Tarun Khanna
Harvard Business School

Yishay Yafeh
School of Business Administration,
Hebrew University of Jerusalem
CEPR and ECGI

Business Groups and Risk Sharing around the World*

We examine the hypothesis that business groups facilitate mutual insurance among affiliated firms and find substantial evidence of risk sharing by Japanese, Korean, and Thai groups but little evidence of it elsewhere. We also find no correlation between measures of capital market development and the nature of the legal system, on the one hand, and the extent of risk sharing provided by business groups, on the other. The popular view that risk sharing in business groups is important is not validated by our analysis; other reasons are more likely to explain the ubiquity of business groups around the world.

I. Introduction

Diversified business groups are common in most emerging markets. They play an important, yet poorly understood, role in the economies of Chile and Mexico, India and Pakistan, Indonesia and Thailand, South Korea and pre-World War II Japan, to name just a few examples.[1] One function often attributed to such groups is that they

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1. Ghemawat and Khanna (1998) list countries where business groups are prevalent.

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enable member firms to share risks by smoothing income flows and reallocating money from one affiliate to another. Starchan (1976), for example, in an early study of Central American business groups, says that groups serve an insurance function in the face of unstable markets. The *Encyclopedia of the Chinese Overseas* suggests that the diversification of Chinese business groups has allowed them to spread their risks very widely (Pan 1999). In addition, business executives in several countries routinely cite the advantages of stability emanating from membership in a diversified organization. For example, Li Ka-shing, the Hong Kong billionaire and dominant owner of the Hutchinson Whampoa group argued that "diversification has provided us with varied sources of income and has shielded us from the worst of the [Asian] financial crisis" (Financial Times, February 24, 1999).

This conventional wisdom is supported by a voluminous literature on the Japanese bank-centered corporate groups (*keiretsu*). For example, Nakatani (1984) shows that the variance of operating profitability (and growth rates) is lower for group affiliated companies than unaffiliated firms. It has also been shown that the level of operating profitability among group firms is lower. One common interpretation of these findings is that they reflect risk sharing within the Japanese corporate groups, serving the interests of employees whose firm-specific human capital cannot be easily diversified.[2] Of all the economic roles that have been attributed to Japan's corporate groups, Yafeh's (2003) survey suggests that risk sharing may be the most empirically substantiated one. A form of risk sharing within the *keiretsu*, which has been particularly well documented, is intervention by the group's main bank to assist distressed member firms.[3] Some degree of risk sharing has also been observed in Japanese vertical (manufacturer-centered) groups (Asanuma 1989; Kawasaki and McMillan 1987).

Mutual insurance arrangements between firms are also consistent with economic theory. In the presence of capital market imperfections, firms are credit constrained, and therefore have to rely on adequate internally available resources (Myers and Majluf 1984; Fazzari, Hubbard, and Petersen 1987; Greenwald and Stiglitz 1993 emphasize firm risk aversion under these circumstances). The lack of an internal capital market might result in substantial bankruptcy costs (e.g.,

2. Aoki (1988) discusses theoretical reasons for risk sharing within the Japanese corporate groups. For empirical evidence on low profitability and low risk within the Japanese corporate groups, see Caves and Uekusa (1976), Weinstein and Yafeh (1995, 1998) and Hoshi and Kashyap (2001). Dewenter (2003) provides more recent evidence on risk sharing within the Japanese *keiretsu* during the 1990s.

3. For example, Sheard (1989) and Hoshi and Kashyap (2001) document a variety of cases in which banks rescued ailing clients within their group, often with the assistance of other group members. Hoshi, Kashyap, and Scharfstein (1990) and Peek and Rosengreen (2003) provide econometric evidence on main bank assistance to financially distressed firms (and offer different welfare implications of this phenomenon).

Altman 1984) or an inability to meet fixed obligations or fulfill investment plans. Such constraints are probably especially severe in emerging markets, where within-business-group internal capital markets might provide the best solution.[4]

Another rationale for risk sharing may exist if firms maximize the joint utility of their corporate constituents, including employees, financial institutions, stockholders, and management (Aoki 1984, 1988). Some of these constituencies, who cannot diversify their human capital—such as managers and employees—are naturally risk averse and the smoothing of negative outcomes can enhance their utility (see also Bertrand 2004 on risk-sharing contracts between firms and employees). If risk sharing reduces the required compensation for hired managers, it may be beneficial to shareholders as well (Hermalin and Katz 2000). In addition, risk sharing reflected in intervention in times of distress can be economically efficient if it conserves human capital that would otherwise be dissipated.[5]

Despite the intuitive appeal of the risk sharing hypothesis and its potential economic importance, the extent of mutual insurance provided by business groups has received surprisingly little empirical attention in the literature. Indeed, risk sharing through business groups has been analyzed only in Japan, using limited econometric techniques. In this paper, we use a newly constructed database on business groups in 12 emerging markets as well as in prewar (1930s) and postwar (1970s and 1980s) Japan, to provide a variety of econometric estimates of risk sharing in business groups around the world.

We proceed as follows. Section II introduces our unique data set and presents some summary statistics, suggesting that the conventional wisdom from Japan on the importance of risk sharing within business groups does not easily generalize to other countries.

Section III introduces three basic empirical tests. The main premise of our analysis is that mutual insurance among group members is likely to result in smoother measures of operating performance for these firms. Group firms whose profits are very low can obtain cheap inputs and other forms of group assistance, so that their profitability is not as low as it would have been otherwise. Group firms whose performance is good share some of their good fortune with less-successful group members.[6] Our analysis therefore focuses, to a large extent, on tests comparing the volatility of operating profitability or growth rates of group affiliates with those of otherwise comparable unaffiliated

4. Our discussion of business groups and risk sharing is therefore indirectly related to the vast (and growing) literature on conglomerates and internal capital markets; for a recent discussion of this literature, see Campa and Kedia (2002).

5. Tax considerations may also make within-group risk sharing worthwhile.

6. This view of business groups is shared also by some sociologists; see Lincoln, Gerlach, and Ahmadijan (1996).

firms.[7] As in the discussion of the sample characteristics, we find little to suggest the existence of Japanese-style risk sharing within most business groups.

The most basic version of our statistical tests in Section III can be criticized, because group affiliation and firms' lines of business are treated as exogenous, whereas it may well be the case that group firms engage in risky activities precisely because they have the ability to smooth risks best. While group boundaries appear to change slowly, so that group affiliation can be reasonably treated as exogenous in the short term, in section IV we construct several tests that address this concern within our data limitations. Our results on the limited extent of business group risk sharing remain unchanged.

Section V attempts to control for group heterogeneity along dimensions such as horizontal diversification, vertical integration, presence of group-specific financial institutions, and in one country, intragroup coordination. Unlike Japanese main banks, the presence of financial institutions within a group does not increase the extent of mutual insurance, and not much is changed in our results when we control for other group attributes.

In section VI, we turn to tests examining the entire distributions of risk and return among group-affiliated and unaffiliated firms around the worlds. This provides the most compelling evidence that the Japan result of lower risk-lower return for group firms does not apply in most other countries.

Section VII concludes the basic empirical analysis with an examination of ex-post risk sharing, that is, after operating income has been generated, in a subsample of countries where data are available. This ex-post smoothing of income can take place through dividend payments, which could act as a natural "shock absorber" given the extensive cross-ownership ties among member firms in different industries, or by "liquidity smoothing" through intragroup transfers. We find no role for dividends as shock absorbers but do find a limited role for liquidity smoothing.

We further discuss our findings and extend our results in section VIII. Overall, the tests we carry out cast doubt on the assertion that the raison

7. These tests focus on smoothing of profit rates rather than absolute profit streams (to better control for size) although the results are generally similar when we use the latter rather than the former. We use operating profitability rather than net profit rates because operating profits are not (directly) distorted by taxation rules, which differ dramatically across countries, and because a consistent measure of operating profit is available in more countries than net profit. We feel that stock-market-based measures of firm performance, such as Tobin's q, are not appropriate for the present study. An implicit assumption in using Tobin's q is that stock prices reflect true firm value. This is a troubling assumption in emerging economies, where capital markets are often illiquid and plagued with untimely disclosure and other problems. Furthermore, we have appropriate data to construct a proxy for Tobin's q only for a subset of countries in the sample and only for a subset of firms in each country.

d'être of business groups is the provision of mutual insurance to member firms. Despite evidence for the income-smoothing role of business groups in some countries in our sample, it is not as common and extensive as previous conjectures suggest it might be. In particular, the long-established result in the Japanese *keiretsu* literature—that group members have lower means and lower standard deviations of profitability relative to unaffiliated firms—does not apply to most of our sample of contemporary emerging markets. As we show in this section, it is not clear why within-group risk sharing is more common in some countries than in others. Perhaps surprisingly, the degree of capital market development cannot explain the extent of risk sharing within business groups in various countries and neither can the commonly used classifications of legal systems and corporate law (La Porta et al. 1997, 1998).

We also examine whether "tunneling" (the exploitation of minority shareholders by controlling shareholders siphoning off cash flows; Johnson, La Porta, Lopez-de-Silanes, and Shleifer 2000) can account for our results. Tunneling is related to risk sharing because, under certain conditions, it may also result in smooth profit streams (Bertrand, Mehta, and Mullainathan 2002) or be combined with "propping up" weak firms (Friedman, Johnson, and Mitton 2003). Our sample is probably not the most appropriate within which to study this phenomenon, yet toward the end of the paper, we discuss tunneling in greater detail and argue that it is probably not the cause for the limited within-group risk sharing that we observe.

We conclude (section IX) that considerations other than risk sharing are probably more likely to account for the common presence of business groups around the world.

II. The Data, Sample Characteristics, and Empirical Design

A. Data Sources

Our emerging markets database, described in table 1, includes 12 countries: Argentina, Brazil, Chile, India, Indonesia, Israel, Korea, Mexico, the Philippines, Taiwan, Thailand, and Turkey. Although our choice of countries is dictated by data availability, the sample covers a variety of emerging markets around the world: four in Latin America and eight in Asia, although two are on the periphery of Europe. The sample provides a rare opportunity to examine business groups in different countries, representing different degrees of financial and economic development, legal systems, and the like. There is no reason to suspect that the availability of data would lead to a selection of countries with particular risk-return profiles of business groups.

