singapore, Taiwan, or Japan. The numeraire is Higher-Middle Income countries (Korea and Malaysia). The income groups are assigned according to World Bank. V and C are the vertical relatedness and the complementarity measures, respectively. SEGN is the number of firm segments. Log(assets) is the natural logarithm of firm assets in thousands of US dollars. The sample includes multi-segment firms in the nine Asian countries. In Equations (3) and (4), firms with excess values greater than four or less than one-fourth are deleted.

Dependent variable	EPM		EXV	
	(1)	(2)	(3)	(4)
Intercept	-0.0518 (-0.840)	-0.0544 (-0.883)	1.5214*** (4.545)	1.4959*** (4.485)
Per-capita GNP		-0.1560 (-0.683)		-9.7390*** (-7.826)
Lower-Middle Income Dummy	0.0269* (1.681)		0.1119 (1.356)	
High Income Dummy	-0.0024 (-0.289)		-0.2612*** (-5.898)	
Vertical Relatedness (V)	-0.4035 (-1.251)	-1.4980*** (-5.964)	-4.3809*** (-2.692)	-3.4311*** (-2.583)
Complementarity (C)	0.0536*** (2.660)	0.0976*** (7.245)	-0.0870 (-0.835)	-0.1220* (-1.756)
Number of firm segments (SEGN)	-0.0176*** (-13.001)	-0.0184*** (-13.632)	0.0180*** (2.665)	0.0152** (2.249)
Log (assets)	0.0106*** (10.122)	0.0109*** (10.216)	0.0124** (2.345)	0.0149*** (2.778)
Per-Capita GNP x V	n.a.	59.9630*** (6.828)	n.a.	17.6224*** (3.827)
Per-Capita GNP x C	n.a.	-3.2240*** (-7.088)	n.a.	6.6650*** (2.858)
Lower-Middle Income Dummy x V	-1.9974*** (-3.940)	n.a.	1.9199 (0.705)	n.a.
High Income Dummy x V	0.7115** (2.105)	n.a.	6.5049*** (3.813)	n.a.
Lower-Middle Income Dummy x C	0.0778*** (2.706)	n.a.	-0.1240 (-0.832)	n.a.
High Income Dummy x C	-0.0555*** (-2.681)	n.a.	0.1755* (1.643)	n.a.
Adjusted R-square	0.0448	0.0428	0.0132	0.0136
Observations	7489	7489	7127	7127

Note: t-statistics in parentheses; Asterisks denote the level of significance: *** 1%, ** 5%, * 10%.

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