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JAPAN'S CORPORATE GROUPS: COLLUSIVE OR COMPETITIVE? AN EMPIRICAL INVESTIGATION OF *KEIRETSU* BEHAVIOR*

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This paper uses data on manufacturing firms listed on the Tokyo Stock Exchange to evaluate whether firms that are part of Japanese financial groups (*keiretsu*) behave differently from other Japanese firms. The results from this analysis reject the hypothesis that these firms collude in order to raise profits. The data do suggest that *keiretsu* firms are heavily influenced by their banks to produce at levels beyond those warranted by pure profit maximization. These higher levels of output may also explain why entry into markets with strong *keiretsu* presence is often described as difficult.

I. INTRODUCTION

INTER-FIRM relationships among Japanese corporate groups (*kigyo keiretsu*) and collusion have often been portrayed as a barrier to entry into the Japanese market and as a major reason for high prices in Japan (Fung [1991]; Lawrence [1991]; Lincoln [1990]; Prestowitz [1988]). However, most of the evidence on *keiretsu* behavior has been anecdotal. In fact, with the exception of Caves and Uekusa's [1976] study rejecting the notion that *keiretsu* coordinate entry and exit decisions, there have been no attempts to demonstrate whether *keiretsu*-affiliated firms compete differently from non-affiliated firms.

This paper is an attempt to clarify how *keiretsu*-affiliated firms behave and whether they are indeed different from independent firms. Using a newly-created data set and two alternative models, we refute popular belief about collusion among Japanese business groups and show that, in fact, *keiretsu*-affiliated firms tend to compete more fiercely than independent firms as a result of their special relations with a major bank. Our analysis suggests that it is fierce competition among group-affiliated firms, not collusion, that may reduce (foreign and domestic) entry into sectors where corporate groups are strong.

Although the term "*keiretsu*" is often used in a variety of different ways, in this paper we focus on bank-centered financial (or horizontal) *keiretsu*. Such groups include firms that operate in many different industries and a

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primary lender (main bank). Firms in financial groups are usually related to each other by the following mechanisms: (a) The main bank is the principal lender to group members, it owns a significant number of shares in group firms, and it often takes part in their management; (b) Group firms cross-sharehold and occasionally exchange personnel as well; and sometimes (c) There are scheduled meetings of presidents or directors at "Presidents Club" (*shacho-kai*) meetings.

These *keiretsu* have often been viewed as collusive institutions that impede foreign entry into Japanese markets, and US policy toward Japan has often focused on eliminating their perceived impact on trade (Prestowitz [1988]). Lawrence [1991, 1992], in two empirical investigations of Japan's international trade, has found that imports and foreign direct investment are especially low in markets where *keiretsu*-affiliated firms have large market shares. He has also shown that financial *keiretsu* presence is not associated with high exports or with industries in which Japan seems to enjoy a comparative advantage. While concluding that *keiretsu* are a major trade barrier faced by Western firms, he does not offer an explicit reason why this is so.

The idea of collusion among *keiretsu* that somehow limits entry and maintains high prices and high profits seems to enjoy wide support. While there are some institutions within groups that might facilitate coordination of members' activities, it is less clear how collusion could be coordinated outside a given group. Presidents Clubs, which are often mentioned as a mechanism of intra-group coordination, do not transcend individual groups and therefore do not seem to constitute an institutional basis for inter-group collusion. Economic theory provides only limited support for the idea of collusion among different groups. One possibility is that their ability to collude may be enhanced by the extensive multi-market contacts among the members of rival *keiretsu*. As Bernheim and Whinston [1990] have shown, multi-market rivalry can facilitate collusion by enabling firms to pool the incentive constraints that determine whether overall collusion is feasible. Their results suggest that multi-market oligopolists may collude in markets where collusion would not be sustainable if each seller competed in that market alone. In fact, since the average manufacturing firm on the Tokyo Stock Exchange (TSE) competes in a market in which between a third to a half of all output is produced by group affiliated firms, *keiretsu* might seem like a clear example of multi-market rivalry.[1]

Although Lawrence's [1991, 1992] empirical analyses seem to suggest that Japan's corporate groups may work together to reduce imports, it is important to note that his results (i.e., the negative relationship between *keiretsu* shares and import penetration) could be used to support the opposite conclusion

[1] The major difference between *keiretsu* and multi-market oligopolists is that *keiretsu* are considerably more loosely organized than a multi-divisional firm.

regarding *keiretsu* collusion. If group-affiliated firms do not collude, but in fact compete more fiercely than independent firms, then markets with strong *keiretsu* presence are likely to be unattractive targets for (foreign and domestic) entry. We will argue that the evidence on *keiretsu* behavior seems to be far more supportive of this latter interpretation than of a collusion hypothesis.