For each firm in each country, we obtain three pieces of information: the group (if any) with which the firm is affiliated, its financial results

TABLE 1 Emerging Market Data Sources

Country	Source of Group Affiliation Data	Source of Financial and Industry Data
Argentina	Interviews by field research team, coupled with publicly available information. Field research carried out by Professor Alvaro Vilaseca in early 1998.	Datastream International.
Brazil	America Economica, *Los principales conglomerados* 1997, published by Dow Jones.	Datastream International.
Chile	Superintendencia de Valores y Seguros, Santiago, Chile. Verified through field research carried out in Chile in multiple trips from middle to late 1997, with assistance from Professor Carlos Caceres, Universidad Adolfo Ibanez, Santiago, Chile. (See Khanna and Palepu 1999).	Superintendencia de Valores y Seguros, Santiago, Chile. Bolsa de Commercio, Santiago, Chile.
India	Centre for Monitoring the Indian Economy, Mumbai, India. Verified through field research and interviews in Chennai, Mumbai, and New Delhi 1996–98. (See Khanna and Palepu 1999, 2000).	Centre for Monitoring the Indian Economy, Mumbai, India.
Indonesia	Kompass Indonesia, *Top Companies and Big Groups in Indonesia* 1996 (Jakarta: Kompass Indonesia). Cross-checked through field research by Raymond Fisman, reported in Fisman (2001).	Jakarta Stock Exchange, *Indonesian Capital Markets Directory* 1996 (Jakarta: Institute for Economic and Financial Research).
Israel	Liat Sack, Hebrew University, unpublished M.A. thesis "Belonging to a Conglomerate in Israel and Its Impact on Firm Profitability, Growth and Risk," 1998.	Liat Sack, Hebrew University, unpublished M.A. thesis "Belonging to a Conglomerate in Israel and Its Impact on Firm Profitability, Growth and Risk," 1998.
Korea	Korea Company Handbook, Autumn 1996 (Seoul: Dongwon Securities Co. Ltd).	Korea Company Handbook, Autumn 1996 (Seoul: Dongwon Securities Co. Ltd). Datastream International.
Mexico	America Economica, *Los principales conglomerados* 1997, published by Dow Jones.	Datastream International.
Philippines	The Ayala Group, Manila, Philippines.	Datastream International.
Taiwan	Translated from the Mandarin edition of *Business Groups in Taiwan* 1997, with assistance from Ishtiaq Mahmood, Kennedy School of Government, Harvard University, and personnel at Yenching Library, Harvard University.	Datastream International.
Thailand	*Thai Business Groups 1996/1997* (Bangkok: Tara Siam Business Information Limited).	Datastream International.
Turkey	Investext, *Istanbul Stock Exchange:* Yearbook of Companies 1996, published by Worldscope, ISI Emerging Markets.	Datastream International.

over as many years as possible, and the industry in which it operates. In most cases, we gather group affiliation data from one (local) source, collect financial and industry information from another (local) source, then merge the two.[8] Note that, because information on group affiliation is based on local sources, our results apply to groups as delineated within each country. Groups are usually not legal entities (Chile is an exception in this respect); the classification of firms into groups is therefore based on historical reports published by the government for antitrust purposes, announcements of new corporate ventures and public listings, filings made by firms, and more. Naturally, it is likely that groups may vary considerably in structure across countries in our sample. We discuss how the possible links between group structure and risk sharing toward the end of the paper.[9]

We now turn to the Japanese data, which we use to make comparisons with contemporary emerging markets. Although a number of group affiliation definitions are commonly used in the literature on postwar Japan (Weinstein and Yafeh 1995), the definition we use here is the most restrictive, that is, membership in one of the six bank-centered groups' Presidents' Clubs (*shacho-kai*). If groups provide mechanisms for risk sharing, they are likely to be most pronounced among the group's core members, which are typically members of these Presidents' Clubs.

To provide an interesting historical comparison, we also use data on the *zaibatsu* corporate groups in prewar Japan. In some important respects (e.g., centralized family control, holding companies, and extreme diversification), the *zaibatsu* were more similar to contemporary business groups in emerging markets, such as Brazil or India, than the postwar Japanese corporate groups (see Hadley 1970; Yafeh 1995). Of the few empirical studies using firm level data in the prewar period, Miyajima (in progress) has one of the largest databases on prewar Japanese firms, which we use here. Group affiliated firms are defined as firms belonging to the three largest and most diversified *zaibatsu*.

8. Local data sources are used wherever available. Such sources cover far more firms than international sources, although they typically require translation and data entry by hand. In several countries where no local source for financial information is available, we use the Company Accounts Database of Datastream International, one of the most comprehensive international providers of information on publicly traded firms. Due to data limitations, the individual country-level data sets cover different periods of time but are all in the late 1980s and 1990s. We construct a concordance of the industry definitions across all our local data sets so that all the industries correspond to two-digit International Standard Industrial Classifications (ISIC).

9. We have annual information concerning group affiliation in Chile. In other countries, the affiliation data are from a single point in time. In practice, changes in affiliation appear to be rare in most countries (Khanna 2000). In relying on local sources to identify groups, we capture the way business groups are viewed locally. Khanna and Rivkin (2000) show that the use of a single metric, for example equity ties, across countries to identify business group members is unlikely to capture the variety of ties by which affiliated firms are bound.

B. Business Groups Around the World: A First Look

Table 2 describes the corporate groups in our sample countries. The fraction of firms classified as group affiliated ranges from about one-fifth in Chile to about two-thirds in Indonesia. By comparison, in Japan, members of Presidents' Clubs account for less than 10% of the firms although other group definitions (e.g., the one provided by Dodwell Marketing Consultants) are much more expansive (Weinstein and Yafeh 1995; Yafeh 2003). With one exception (Turkey), in all countries, group-affiliated firms are larger than unaffiliated firms.

In 3 of the 12 countries, Brazil, Israel, and the Philippines, groups exhibit superior performance: high profitability and low risk relative to unaffiliated firms. In Chile, India, and Mexico, the profitability of group-affiliated firms exceeds that of other companies and so does their profit volatility. Only in six of the emerging markets in the sample is the low standard deviation of operating profitability accompanied by low profitability, the "Japanese pattern." Many of these differences are not statistically significant, and we argue later that these (mixed) basic statistics probably overstate the magnitude of insurance provided by most groups.[10]

Several preliminary observations can be made on the basis of the sample statistics in table 2. In contrast to the literature on Japan, where members of bank-centered Japanese groups underperform otherwise comparable unaffiliated firms (Yafeh 2003), in many emerging markets, group-affiliated firms outperform other companies, albeit, in most cases, not in a statistically significant manner. This may be because groups make up for missing (capital market and other) institutions (Khanna 2000; Khanna and Palepu 2000) or may be associated with minority shareholder expropriation or rent seeking (Fisman 2001).[11] Another observation, based on table 2, is that the relative performance of group-affiliated firms (the risk and return characteristics of business groups) is not clearly related to the often-cited differences in legal origins across countries (La Porta et al. 1997, 1998). The World Bank's Doing Business data set provides additional institutional characteristics on the duration and cost of bankruptcy procedures as well as on the efficiency of contract enforcement (http://rru.worldbank.org/DoingBusiness/), yet it is hard to find common institutional features among the countries where group firms do relatively well. For example, contract enforcement is relatively efficient in Israel and poor in the Philippines (Brazil is in between). Similarly, among the countries where group firms

10. The differences between Japanese group-affiliated firms and other companies are also insignificant here, although they reflect the common view of low risk and low return. Other group definitions produce statistically significant differences; see Yafeh (2003).

11. See Khanna (2000) for further detail on the characterization of business groups and on empirical studies of their performance.

TABLE 2 Group Affiliation around the World

	Years of Data	No. of Firms	No. of Group-Affiliated Firms	(Median Size of Group-Affiliated Firms)/(Median Size of Unaffiliated Firms)	Median ROA of Group-Affiliated Firms (%)	Median ROA of Unaffiliated Firms (%)	Median Standard Deviation of ROA, Group-Affiliated Firms (%)	Median Standard Deviation of ROA, Unaffiliated Firms (%)
Argentina	90–97	25	11	5.5	3.9	7.8**	3.7	4.9**
Brazil	90–97	108	51	2.5	3.3	1.8**	4.1	5.1
Chile	89–96	225	50	18.7	5.9	2.2*	4.4	4.1.
India	90–97	5446	1821	4.4	11.7	9.6*	4.6	4.4*
Indonesia	93–95	236	153	2.8	7.3	7.8	1.9	2.5*
Israel	93–95	183	43	5.0	6.3	3.9*	2.1	2.6
Korea	91–95	427	218	3.9	4.8	5.1	1.9	2.6*
Mexico	88–97	55	19	2.3	8.2	6.1	3.1	2.6
Philippines	92–97	148	37	3.4	7.3	4.0	2.5	2.9
Taiwan	90–97	178	79	2.0	5.1	6.2	1.7	2.3**
Thailand	92–97	415	258	2.3	2.9	4.4*	4.3	4.9**
Turkey	88–97	40	21	1.0	24.6	26.3	6.2	9.1
Prewar Japan	32–43	58	17	6.8	5.5	6.4	4.4	7.1
Postwar Japan	77–92	1002	94	8.5	3.4	3.6	2.2	2.3

NOTE.—The table shows summary statistics on group risk and operating performance for 12 emerging markets as well as for prewar and postwar Japan. All firm numbers, as well as statistics on firm size (total assets) and median return on assets (ROA) are based on the year for which we have maximal coverage for the country in question. In prewar Japan, group affiliation refers to affiliation in the largest three *zaibatsu* only. In postwar Japan, group members are defined as members of Presidents' Clubs only. Significance levels for the comparisons of medians are based on Wilcoxon signed-rank tests. Firms with profit rates above 100% or below −100% are excluded from the analysis. The * and ** denote a difference between group-affiliated and other firms that is significant at the 5% and 10% levels, respectively.

are characterized by low risk and low return, Korea ranks relatively high in contract enforcement and Argentina relatively low. We examine measures of bankruptcy costs later.

III. The Benchmark Specification

We now turn to more formal tests of the hypothesis that business groups provide a mechanism of mutual insurance for member firms. The tests in this section are based on the assumption that group and industry affiliations of firms are exogenous in the relatively short run for which we have data. Whether or not groups are formed and evolve over time in a fashion that enhances risk sharing is beyond the scope of the present paper. This assumption is reasonable, given that we are unaware of any study that explains the endogenous formation of corporate groups and in view of the fact that the structure of groups is typically historically determined to a very large extent. For example, the Japanese prewar groups were formed following a large-scale privatization in the 1880s. Hoshi (1994) and Yafeh (1995) show that the best predictors of membership in postwar Japanese corporate groups are prewar ties. Indian groups emerged when wealthy families acquired assets previously held by the British (Piramal 1996). Korean groups emerged in a similar fashion after the end of the Japanese colonial rule (Nam 2000). McDermott (2002) argues that membership in recently formed Eastern European groups (which are not included in our sample) is also based on historical factors. There is absolutely no evidence on firm selection into groups according to their profit volatility or attitudes towards risk, furthermore, groups appear to be extremely stable; exit and entry of firms seem to be rare events. Nevertheless, tests that are not sensitive to this assumption are discussed next.[12]

The simplest benchmark test of the general notion that group members have smooth profit rates relative to other firms is based on eq. (1):

$$\begin{aligned} \nu\text{prof}_i = {} & \text{constant} + \beta_0(\text{assets}_i) \\ & + \beta_1(\text{prof}_i) + \beta_2(\text{group dummy}) + \text{industry dummies} \end{aligned} \quad (1)$$

where νprof_i is the standard deviation of each firm's operating profitability calculated over all years for which we have data, assets_i is the firm's average size (measured by assets), and prof_i is the firm's average operating profitability. The group dummy variable equals one for firms affiliated with business groups.[13] We control for the fact that the standard deviation

12. Kim (2004) tries to model "conglomeration," the formation of conglomerates but provides no supporting empirical evidence.

13. This specification is in line with early studies of risk sharing in Japanese corporate groups such as Caves and Uekusa (1976) and Nakatani (1984). In India, data constraints

of profits is calculated on the basis of time series of different lengths for different firms within each country by using weighted regressions, where we use the number of observations per firm as weights. We also examine a specification where we estimate standard errors while allowing for the fact that the error terms are not independent across firms of the same business group. This specification does not affect any of the results and is not reported.[14]

Table 3 presents measures of risk sharing by corporate groups, which are based on country-by-country estimation of eq. (1). We find a negative and significant effect of groups on the standard deviation of operating profitability in 4 of the 12 emerging markets in the sample. With the exception of India, the group coefficients in the remaining seven countries are negative but not significantly different from zero. There is evidence of profitability smoothing in prewar Japan and some smoothing among core members of the large bank-centered corporate groups in postwar Japan as well (in line with Nakatani 1984). Nevertheless, prewar smoothing is restricted to the largest groups; the magnitude of postwar profitability smoothing in Japan falls significantly if a broader definition of group affiliation (Dodwell Marketing Consultants') is used. Despite these mixed results, the coefficients on the group dummy variable in all countries are jointly negative.[15] Moreover, in the emerging markets where group-affiliated firms exhibit significantly lower profit volatility, the magnitude of the difference is rather large. Group firms enjoy a standard deviation of operating volatility lower than the sample average (column 2) by over 20% in Thailand, Korea, and Taiwan and by about 30% in Brazil.

For completeness' sake, column 3 of table 3 presents the results of regressions similar in spirit to those based on eq. (1), but with profitability (ROA) as the dependent variable, drawn from Khanna and Rivkin (2001).[16] Only a few of the differences are statistically significant. Moreover, our observations based on table 2 are confirmed: It is

force us to use [net income + interest expenses times (1 − tax rate)]/(total net assets) instead of operating profits.

14. Following Moulton (1990), we note that observations sharing an observable characteristic like group membership may also share unobservable characteristics that may cause the error terms to be correlated. This could make the standard errors obtained using ordinary least squares (OLS) incorrect, leading to potentially spurious claims of statistical significance, with the problem being more acute the greater is the extent of within-group unobservable correlation (Moulton 1986). Accordingly, we also examine a specification in which we assume that observations are independent across groups but not necessarily within groups.

15. The test statistic is calculated as follows: under the null hypothesis, group affiliation should not be correlated with profit volatility ($\beta_2 = 0$). Thus, under the null hypothesis, the sum across all the individual country equations of the β_2 coefficients divided by the square root of the sum of their variances is a standard normal variable. Critical values for the standard normal distribution can then be used to calculate the probability that the null hypothesis is correct.

16. The coefficients are country-specific effects of affiliation with a business group, drawn from a linear regression with controls for industry, time, and other effects; see Khanna Rivkin

TABLE 3 Risk Sharing and Operating Profitability: Benchmark Specification

Country	(1) Effect of Group Affiliation on Profit Volatility: Estimation of Eq. (1)	(2) Mean Std. Deviation of Operating Profitability in the Sample	(3) Effect of Group Affiliation on Profitability (ROA)
Argentina	−8.3	5.3	−2.8*
Brazil	−1.7*	5.6	−.1
Chile	−1.0	6.4	−.4
Pre-liberalization Chile (pre-1991)	+0.2	4.5	N.A.
Postliberalization Chile (1991–96)	−1.9	5.8	N.A.
India	+.1*	6.1	+4.0*
Indonesia	−.0	2.7	+2.2*
Israel	−.3	3.7	+2.4
Korea	−.6*	2.8	.6
Mexico	−.9	3.4	−.6
Philippines	−.8	4.5	−1.9
Taiwan	−.7**	2.9	+1.9*
Thailand	−1.4*	6.1	1.1
Turkey	−1.5	8.1	−2.5
Prewar Japan	−3.8*	4.9	−5.9
Postwar Japan, 1977–92	−.4*	2.5	See text and footnotes 2 and 16
Postwar Japan, 1977–83	−.4**	2.5	See text and notes 2 and 16
Postwar Japan, 1984–92	−.4*	2.4	See text and notes 2 and 16

NOTE.—The table displays coefficients on a group-affiliation dummy in a regression where the dependent variable is the standard deviation of operating profitability and right-hand-side variables include firm assets, industry dummies, average profitability (coefficients not shown), and the group dummy. All regressions in this column are weighted by the number of observations per firm and include heteroscedasticity-consistent standard errors. To get a sense of the magnitude of the coefficients, the mean standard deviation of operating profitability for each country appears in column 2. The sample (number of firms and the proportion of group-affiliated firms) is described in table 2. Firms with profit rates above 100% or below −100% are excluded from the analysis. Column 3 reproduces the regression coefficients on group affiliation, where the dependent variable is profitability (ROA), drawn from Khanna and Rivkin (2001), table 3. The * denotes that a coefficient is significant at the 5% level, and ** denotes that a coefficient is significant at the 10% level.

difficult to identify a clear relation between a country's characteristics (financial or legal system, level of development, etc.) and the relative performance (risk and return) of corporate groups.[17] In particular, it does not appear that countries where bankruptcy costs (as measured by the World Bank) are high tend to have more within-group mutual

(2001) for further details. This is shown for illustration only; Khanna and Palepu (2000) propose a more elaborate nonlinear specification to gauge the impact of group affiliation in India on profitability. There are many specifications documenting the low profitability of members of Japan's postwar business groups; see note 2 and Yafeh (2003) for further details.

17. See Khanna and Rivkin (2001) for further discussion of this point with respect to the effects of groups on profitability. We return to the relation between risk sharing within business groups and country characteristics below.

insurance to avoid bankruptcy. Taiwan, for example, seems to have fairly efficient bankruptcy procedures, and Korea is above average as well.

Risk Sharing and the Volatility of Growth Rates

Some forms of risk sharing may not always be reflected in smooth operating profitability. For example, internal transfers among group members could enable investment smoothing, which, in certain cases, need not lead to smooth profit rates. To address this possibility, we also estimate a version of eq. (1), where the dependent variable is the volatility of asset growth rates rather than the volatility of profit rates. (This specification is close to the one estimated by Nakatani 1984 for Japanese corporate groups.) The results (not shown) indicate that significant (at the 10% level only) smoothing of growth rates by corporate groups takes place only in Korea, but not in other countries, where the coefficients are typically very close to zero. We conclude that our results on the limited extent of risk sharing by groups are probably not driven by our focus on the volatility of firm profitability rather than on other measures.

IV. On the Assumption that Group Affiliation is Exogenous: Three Tests

Equation (1) raises several conceptual and econometric concerns. First, it does not specify how groups provide insurance and may not capture all forms of risk sharing. Second, group firms might systematically choose risky investments if they are "insured" by other members of their group, so that there may not be any observable differences in profit volatility, even though groups provide risk sharing. The tests that follow are designed to address these issues and to examine several specific notions of risk sharing.[18]

A. Conditional Variance of Profitability

Consider a form of within-group risk sharing, in which firms with abnormally high profits assist other group firms whose profitability is lower than usual. In this specification, unlike eq. (1), we allow profitability (reflecting investment strategy) to be endogenously determined by firm and group characteristics. We begin by estimating

$$\text{prof}_i = \text{constant} + \gamma_0(\text{assets}_i) + \text{year dummies} + \text{firm-fixed effects} \quad (2)$$

Note that the firm-fixed effects capture all time-invariant firm attributes, including group affiliation. Risk sharing of the type described here would

18. "Simple" joint determination of risk and return is unlikely to be a serious problem in our accounting data, where there is a low correlation between profitability (which may depend, for instance, on the firm's market power) and its standard deviation.

TABLE 4 Conditional Variance of Profitability

Country	(1) Effect of Group Affiliation on Conditional Volatility of Profitability	(2) Mean squared Residuals in the Sample (from eq. 2)
Argentina	N.A.	N.A.
Brazil	−25.4**	67.7
Chile	−16.5	186.1
India	+.3*	1.20
Indonesia	N.A.	N.A.
Israel	N.A.	N.A.
Korea	N.A.	N.A.
Mexico	−26.7**	39.1
Philippines	N.A.	N.A.
Taiwan	−32.9*	39.6
Thailand	−20.4	93.2
Turkey	N.A.	N/A
Prewar Japan	N.A.	N.A.
Postwar Japan, 1977–92	−.1*	.25

NOTE.—Column 1 presents conditional variance estimates calculated as follows: Firm profitability is regressed on firm size, year, and firm-fixed effects (eq. [2]). The squared residuals from this regression are then regressed on the group-affiliation dummy (shown) and firm size and year dummies (not shown; eq. [3]). To get a sense of the magnitude of the coefficients, column 2 presents the mean squared residuals from eq. (2) for each country. The sample (number of firms and the proportion of group affiliated) is described in table 2. Firms with profit rates above 100% or below −100% are excluded from the analysis. The * denotes a coefficient significant at the 5% level, and ** denotes a coefficient significant at the 10% level.

imply that unexplained changes in profitability (i.e., deviations from the regression line) should be smaller for group firms. This is tested by regressing the squared residuals from eq. (2), which we call the *conditional variance of profitability*, on the group-affiliation dummy and firm-size and year dummies:

$$\text{Squared residuals from eq-(2)} = \text{constant} + \delta_0(\text{assets}_i) + \delta_1(\text{group dummy}) + \text{year dummies} \quad (3)$$

The coefficient of interest in this specification, δ_1, is estimated for Japan and six emerging markets with a time series long enough to estimate eq. (2) with firm-fixed effects, see table 4. In general, the results of this test are similar to those in the previous specification: There is evidence of significant risk sharing in postwar Japan and three emerging markets (Brazil, Mexico, and Taiwan). There is also evidence of a certain degree of risk sharing in Thailand, although it is not quite significant at conventional significance levels. As in the previous test, the magnitude of the group coefficients in these countries is quite large (relative to the squared residuals in column 2). By contrast, as in the previous test, no significant effect of group affiliation on the unexplained volatility of profits is found in the remaining two countries, Chile and India.

B. Matched Portfolios

In addition to linear regressions, we construct matched portfolios of firms for each group in our data. Matching for each firm in each group is based on industry, size, and country. We calculate the standard deviation of group operating profitability, which is an asset-weighted average of the standard deviation of operating profitability of firms within the group (or portfolio). We then compare means and medians of the standard deviation of operating profitability calculated across "real" groups with the means and medians of the standard deviation of operating profitability calculated across the matched portfolios. This approach is relatively immune to the critique that industry choice by groups may be endogenous or that groups tend to concentrate in certain industries.[19]

The results are presented in table 5. There is statistically significant evidence of smoothing of profitability in only two countries, Korea and Thailand, in line with the results of earlier tests. There seems to be 'dis-smoothing' in Indonesia (as in Fisman 2001) and in Taiwan. Thus, the matched portfolio test portrays a mixed picture of group risk sharing.

C. Responses to Shocks to Profitability

The next two tests are designed to examine if groups provide assistance to member firms that are subject to a (positive or negative) external shock.[20] We begin by measuring the differential impact of industry shocks on the profitability of group-affiliated and unaffiliated firms. Because industry (and group) affiliation of firms is certainly exogenous in the short run, these tests are not subject to the critique that groups may choose industries (or firms) to minimize vulnerability to shocks.

Data from the United Nations' *International Yearbook of Industry Statistics* (2000) are used to identify shocks to two-digit manufacturing industries (ISIC codes between 20 and 39). The identification of the shocks is based on the percentage change in real output (nominal output adjusted by producer price indices obtained from the UN data

19. This test is similar in spirit to the "chop shop" approach used by Lang and Stulz (1994) and LeBaron and Speidell (1987). The matching may be flawed if one believes that unobserved intraindustry heterogeneity is high, leading to comparisons between a group firm in a particular industry subsegment and an unaffiliated firm in a different industry subsegment. To guard against this, we rank industries within each country by intraindustry variation in long-run average profitability and repeat the analysis by constructing matched portfolios using only those industries that display below-median intraindustry variation, where the matching is likely to be more accurate. This implies that we can construct meaningful matched portfolios for only a subset of groups; the results remain qualitatively unchanged and are not reported. In addition, recent econometric developments propose matching algorithms that improve on the method used here (e.g., Dehejia and Wahba 1999; Villalonga 2004). Data constraints preclude the implementation of these methods in this study.

20. Within the internal capital markets literature, Lamount (1997), who examines the impact of oil price shocks on American conglomerates, is close in spirit.

TABLE 5 The Volatility of Profitability for Business Groups vs. Matched Portfolios

	Number of Matched Groups	Mean std. Deviation of Group Operating Profitability	Mean Std. Deviation of Matched Portfolio Operating Profitability	Median std. Deviation of Group Operating Profitability	Median std. Deviation of Matched Portfolio Operating Profitability
Argentina	4	4.9	12.7	5.2	6.2
Brazil	35	5.4	5.4	4.3	4.4
Chile	19	9.4	4.8	4.5	4.7
India	439	7.4	6.7	5.1	5.2
Indonesia	85	2.6	1.9**	2.0	1.4**
Korea	122	2.3	3.6*	1.9	3.9*
Mexico	13	3.5	3.1	3.7	2.8
Philippines	11	2.7	2.0	1.8	1.5
Taiwan	45	2.4	1.6**	2.1	1.7**
Thailand	99	5.9	11.1*	5.2	9.0*
Turkey	7	9.3	7.7	9.9	8.5

NOTE.—The table compares the standard deviation of operating profitability of groups (calculated as a size-weighted average of the standard deviation of operating profitability of affiliated firms) with a similar measure calculated for a matched portfolio for each group. Portfolios are matched on the basis of industry, size, and country. This test is not conducted for Israel because of data limitations. The number of groups within each country represents those groups for which a matched portfolio could be constructed. Firms with profit rates above 100% or below −100% are excluded from the analysis. Significance levels are based on two-tailed difference of means t-tests and Wilcoxon signed-rank tests for the difference of medians. The * denotes a difference significant at the 5% level, and ** denotes a difference significant at the 10% level.

and the IMF). A 30% threshold for this statistic proves sensible in delineating periods of shocks from others. For a shock to enter our analysis, we also require performance data on at least five group-affiliated and five unaffiliated firms in our country-specific data sets for the years surrounding the shock. Even so, the number of observations in some of the industry shocks regressions is small. We then estimate

$$\Delta\text{prof}_i = \text{constant} + \beta_0(\text{assets}_i) + \beta_1(\text{prof}_i) + \beta_2(\text{group dummy}) \quad (4)$$

where Δprof_i is defined as the difference between the profit rate at the end of each shock and the profit rate at the beginning of the shock, and prof_i is preshock profitability.

The results for three positive industry-specific shocks and a single negative one are presented in panel A of table 6. The group effect is statistically significant in two of the four shocks, reflecting smoothing in India and Korea, apparently in response to both positive and negative shocks. The small number of observations in three of the four regressions, however, limits the power of this test. Overall, the impression that group firms are not necessarily well insured against industry-specific shocks is in line with Chui, Titman, and Wei's (2001) findings for Indonesian groups during the Asian crisis.

We now turn to macroeconomic shocks. If not all industries are equally affected, then within-group risk sharing can lower the average volatility of group members.[21] To examine the conjecture that risk sharing is especially pronounced during periods of shocks, we re-estimate eq. (1) in years of banking and currency crises (identified by Bordo and Eichengreen 1999) and in years in which average profitability of firms within the sample changed by at least 15%. The results are presented in panel B of table 6: With the exception of India, all the group coefficients are negative; and the coefficients for Mexico, the Philippines, and Thailand are statistically significant. Yet, with the exception of the Philippines, the magnitude of the estimated coefficients is similar to, or smaller than, their full-sample estimates in table 3. We conclude that there is no strong evidence that group firms are better insured in times of adverse macroeconomic shocks (on this point see also Friedman et al. 2003).

V. Risk Sharing and Group Heterogeneity

The preceding tests treat all groups as similar to each other. It is possible, however, that group characteristics affect the extent of risk

21. For example, imagine two pairs of firms of a similar size, located in two industries, one whose profits fall by 75% and the other whose profits decline by a quarter as a result of an economywide shock. If the two belong to the same group and are mutually insured, each firm will have its profits fall by 50%. It is easy to show that the volatility (standard deviation of profitability) is higher for the uninsured two firms than for the two group members.

TABLE 6 Group Responses to Economic Shocks

Country	Year of Shock	Magnitude of Shock (UN data)	Industry (ISIC code), Panel A; Identification of Shock, Panel B	Group Coefficient	Number of Firms in the Industry
			A. Industry-Specific Shock		
India	1994–95	30%	Indust'l/Comm/Mach. 3500	−1.3	95
India	1994–95	37%	Transportation Equip. 3700	−5.9*	23
Indonesia	1993–94	39%	Transportation Equip. 3700	4.8	10
Korea	1991–92	−40%	Transportation Equip. 3700	2.2*	28
			B. Macroeconomic Shocks		
Brazil	1990–92		Bordo-Eichengreen (1999)	−.76	
Brazil	1992–93		Within sample	−1.26	
India	1995–96		Within sample	.01*	
Mexico	1990–94		Bordo-Eichengreen (1999)	−.99**	
Mexico	1993–96		Within sample	−1.22*	
Philippines	1995–96		Within sample	−1.73**	
Taiwan	1995–96		Within sample	−.57	
Thailand	1995–97		Within sample	−1.30*	

NOTE.—Panel A reports estimates of the differential responses of group affiliated and unaffiliated firms to industry-specific shocks. Data from the United Nations' *International Yearbook of Industry Statistics* (2000) are used to identify shocks to two-digit manufacturing industries (ISIC codes between 20 and 39). The percentage change in real output (nominal output adjusted by producer price indices obtained from the UN data and the IMF) is used to identify shocks of at least 30%. In addition, there must be at least five group affiliated and five unaffiliated firms in our country-specific data sets for which performance data exists in the years surrounding the shock. The group coefficient is estimated in a regression of the change in ROA, defined as the difference between the mean ROA at the end of the shock and the mean ROA at the beginning of the shock, on firm size, preshock profitability, and a group dummy, with robust standard errors. The results are similar when we allow for correlation of errors among observations within a group (Moulton 1986, 1990). Firms with profit rates above 100% or below −100% are excluded from the analysis. The * denotes a coefficient significant at the 5% level, and ** denotes a coefficient significant at the 10% level.

Panel B reports estimates of the differential responses of group affiliated and unaffiliated firms to macro-economic shocks. Shocks are either banking and currency crises identified by Bordo and Eichengreen (1999), or "within-sample shocks" which are periods in which the average profitability in the sample changes by at least 15 percent. The group coefficient is estimated in a regression similar to the benchmark specification (1), estimated for the shock years only. The sample (number of firms and the proportion of group affiliated) is described in table 2. Firms with profit rates above 100 percent or below −100% are excluded from the analysis. The * denotes a coefficient that is significant at the 5 percent level, and the ** denotes a coefficient that is significant at the 10 percent level.

sharing provided member firms. For example, diversified groups might provide more insurance to member firms than focused groups, because of their ability to transfer resources between depressed and more successful sources. Perhaps, vertically integrated groups can adjust prices and volumes of intragroup transactions more easily to assist member firms. As documented in literature on Japanese groups, the presence of financial institutions may affect the need and ability to smooth operating profitability among group firms.

To examine these issues, we re-estimate eq. (1), with additional group control variables. Group diversification is defined as the number of two-digit ISIC industries in which the group operates. Our measure of group vertical integration captures the extent to which group firms are in industries that, on average, rely on the industries of other group firms for their inputs.[22] The importance of financial institutions within the group is measured by the fraction of total group assets held by financial institutions.[23]

Table 7 displays regression coefficients measuring the effect of group characteristics on the extent of risk sharing provided. Our earlier results do not change much: As in table 3, the group affiliation coefficients for Brazil, Korea, Taiwan, and Thailand are negative and statistically significant (the coefficient for Turkey is significant as well). However, it is hard to argue that diversified or vertically integrated groups provide more insurance to member firms than other groups (all but two of the coefficients are statistically insignificant).

There is, however, some evidence that, in Taiwan and Thailand, the presence of a large financial ''arm'' tends to reduce the extent of operating profitability smoothing, in contrast with the results for Japan. It appears that group risk-sharing and bank assistance during distress may be substitutes in these countries, in contrast with evidence from Japan, where the two seem to be complements, perhaps because of the large influence that Japanese banks have traditionally had within their corporate groups (Weinstein and Yafeh 1998).[24]

22. Following Rajan and Zingales (1998), we use U.S. input-output tables for this exercise (http://www.bea.doc.gov/bea/dn2/i-o.html). International input-output tables are available from UNIDO but are generally of poor and inconsistent quality. Classifying group firms into two-digit ISIC industries, we observe for each pair of firms (x, y) the fraction of inputs from x's industry to y's and vice versa. We then record the higher value for each pair and average over all pairs in the group to obtain the group's vertical integration index. Since we are dealing with a fairly coarse industry categorization, it is possible that groups having multiple firms within a two-digit ISIC code supply inputs to one another. We therefore do not treat all group firms in a particular two-digit ISIC code as a single entity, but form pairs out of these firms, just as we do when group firms are in different two-digit ISIC codes, thus potentially overstating the extent of vertical integration within the groups.

23. We include banks, insurance companies, mutual funds, and pension funds in our definition of financial institutions. Restricting this measure to banks only or using the number of financial institutions as a fraction of total number of group firms, does not affect the results.

24. The coefficients imply that, in Thailand, for example, a change in the composition of a group increasing the fraction of assets held by financial institutions by 10%, would reduce

TABLE 7 The Impact of Group Heterogeneity

Country	Coefficient on Group Dummy	Coefficient on Group Diversification	Coefficient on Group Vertical Integration	Coefficient on Percentage of Group Assets in Financial Firms
Brazil	−1.8*	−.5	5.7	N.A.
Chile	−.8	−.1	11.6	−.5
India	.9*	−.4	−4.1*	1.0
Indonesia	.1	+.0	−2.9	−.5
Korea	−.6*	+.1	−1.6	N.A.
Mexico	−.8	−.3	12.8	−.2
Philippines	−1.4	.1	5.8	.3
Taiwan	−.8**	−.1	7.4	.2*
Thailand	−1.1**	−.3*	4.4	2.0*
Turkey	−3.1*	.1	7.2	1.7

NOTE.—The dependent variable is the firm-level standard deviation of operating profitability. Right-hand-side variables include firm assets, industry dummies, average profitability (coefficients not shown), the group dummy, a measure of group diversification (number of two-digit industries in which the group operates), a measure of group vertical integration (average input-output coefficient across all pairs of firms within the group), and the fraction of all group assets in group financial firms. Results are not available for Argentina and Israel because of data limitations. Regressions are weighted by the number of observations per firm and include heteroscedasticity-consistent standard errors. The sample (number of firms and the proportion of group affiliated) is described in table 2. Firms with profit rates above 100% or below −100% are excluded from the analysis. The * denotes a coefficient significant at the 5% level, and ** denotes a coefficient significant at the 10% level.

For Chile, we are also able to distinguish groups whose affiliates are more closely coordinated from other groups, to test whether members of tightly coordinated groups are better insured. For this purpose, we collect additional data from the Chilean *Superintendencia de Valores y Seguros* for 1996, the year for which our local data are most comprehensive. Using the amount of equity in each group firm held by other group companies, the identity of the largest 10 owners in each group firm, and the identity of the board members, we construct measures of coordination through direct and indirect (including pyramidal) ownership and through common directors. We also construct an aggregate measure of coordination, which indicates the extent to which affiliates of a particular group are "tightly bound" (appendix A). All these measures are weakly negatively correlated with group-level measures of the standard deviation of operating profitability (constructed as in the matched portfolio tests) though not statistically significantly. Regressions similar to eq. (1) with group coordination measures in addition to the group dummy also tend to yield negative relations between the standard deviation of operating profitability and measures of group tightness, but the estimated coefficients are far from being statistically

group risk sharing by 0.2 or close to 20%. The regressions in table 7 do not control for group size, because it is typically highly correlated with group diversification. Using a measure of group size (assets), we find little evidence that large groups provide more risk-sharing opportunities to member firms (results not shown).

insignificant.[25] There is little to suggest that tight coordination within groups is correlated with more risk sharing in Chile.

VI. Tests Based on the Distributions of Profitability and Profit Volatility

A. One-Dimensional Stochastic Dominance Tests

If group-affiliated firms are indeed mutually insured, the whole distribution of profit volatility among them is likely to differ from that of uninsured firms. We therefore test (nonparametrically) the hypothesis that the distribution of the standard deviation of profitability for group-affiliated firms is first-order stochastically dominated by that for unaffiliated firms (Conover 1980, pp. 344–85).[26] The results of a one-sided Kolmogorov-Smirnov test of the equality of distributions and a one-sided Wilcoxon (sum-of-ranks) test are presented in columns 1 and 2 of table 8. There is evidence of group-provided insurance in Korea, Taiwan, Thailand, and postwar Japan, in line with previous tests. In addition, there is evidence of group-provided insurance in certain other countries (e.g., Indonesia, Turkey). However, stochastic dominance tests do not support the view that business groups around the world typically provide substantial risk-sharing opportunities (reflected in a lower distribution of profit volatility) to member firms.

B. Skewness of the Distribution of Profitability

One plausible form of group-provided insurance is assistance during financial distress. According to this form of risk sharing, no reallocation of resources takes place within the group in normal circumstances. However, troubled affiliates receive assistance from other group members (as in Hoshi et al. 1990). An implication of this conjecture is that the distribution of profit rates among group-affiliated firms is not normal but rather skews to the right.[27] In other words, relative to the distribution of profit rates of unaffiliated firms, fewer group firms show very negative profit rates. However, the opposite prediction can also be derived from the hypothesis that group firms help member firms in distress. Nongroup companies might be a "Darwinian selection of survivors" (because poorly performing nongroup firms go bankrupt,

25. Including the coordination measure along with the other measures of Chilean group heterogeneity does not qualitatively change any of the results reported for Chile in table 7.

26. Let $F(x)$ denote the cumulative density function for group affiliated firms' standard deviation of returns (x), and $G(x)$ denote the same for unaffiliated firms. Then, the test is based on deriving the asymptotic limiting distribution for the test statistic, $D = \min_x[F(x) - G(x)]$, for which exact p-values can be obtained through numerical approximation techniques (Gibbons 1971: pp. 127–31).

27. If a distribution is normal, the skewness statistic equals zero. If there is a "tail" to the right and a "hump" to the left, the coefficient is positive; if there is a "tail" to the left the coefficient is negative.

TABLE 8 Tests Based on Comparisons of Distributions

Country	(1) *p*-Value of 1-Sided KS test of FOSD	(2) *p*-Value of 1-Sided Wilcoxon rank-Sum Test of FOSD	(3) Skewness of the Profit Distribution of Group Firms	(4) Skewness of the Profit Distribution of Nongroup Firms	(5) *p*-Value of 2-Sided Test of 2-Dimensional Stochastic Dominance	(6) *p*-Value of 1-Sided Test of 2-Dimensional Stochastic Dominance
Argentina	.16	.04*	−.4^{+}	−2.4	.03*	.01*
Brazil	.27	.19	.8	−.5	.14	.34
Chile	.71	.57	−1.2	−1.3$^{\#}$	.01*	.18
India	1.00	1.00	−.5	−.1	.00*	1.00
Indonesia	.08**	.02*	1.8	1.9	.06**	.03*
Israel	.14	.05*	2.4	2.0	.03*	.01*
Korea	.00*	.00*	−.05^{+}	−.8$^{\#}$	.00*	.00*
Mexico	.17	.38	−.15^{+}	−1.5	.47	.99
Philippines	.38	.44	−1.6	−1.1	.18	.52
Taiwan	.06**	.05*	1.0	.5	.29	.14
Thailand	.06**	.05*	−.9	−2.1	.10**	.04*
Turkey	.04*	.07**	.1^{+}	−.1^{+}	.38	.18
Prewar Japan	.28	.26	−1.0	.8^{+}	.26	.10**
Postwar Japan, 1977–92	.07**	.00*	.7	.0$^{+, \#}$	.27	.15

NOTE.—Column 1 shows the significance level of a one-sided Kolmogorov-Smirnov test of the hypothesis that the standard deviation of profitability for group firms is first-order stochastically dominated (FOSD) by that for unaffiliated firms. Column 2 shows the significance level of a one-sided Wilcoxon test of the hypothesis that the sum of the ranks of the standard deviation of profitability for group-affiliated firms is lower than for unaffiliated firms. Columns 3 and 4 compare the skewness of the profitability distribution of group-affiliated and of unaffiliated firms. The skewness measures should be interpreted as follows: If a distribution is normal, the skewness statistic equals zero. If there is a "tail" to the right, the coefficient is positive, and if there is a "tail" to the left the coefficient is negative. The $^{+}$ denotes that it is impossible to reject the hypothesis that the distribution is normal at the 5% level. The $^{\#}$ (in column 4) denotes that the difference in the skewness coefficients is statistically significant at the 5% level, based on bootstrapping estimates of the standard deviation of this measure described in appendix B. Columns 5 and 6 report results of a parametric test of two-dimensional stochastic dominance (appendix C): Column 5 reports the significance level of a test of the joint hypothesis that the distributions of both the mean and the standard deviation of profitability are identical for group and nongroup firms. Column 6 reports the significance level of a one-sided test of the hypothesis that the distributions of both the mean and the standard deviation of profitability are lower for group-affiliated firms (i.e., that groups have low-risk, low-return characteristics). The sample (number of firms and the proportion of group affiliated) is described in table 2. Firms with profits above 100% or below −100% are excluded from the analysis. In columns 1, 2, 5 and 6, the * indicates significance at the 5% level, the ** indicates significance at the 10% level.

whereas it is feasible for poorly performing group firms to remain in business longer). If this is the case, one would expect to see a normal distribution of profitability among group-affiliated firms, whereas unaffiliated firms are predominantly high performers.

Column 3 and 4 of table 8 present the results. We begin by measuring skewness statistics for the distributions of each of group and nongroup firms and test if each of these distributions (separately) is significantly different from a normal distribution. In the cases where this is so, we find a roughly equal number of departures in the direction of both positive and negative skewness, revealing no consistent pattern in either group or nongroup profitability distributions. This is inconsistent with the idea that groups provide similar risk-sharing benefits in all countries in the sample.

We then turn to differences in skewness between the distribution of profitability among group-affiliated and unaffiliated firms. Since we are unaware of any existing formal test of the statistical significance of the difference in skewness coefficients of two distributions, we derive bootstrap confidence intervals (appendix B).[28] In the vast majority of cases, the group profitability distribution has a more positive (or less negative) skewness coefficient. However, only in postwar Japan, Korea, and Chile is this difference statistically significant at the 5% level. Hence, there is some evidence that groups in these three countries support firms in distress, in line with the Japan results (Hoshi et al. 1990), but this does not seem to be generally true across most countries.

C. Two-Dimensional Stochastic Dominance Tests

We develop a two-dimensional stochastic dominance test of the joint hypothesis that group firms have both low risk (low volatility) and low returns (low profitability), as the literature on the Japanese groups has suggested (albeit somewhat informally). Unfortunately, unlike tests of stochastic dominance for a single variable for which there are standard nonparametric tests based on ranks, there seems to be no standard theory on nonparametric multivariate tests. We therefore design a parametric test of stochastic dominance in two dimensions by adapting one-sided tests based on normal theory. In two dimensions, stochastic dominance means that the distribution for one set of firms (group affiliated) is below and to the left that of the other set (unaffiliated firms). The test is performed by computing the ranks of the standard deviation

28. We compute the statistics for the difference in skewness of group and nongroup profitability distributions for each year for which we have data, as well as for pooled data with observations across all years. Since the bootstrapping process we use is inefficient when the number of observations is small, we perform the yearwise computations only for those country-years where there are more than 100 firms. For other countries we perform only the pooled sample computation. We report skewness differences as significant only if they are found to be so in virtually all the year-wise computations for that country and for the pooled sample computation.

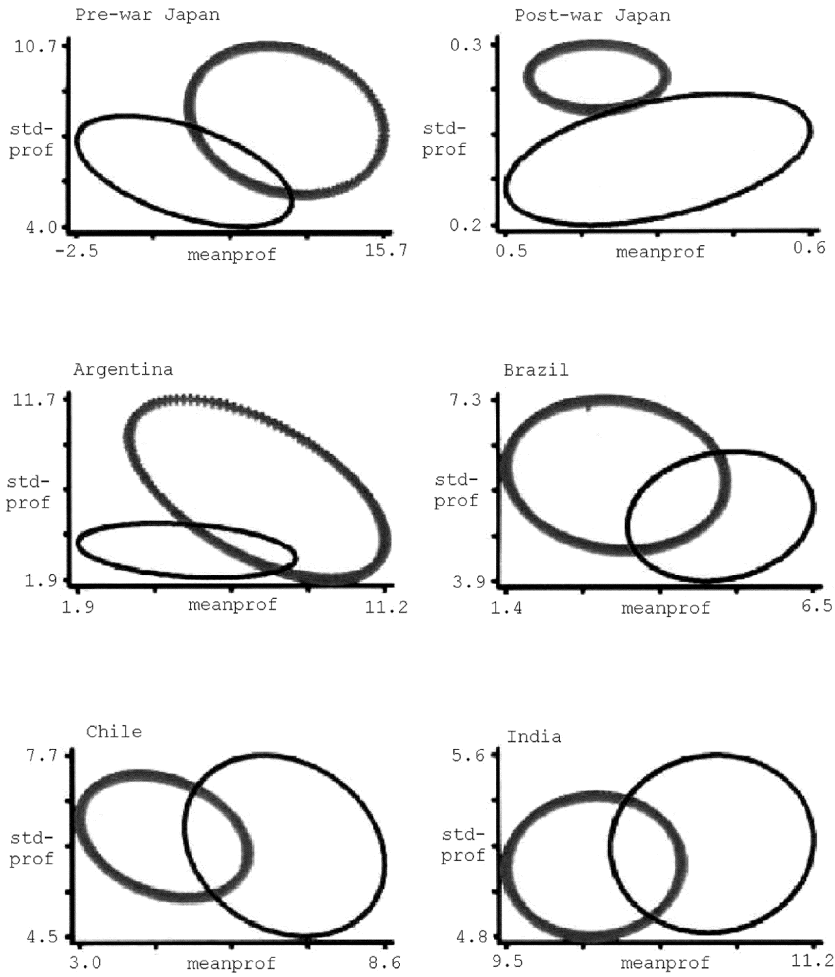

FIG. 1.—Confidence ellipses by country for group affiliated and unaffiliated firms. The thinner line is the 95% confidence ellipse for group affiliated firms, while the thicker line is the 95% confidence ellipse for unaffiliated firms. The plot is of the standard deviation of operating profitability (y-axis) versus the mean of operating profitability (x-axis).

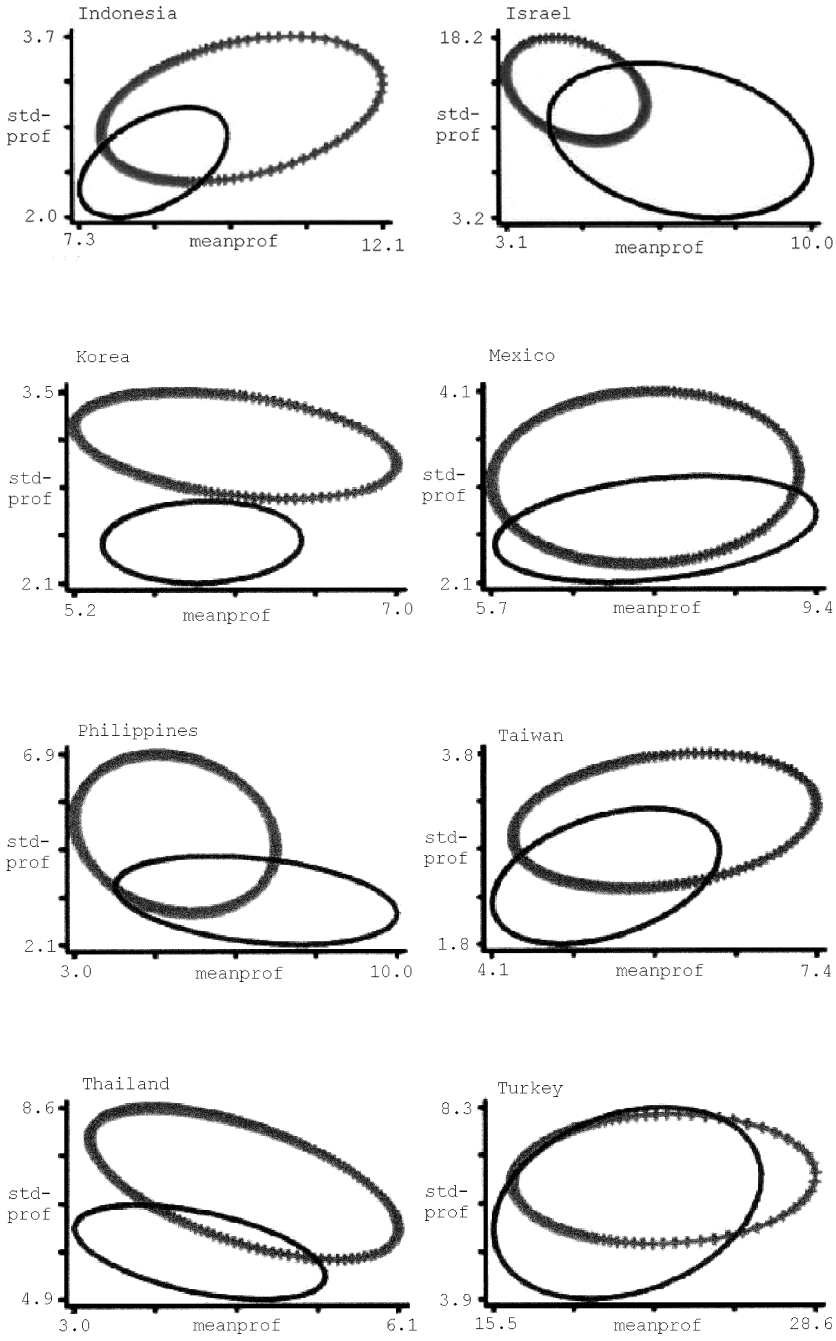

FIG. 1.—*Continued.*

of profitability of all firms (with low ranks corresponding to low standard deviations) and the ranks of the mean profitability, and then converting them to normal scores. Parametric tests designed for normally distributed data are then used to test if group-affiliated firms have both lower standard deviations and lower means of profitability than unaffiliated firms (appendix C).

Columns 5 and 6 of table 8 describe the results of these two-dimensional stochastic dominance tests; graphical depictions of confidence ellipses for group-affiliated and unaffiliated firms are displayed in figure 1, providing a visual depiction of stochastic dominance in two dimensions. Each ellipse is centered on the average (across firms) value of the mean operating profitability and the mean of the standard deviation of operating profitability. It therefore corresponds to the set of points for which one would not reject the hypothesis that the mean profitability and the average standard deviation are equal to the values at the center of the ellipse. The results are consistent with those of earlier tests: In some countries (e.g., Korea and Thailand), there is certainly evidence of group-provided insurance. In most countries, it is impossible to reject the hypothesis that the distributions of profitability and profit volatility are identical for group-affiliated and unaffiliated firms. The "conventional wisdom" about low-risk, low-return Japanese corporate groups does not appear to be generally valid.[29]

VII. Risk Sharing through Dividends and Intragroup Loans

For Chile, India, and postwar Japan, we collect dividend data and measure within-group risk sharing using a method adapted from Asdrubali, Sorensen, and Yosha (1996).[30] A large volume of literature suggests that frequent increases in dividend payout ratios are not very common, in part because future reductions in dividends may have a large negative impact on share prices (Lintner 1956; Benartzi, Michaely, and Thaler 1997). Tax considerations—as well as the fact that, when dividends are distributed, funds are transferred to all shareholders and not just to

29. We do not find a significant difference between group-affiliated and unaffiliated firms in postwar Japan according to this test. The effect of group affiliation becomes significant if a broader definition of group affiliation (Dodwell Marketing Consultants') is used.

30. We require data on net dividends issued by each firm, since the objective is to measure the smoothing of income after all flows due to dividends (received as well as issued) have been accounted for. While data on dividends issued is commonly available for publicly traded companies around the world, data on dividends received from other firms-as a result of ownership stakes in these other firms-is exceedingly hard to find. (Datastream has a field for dividends received, but the data contained therein are exceedingly sparse and unreliable.) We have been able to collect these data from local sources for the three countries on which we focus in this section. The (plausible) premise here is that there exist more equity interlocks within groups than between firms across group boundaries (i.e., between firms in different groups or between unaffiliated firms). Khanna and Rivkin (2000) provide evidence that this is the case in Chile.

group members that require funds to smooth income—also suggest that corporate groups are unlikely to use dividends as a major time-varying risk-sharing mechanism. Nevertheless, even a relatively constant dividend payout ratio can provide a regular mechanism of smoothing income for group firms operating in different industries.

Our test of this hypothesis proceeds as follows. We denote the operating profitability of firm i in year t by x and the after-dividend profitability by y. Using the identity $x = x - y + y$ (and omitting firm and time subscripts), we take first differences and multiply both sides by Δx to get

$$\Delta x^2 = \Delta x[(\Delta x - \Delta y) + \Delta y].$$

Taking expectations on both sides, we obtain

$$\mathrm{Var}(\Delta x) = \mathrm{Cov}[\Delta x,\ (\Delta x - \Delta y)] + \mathrm{Cov}[\Delta x,\ \Delta y].$$

Dividing by $\mathrm{Var}(\Delta x)$ yields

$$1 = \mathrm{Cov}[\Delta x,\ (\Delta x - \Delta y)]/\mathrm{Var}(\Delta x) + \mathrm{Cov}[\Delta x,\ \Delta y]/\mathrm{Var}(\Delta x) \qquad (5)$$

Our estimate of risk sharing is based on the first term, which is the regression coefficient of $(\Delta x - \Delta y)$ on Δx, whereas the second term represents income that is not smoothed.[31]

Finally, India is the only country for which we have additional information on intragroup loans and receivables. We use this information to estimate an equation similar to eq. (5) with two layers of smoothing, one being dividends and the other loans and receivables (which actually smooth "liquidity" rather than income). Denoting changes in the ratio of loans to assets by Δz, the estimated equation becomes

$$1 = \mathrm{Cov}[\Delta x,\ (\Delta z - \Delta y)]/\mathrm{Var}(\Delta x) + \mathrm{Cov}[\Delta x,\ (\Delta x - \Delta y)]/\mathrm{Var}(\Delta x) + \mathrm{Cov}[\Delta x,\ \Delta z]/\mathrm{Var}(\Delta x) \qquad (5')$$

and it is possible to obtain an estimate of the amount of smoothing achieved at each layer.

We find that dividends do not play much of a smoothing role in any of the three countries (Chile, India, and postwar Japan) where data are available (table 9). This is consistent with the conjecture that, because

31. Suppose that x goes up by 1. If income shocks are perfectly smoothed, dividends fall by exactly 1, keeping after-dividends profitability, y, unchanged, and regressing $\Delta x - \Delta y$ on Δx would yield a coefficient of 1. If Δx goes up by 1 and there is no smoothing at all, regressing $\Delta x - \Delta y$ on Δx yields a coefficient of zero. In intermediate cases, the magnitude of the estimated coefficient (between zero and 1) corresponds to the percent of income smoothed by dividends, and a negative coefficient represents "dis-smoothing." When there is only one level of profitability smoothing, the extent of risk sharing can be expressed as $1 - [\mathrm{Cov}[\Delta x, \Delta y]/\mathrm{Var}(\Delta x)]$. In practice, when estimating eq. (5), we include year dummies in the regressions to control for macroeconomic effects and firm-fixed effects.

TABLE 9 Risk Sharing through Dividends

Country	Operating Profitability Smoothed through Dividends (%)
Chile, group firms, 1988–96	0.7
Chile, non-group firms, 1988–96	0.0
Chile, group firms, pre-1991	0.0
Chile, group firms, post-1991	2.8
India, group firms, 1989–96	2.2*
India, nongroup firms, 1989–96	2.9*
Japan, Presidents' Clubs members	0.7*
Japan, other firms	0.4*
Japan, Presidents' Clubs members, 1977–83	1.1*
Japan, Presidents' Clubs members, 1984–92	0.3*

NOTE.—Estimates of the percent of operating profitability smoothed through the issuance of dividends are based on the Asdrubali-Sorensen-Yosha method described in the text. Heteroscedasticity-consistent standard errors are used throughout. The sample (number of firms and the proportion group affiliated) is described in table 2. Firms with profits above 100% or below −100% are excluded from the analysis. The * denotes a coefficient significant at the 5% level, and ** denotes a coefficient significant at the 10% level.

dividends cannot be adjusted easily and must be distributed to all shareholders, they do not constitute a major mechanism of income smoothing within corporate groups.[32]

The Role of Loans

Using data for India only, we estimate eq. (5′) with two levels of profitability smoothing, dividends and intragroup loans. In comparison with dividends, intragroup loans dampen a somewhat larger fraction of shocks to operating profitability, about 5%. The existence of a certain degree of liquidity smoothing in India is consistent with evidence from Japan on (main bank and) group transfers to member firms in financial distress (e.g., Hoshi et al. 1990). However, the magnitude of smoothing through this mechanism is quite small.

In summary, we find evidence in support of the notion that business groups smooth operating profitability in Japan. Similar results are obtained for Korea, as well as (in most tests) Thailand. In other emerging markets, only limited evidence is found of such smoothing, and the pattern of lower-variance and lower levels of profitability of the Japanese *keiretsu* can be replicated in less than half our sample of emerging markets. We also find that dividends play virtually no role in smoothing and the importance of intragroup loans in India is limited. We conclude that the Japan results on risk sharing by corporate groups are not universal. We also conclude that, in most countries, reasons

32. Surprisingly, in India, nongroup firms rely on dividends to dampen profitability shocks more than group members. This bears some resemblance to Nakatani's (1984) finding that *keiretsu* firms pay out lower dividends than comparable unaffiliated firms.

other than risk sharing are probably better able to explain the ubiquity of business groups in emerging markets.[33]

VIII. Further Discussion and Interpretation

A. Group Risk Sharing and Capital Market Development

We now turn to the relation between the extent of group risk sharing and financial market development. Table 10 lists the emerging markets in the sample in order of the extent of income smoothed in the benchmark specification. The extent of profitability smoothing reported is the coefficient on group affiliation estimated in column 1 of table 3 divided by the country mean of the standard deviation of operating profitability (column 2 of table 3). The table also presents several measures of capital market development, drawn from IMF data and Levine and Zervos (1998). It is quite clear that there is little relation between the degree of capital market development and the role of business groups in profitability smoothing. For example, among the countries where no profitability smoothing is detected, one can find Chile, where capital markets and bank credit appear to be fairly developed (in particular, the 1997 ratio of market capitalization to GDP in Chile is the highest in the sample). Yet there is also no profitability smoothing in Turkey, where financial markets are quite underdeveloped. In India, where capital markets are also underdeveloped, there is even "dis-smoothing" according to this test. Moreover, the group of countries where some risk sharing is detected seems to consist of countries in the middle range of the capital market development "league." This can be seen also from simple correlation coefficients between measures of capital market development and the extent of profitability smoothed, which are actually positive (albeit not very high).

Intertemporal evidence also casts doubt on the relation between capital market development and group risk sharing. For Chile and Japan, we compare profitability smoothing by groups before and after significant liberalization of capital markets. For Chile, profitability smoothing is insignificant both before and after the deregulation of financial markets in 1991; and in Japan, the effect of group affiliation on the standard deviation of operating profitability is identical before the liberalization of the early 1980s and afterward (table 3). Turning to dividends, in pre-1984 Japan, there appears to be somewhat more

33. Khanna (2000) and Yafeh (2003) survey a variety of possible explanations for the business group phenomenon. These include lower transaction costs, internal labor markets, and other positive ways in which groups efficiently make up for missing institutions or inefficient rent seeking and expropriation of minority shareholders.

TABLE 10 Risk Sharing, Capital Market Development, and Group Structure

Country	Operating Profitability Smoothed (%; the ratio of column 1 to column 2 in table 3)	1997 Market Capitalization/GDP	1976–93 Market Capitalization/GDP	1976–93 Value of Trade on the Stock Market/GDP	1976–93 Turnover/Stock Market Value	1976–93 Bank Credit/GDP	Mean Group Diversification	Mean Group Vertical Integration	Mean Percent of Group Assets in Financial Firms
Brazil	31	.32	.21	.04	.35	.23	1.4	.04	N.A.
Taiwan	22	N.A.	.41	1.16	2.05	1.38	1.6	.02	.01
Thailand	23	.14	.18	.14	.74	.75	3.5	.04	.35
Korea	22	.09	.21	.19	.83	.82	1.7	N.A.	N.A.
Argentina	Insignificant	.18	.05	.01	.27	.29	N.A.	.06	N.A.
Chile	Insignificant	1.02	.40	.02	.06	.75	5.1	.04	.24
Indonesia	Insignificant	.13	.03	.01	.19	.47	2.1	N.A.	.45
Israel	Insignificant	.48	.36	.14	.67	.96	N.A.	.02	N.A.
Mexico	Insignificant	.45	.13	.04	.50	.24	2.7	.08	.05
Philippines	Insignificant	.35	.15	.03	.25	.45	3.1	.07	.60
Turkey	Insignificant	.31	.07	.03	.21	.65	5.5	.04	.32
India	Dis-smoothing	.36	.10	.04	.54	.46	4.2	.04	.05

NOTE.—For countries where significant profitability smoothing is found in column 1 of table 3, the percent of volatility in operating profitability smoothed by groups (the ratio of column 1 to column 2 in table 3) is presented. Countries where there is a negative but statistically insignificant effect of groups on volatility are listed as "insignificant." Countries with a positive and significant effect of groups on volatility are described by "dis-smoothing." The 1997 market capitalization is based on the IMF's *International Financial Statistics*. All the other measures of capital market development are from Levine and Zervos (1998) and refer to average values for 1976 through 1993.

use of this mechanism, although the magnitude of the coefficient is miniscule, implying that merely 1% of shocks to operating profitability is smoothed. The results for Chile reveal no evidence on more dividend-based risk sharing prior to the liberalization of financial markets (table 9). We conclude that there is little to indicate the existence of more group risk sharing in periods or countries where capital markets are restricted or underdeveloped.

B. More on Tunneling, Legal Systems, Institutions, and Risk Sharing

Tunneling may explain why some group firms are insulated from positive shocks: The additional profits are diverted to group owners (Bertrand et al. 2002; Claessens et al. 2002; Johnson, La Porta et al. 2000). However, this phenomenon is less likely to explain why group members would be insulated from negative shocks, as our evidence suggests they sometimes are (table 6). Furthermore, if tunneling is worse when firm profits are low, as Johnson, Boone, Breach, and Friedman (2000) suggest, then we should observe risk exacerbation (firms whose profits are low are ''plundered''), not risk sharing, but this too is not a common phenomenon in our data. If tunneling is interpreted primarily as a diversion of funds from public firms to private ones when the former are profitable, we would expect to see the distribution of operating profitability of group members to include relatively few profitable firms, that is, a skew distribution with a tail to the left. However, the distribution seems to be significantly different from a normal distribution and skew in this direction only in prewar Japan.[34]

More generally, Johnson, La Porta et al. (2000) imply that tunneling is likely to be common in countries where minority shareholders are least protected, typically countries whose legal system is of the ''civil law'' tradition. The countries where we consistently observe evidence of risk sharing in several different statistical tests (e.g., Japan and Korea), however, are not part of this set—they belong to the German legal tradition. In Japan, for example, minority shareholders are relatively well protected, and furthermore, there is no ''large shareholder'' within the Japanese corporate groups. We also find no significant differences in smoothing between group-affiliated and unaffiliated firms in most of our Latin American countries, where

34. The only case where tunneling would be observationally equivalent to risk sharing is if profitable firms within the group are ''plundered'' and distressed firms are bailed out or, to use the terminology of Freidman et al. Friedman et al. (2003), ''propped.'' We cannot dismiss this possibility. However, we use the detailed Chilean data (appendix A) to construct firm-level proxies for the propensity to tunnel, such as the average extent to which the group affiliate is linked to others in the group through indirect equity links. This and similar measures are not correlated with the standard deviation of operating profitability. At least in Chile, there does not appear to be a strong link between tunneling proxies and profit volatility.

minority shareholders are generally unprotected. We therefore believe that tunneling is unlikely to fully account for our results, although it may well be an important phenomenon.[35] More generally, there is little to suggest the existence of a relation between mutual insurance within corporate groups and the often-cited differences in legal origins.

The World Bank measures of investor protection discussed previously also offer limited guidance on the reasons why risk sharing is observed in some countries and not in others. In terms of contract enforcement measures (duration and complexity of legal procedures), the countries with the most-consistent evidence of risk sharing, Korea and Thailand, receive scores that are about average for our sample of emerging markets. Bankruptcy costs (time and costs involved in bankruptcy procedures) might also provide a motivation for risk sharing (to avoid distress), but again, Korea and Thailand are not characterized by the World Bank as countries where these costs are particularly high. The relation between measures of institution or investor protection and the extent of group risk sharing remains unclear.

C. Do Group Firms Locate in Volatile or Concentrated Industries?

It is interesting to examine if the risk sharing observed in the data is because groups tend to operate in less-volatile industries (Maksimovic and Philips 2002). It is also possible that groups tend to operate in relatively concentrated industries, where the possibility of collusion is arguably higher and consequently profit volatility is lower. We find little support for either of these conjectures. Using industry-level UN data (described in the analysis of profitability shocks), we find no evidence that group firms tend to locate in relatively less-volatile industries. Calculating industry concentration using firms in our sample, we also do not find that group firms tend to locate in more concentrated industries relative to other firms.

D. Do Group Characteristics Explain the Observed Differences Across Countries?

We inquire whether groups in countries where there is some evidence of risk sharing (Brazil, Korea, Taiwan, Thailand, and Japan, see table 10) are typically different from groups in other countries. However, we find no consistent differences in group diversification, vertical integration, and presence of financial institutions between countries where risk

35. Ball, Kothari and Robin (2000) argue that, in civil law countries, nonshareholders are involved in determining how earnings are reported, and since they are less diversified than individual shareholders, their demand for earnings smoothing is higher. However, this does not appear to drive our results because (1) our results do not bifurcate cleanly between civil law and other countries and (2) this reasoning does not explain within-country variations in risk sharing between group-affiliated and other firms.

sharing is observed and other countries in the sample, suggesting that different group attributes cannot (easily) explain intercountry differences in group-provided risk sharing.

IX. Conclusion

Economic theory, empirical work set primarily in Japan, and anecdotal evidence all suggest that risk sharing may be an important function of corporate groups. Table 11 summarizes our findings. In several tests using data from postwar Japan, we are able to replicate results consistent with the notion that group affiliation is correlated with lower standard deviation (and lower levels) of profitability in that country. Most of our estimations support a similar conclusion regarding the effect of group affiliation on the variance of profitability in two of other emerging markets, Korea and Thailand. In addition, whenever we find statistically significant evidence of profitability smoothing in our benchmark estimation, the magnitude of the estimate is economically large, on the order of 20–30% reduction in the standard deviation of operating profitability. In most other countries, there is evidence of profitability smoothing in some of the tests, but the majority of tests do not support this conclusion. In Chile, a country where groups have increased in dominance over time (Khanna and Palepu 1999), there is no indication of group-provided smoothing of profitability in all but one test.

We conclude that business groups around the world do not generally follow the pattern of the Japanese *keiretsu* in providing mutual insurance to member firms, at least not in the form of smoothing operating performance. Moreover, our test of two-dimensional stochastic dominance shows that, in less than half our sample are both the standard deviation and level of operating profitability lower for group-affiliated firms. Finally, dividends do not seem to be used by groups as a "shock absorber," and evidence from India casts doubt on the extent of liquidity smoothing through intragroup loans and receivables, although we do not know how widespread the use of such transfers is in other countries. Even though the power of some of our tests is not that high, our results are nevertheless consistent with those of Shin and Stulz (1998), who argue that transfers within internal capital markets in the United States are of limited magnitude.

Data limitations prevent us from addressing several interesting issues. First, we find no evidence that the extent of smoothing is related to capital market underdevelopment, group structure, or the type of legal system. This leaves open the question of the motivation for smoothing. Second, a long time-series investigation of the manner in which the industry composition of groups evolves over time could shed further light on the causes and consequences of risk sharing within business groups.

TABLE 11 Summary of the Results in Different Tests

Country	Benchmark Test (table 3)	Conditional Variance Test (table 4)	Matched Portfolio Test (table 5)	Response to Industry Specific Shocks (table 6)	KS Test of FOSD (table 7)	Wilcoxon Test of FOSD (table 8)	Skewness Test (table 8)	1-sided test of 2-Dimensional Stochastic Dominance (table 8)	Dividends (table 9)
Argentina	No	N.A.	No	N.A.	No	No	No	Yes	N.A.
Brazil	Yes	Yes	No	N.A.	No	No	No	No	N.A.
Chile	No	No	No	N.A.	No	No	Yes	No	No
India	No	No	No	Yes	No	No	No	No	No
Indonesia	No	N.A.	No	No	Yes	Yes	No	Yes	N.A.
Israel	No	N.A.	N.A.	N.A.	No	Yes	No	Yes	N.A.
Korea	Yes	N.A.	Yes	Yes	Yes	Yes	Yes	Yes	N.A.
Mexico	No	Yes	No	N.A.	No	No	No	No	N.A.
Philippines	No	N.A.	No	N.A.	No	No	No	No	N.A.
Taiwan	Yes	Yes	No	N.A.	Yes	Yes	No	No	N.A.
Thailand	Yes	No	Yes	N.A.	Yes	Yes	No	Yes	N.A.
Turkey	No	N.A.	No	N.A.	Yes	Yes	No	No	N.A.
Prewar Japan	Yes	N.A.	N.A.	N.A.	No	No	No	Yes	N.A.
Postwar Japan	Yes	Yes	N.A.	Yes	Yes	Yes	Yes	No	Yes

NOTE.—The table summarizes the results of nine of the tests reported earlier. "Yes" denotes evidence of statistically significant risk sharing. In prewar Japan, group affiliation refers to affiliation in the largest three *zaibatsu* only. In postwar Japan, group members are defined as members of Presidents' Clubs only.

Appendix A

Constructing Measures of Group Coordination in Chile

From 1996 data obtained from *Superintendencia de Valores y Seguros* in Santiago, Chile, we construct an equity interlock matrix, detailing the ownership of every company i in every company j (for all i, j pairs) from the raw data. We transform the matrix so that the i, j'th entry is the maximum of two figures: the fraction of firm i's shares held by firm j and the fraction of firm j's shares held by firm i. To account for indirect holdings, we calculate firm i's total stake in j by all direct and indirect routes, then subtract out any direct holding. Formally, let $\mathbf{H}[k]$ be a matrix with entry $h_{ij}[k]$, the portion of firm j held by firm i through k links. (Thus, if i owns x% of j directly, then $h_{ij}[1] = x$. If i owns x% of firm m, and m owns y% of firm j, and $m \neq i$, j then $h_{ij}[2] = \sum_m xy$, and so on. Then the matrix of indirect stakes is equal to

$$\mathbf{H}[2] + \mathbf{H}[3] + \mathbf{H}[4] + \ldots, \text{where } \mathbf{H}[n] = \mathbf{H}[n-1] \times \mathrm{H} - \mathrm{diag}(\mathbf{H}[n-1] \times \mathbf{H}).$$

From this we are able to construct a matrix of indirect equity ownership whose i, j'th entry is the maximum of i's indirect share in j and j's indirect share in i. We also manipulate the data on the identity of owners and directors to construct a measure of the fraction of common owners (directors) among the firms in each pair: [number of owners (directors) in common]/[average number of owners (directors) in pair].

Group level measures of coordination through ownership are constructed by averaging the pairwise direct equity measure across all pairs in the group. Similarly, we construct measures based on the average, across all pairs, of the pairwise indirect equity measure and the average of the pairwise total equity measure (the sum of direct and indirect equity ownership links between i and j). Firm-level measures of coordination with other group affiliates are simply the corresponding averages across all pairs within the group in which the firm in question is one of the pair members. We also construct analogous group- and firm-level measures of coordination based on the derived measures of common owners and common directors.

Finally, we construct a measure of aggregate coordination of the group as follows. We create an indicator variable, which takes on the value of unity if a group has a measure of coordination through total ownership greater than the median of this statistic in our sample. Similar indicator variables indicate "high" levels of group coordination through common owners and common directors. The sum of the three indicators gives a statistic, ranging from zero to 3, of the degree to which group affiliates are "tightly bound." Similar indicator variables are constructed and aggregated to indicate whether an individual firm is tightly bound to other affiliates in its group.

Appendix B

Test of Statistical Significance of Differences in Skewness

We calculate bootstrap confidence intervals for a test statistic, which is the difference in the skewness coefficients of the distribution of operating profitability for

group firms and the corresponding distribution for nongroup firms. This is a useful technique for calculating the precision of estimation measures in the absence of a precise formula (Davison and Hinkley 1997; Efron and Tibshirani 1998).

For each country, we generate 500 samples, each of the same size as the total number of firms in the data (sampling with replacement procedure). For each sample, we compute the difference of skewness coefficients (skewness of group distribution minus skewness of nongroup distribution). The confidence intervals are constructed from the empirical distribution of the difference of skewness coefficients thus generated; Efron and Tibshirani (1998) provide evidence that the statistics generated in this way are nearly unbiased.

Appendix C

A One-Sided, Two-Dimensional Test of Stochastic Dominance

We first compute the ranks of the standard deviation of profitability of all firms (with low ranks corresponding to low standard deviations), as well as the ranks of mean of profitability. These ranks are then converted to normal scores using the formula $V\text{norm}_j = \mathbf{\Phi}^{-1}(V\text{rank}_j/(N+1))$, where $V\text{rank}_j$ is the rank based on variable j, N is the total number of ranks, and Φ^{-1} is the inverse cumulative normal. This conversion from the original nonnormally distributed data to approximately normally distributed data allows us to use parametric tests based on normal distribution. We then estimate simple seemingly unrelated regressions (SUR), where the normal scores of ranks, based (separately) on firm standard deviation of returns and firm mean returns, are regressed on group affiliation:

$$V\text{rank}_{\text{sd}} = \beta_1 \times \{\text{group dummy}\} + \varepsilon_1$$

$$V\text{rank}_{\text{mean}} = \beta_2 \times \{\text{group dummy}\} + \varepsilon_2,$$

where ε_1 and ε_2 are allowed to be correlated. The null hypothesis is that $\beta_1 = 0, \beta_2 = 0$. The alternative hypothesis is that $\beta_1 < 0, \beta_2 < 0$ corresponding to group-affiliated firms having both lower standard deviation of returns and lower mean returns than unaffiliated firms.

It can be shown that a one-sided modification of the usual likelihood ratio test rejects this null against the alternative for large values of the test statistic

$$(\mathbf{b}'^{*}\mathbf{V}^{-1} \times \mathbf{b}) - [(\mathbf{b} - \mathbf{b}^{*})' \times \mathbf{V}^{-1} \times (\mathbf{b} - \mathbf{b}^{*})],$$

where $\mathbf{b}$ is the estimate of β, $\mathbf{V}$ is the variance/covariance matrix of the estimates, and $\mathbf{b}^{*}$ is the maximum likelihood estimate under the alternative. (The first term in this expression corresponds to $-2 \times$ log likelihood under the null, and the second corresponds to $-2 \times$ log likelihood under the alternative; see Kudô 1963; Nüesch 1966; and Barlow et al. 1972).

The log likelihood under the alternative is more complex than under the null. The null hypothesis distribution of the test statistic is a mixture of x^2 distributions. The

p-values for the test can be computed from the observation that, under the null, for a value C of the test statistic,

$$\Pr\{\chi^{\wedge 2} \geq C\} = \Sigma_j Q(j,p)\Pr\{\chi_j^2 \geq C\}, \quad C > 0$$

$$\Pr\{\chi^{\wedge 2} = 0 = Q(0,p)$$

where $Q(j, p)$ is the probability that $\mathbf{b}^*$ has exactly j nonzero elements, and χ_j^2 denotes a random variable that is distributed as χ^2 with j degrees of freedom (Barlow et al. 1972).

Computing p-Values

The regular Wald/likelihood ratio test, where the alternative hypothesis does not restrict β_1 and β_2 to a particular quadrant, calculate $\mathbf{b}' \times \mathbf{V}^{-1} \times \mathbf{b}$ where $\mathbf{b}$ is the estimate of β, and $\mathbf{V}$ is the variance/covariance matrix of the estimates. This is asymptotically distributed as χ_p^2, where p is the number of parameters. This can be derived from $-2 \times$ (log likelihood under null hypothesis minus log likelihood under alternative hypothesis (unrestricted)).

The one-sided test is done similarly, but the log likelihood under the alternative hypothesis is more difficult to calculate and the test statistic is distributed as a mixture of χ^2 with different degrees of freedom. Under the null, $-2 \times$ log likelihood has a term $\mathbf{b}' \times \mathbf{V}^{-1} \times \mathbf{b}$, just as in the usual test. However, the corresponding term under the alternative hypothesis is no longer zero, but $(\mathbf{b} - \mathbf{b}^*)' \times \mathbf{V}^{-1} \times (\mathbf{b} - \mathbf{b}^*)$, where $\mathbf{b}^*$ is the maximum likelihood estimate under the alternative. If the coefficient estimate actually satisfies $\mathbf{b} > 0$, then the maximum likelihood (ML) estimate is the usual one and the term equals zero. However, if one or more components of $\mathbf{b}$ is negative, the ML estimate is on the boundary of the alternative region (i.e., one or more of the components of $\mathbf{b}^*$ is 0).

Finding $\mathbf{b}^*$ in the general case requires solving a quadratic programming problem (i.e., minimizing $[\mathbf{b} - \mathbf{b}^*] \times \mathbf{V}^{-1} \times [\mathbf{b} - \mathbf{b}^*]$ subject to $\mathbf{b}^* > 0$). However, in our case, there are only two parameters, so the solution to the problem is relatively simple. As mentioned above, if $\mathbf{b} > 0$, then $\mathbf{b}^* = \mathbf{b}$. If not, then either the first or second component of $\mathbf{b}^*$ must be zero, and the other component can be found by solving a univariate minimization problem (where the objective function is quadratic, so the solution is unique). So there is a potential solution where $b_1^* = 0$ and one where $b_2^* = 0$. When $b_1^* = 0$, then $b_2^* = b_2 + \mathbf{V}_{1,2}^{-1}/\mathbf{V}_{2,2}^{-1} \times b_1$. When $b_2^* = 0$, then $b_1^* = b_1 + \mathbf{V}_{1,2}^{-1}/\mathbf{V}_{1,1}^{-1} \times b_2$. If the calculated b_1^* or $b_2^* < 0$, then the corresponding solution is not admissible. If neither solution is admissible, then $\mathbf{b}^* = (0, 0)$. If only one is admissible, then the solution is $(b_1^*, 0)$ or $(0, b_2^*)$. If both are admissible, then the solution with the smaller function value is taken.

Once the quadratic program is solved, the test statistic is $(\mathbf{b}' \times \mathbf{V}^{-1} \times \mathbf{b}) - [(\mathbf{b} - \mathbf{b}^*)' \times \mathbf{V}^{-1} \times (\mathbf{b} - \mathbf{b}^*)]$, which Barlow et al. (1972, chapter 4) show is equivalent to $\mathbf{b}^{*\prime} \times \mathbf{V}^{-1} \times \mathbf{b}^*$. Now the problem is to find the distribution of the test statistic under the null. There is a nonzero probability that the test statistic is zero, corresponding to the case where $\mathbf{b}^* = (0, 0)$. Also, there is a certain probability that the solution will be on a boundary $(\boldsymbol{b}_1^*, 0)$ or $(0, \boldsymbol{b}_2^*)$, in which case the quadratic form corresponds to only one parameter, and the test statistic

$\sim \chi_1^2$. If the quadratic program solution is inside the region, then the test statistic $\sim \chi_2^2$. So for a value of the test statistic **C**, the probability of obtaining a value greater or equal to **C** under the null is 1 if **C** is 0, otherwise $Q(1, 2) \times \Pr(\chi_1^2 \geq C) + Q(2, 2) \times \Pr(\chi_2^2 \geq C)$, where $Q(1, 2)$ is the probability under the null that exactly one of the components of $\mathbf{b}^*$ is nonzero, and $Q(2, 2)$ is the probability that both are nonzero. It turns out that $Q(1, 2) = 1/2$, independent of the correlation between the parameters, and $Q(2, 2) = 1/2 - \cos^{-1}(\rho)/2\pi$, where ρ is the correlation between the parameter estimates (Gouriéroux and Monfort 1982, p. 71).

For accuracy, we should observe that these results are asymptotic. Not only do they depend on $\mathbf{V}^{-1}$ being known, but they depend on ρ being known to calculate $Q(2, 2)$. However, our sample sizes are large enough for us to sensibly rely on asymptotic results.

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