Much of the theory that we introduce in this paper is heavily influenced by the writings of Aoki [1988, 1990]. Aoki emphasizes the role of cross-shareholding within groups, and in particular the special relations with the group bank, in risk sharing arrangements and in preventing hostile takeovers. This theory suggests that the main bank closely monitors the firm, reduces problems of imperfect information between lenders and borrowers, and may engage in rescue operations during financial distress. In exchange, group firms pay "agency fees" to the main bank in the form of "overborrowing" and high interest payments. Indeed, Aoki demonstrates that there need not be unanimity between the main bank and firm shareholders; the bank would like the firm to borrow beyond the level warranted by share value maximization.

Empirical studies have tended to support Aoki's general theories. Nakatani [1984] found that group-affiliated firms have relatively stable performance and borrow more than independent firms. Hoshi, Kashyap, and Scharfstein's studies [1990a, 1990b, 1991] also suggest that main bank relations have a large effect on investment behavior of group-affiliated firms, as well as on the likelihood of recovery from financial distress. Morck and Nakamura [1992] emphasize the bank's role in disciplining managers. Teranishi [1993] has argued that historically main banks often tried to pressure their client firms to engage in sales maximization rather than profit maximization. Arguing along similar lines, we suggest that firms under bank influence may produce more than the profit maximizing level and appear as if they had a lower cost of capital. Since banks have an incentive to try to maximize their profits from loans, to the extent that they have sway over the firm's production decisions, banks will try to influence firms to use more capital and expand output levels in order to take on more debt. The main bank can exert much pressure during frequent negotiations on bank-supplied short-term loans or through the influence of board members who hold concurrently, or have held in the past, positions at the main bank (Hadley [1970]). Hence, managers seeking to placate both shareholders and banks may over-emphasize production relative to profits.

In this paper, we attempt to evaluate empirically how *keiretsu* affiliation affects the form and intensity of market rivalry. We test empirically two alternative models, in order to identify differences between *keiretsu* affiliated and independent firms. Some testable implications of collusion among the different groups are derived from our first model. Our second model examines whether *keiretsu* firm behavior seems to be consistent with the predictions of a model of excessive bank influence.

The paper is organized as follows: in Section II the two models are

developed, and alternative empirical hypotheses are derived. Section III describes the data and various definitions of *keiretsu*. Major results are presented in Section IV. Section V contains final remarks and directions for further research.

II. MODELS OF *KEIRETSU* BEHAVIOR

In this section we derive structural equations of *keiretsu* and non-*keiretsu* firm behavior under several possible modes of competition. In section II(i) the null hypothesis that *keiretsu* firms behave as Cournot competitors with no distinctive features is presented. The following section examines the implications of assuming that *keiretsu* firms jointly choose their output levels. In section II(iii) we examine a model of *keiretsu* behavior in which we postulate that managers in *keiretsu* firms balance the interests of their main banks and their shareholders. In all our models, we treat group-affiliation as an exogenous, historically determined firm characteristic.[2]

II(i). *Simple Cournot Competition*

Consider J industries, each composed of m_j *keiretsu* firms and n_j non-*keiretsu* firms. Let the price for goods in each industry be denoted by $p_j(Z_j)$ where Z_j is total output in that sector. Assume that each firm i produces with a Cobb-Douglas technology given by

$$x_{ij} = f(K_{ij}, L_{ij}) = A_{ij} K_{ij}^{b_{ij}} L_{ij}^{1-b_{ij}}$$

where x_{ij} is firm i's output in sector j, A_{ij} is a measure of the firm's technological level, K is capital, L is labor and b_{ij} is between zero and one. Assume further that firms simultaneously pick inputs and outputs (with a Cournot conjecture) consistent with their production technology in each market to maximize total profits. This implies that their maximization problem can be written as

$$\max_{x_{ij}} \sum_j (p_j - c_{ij}) x_{ij}$$

where c_{ij} is the marginal cost of producing a unit of output. The first order conditions for each market can now be written as

$$p_j - c_{ij} = \frac{p_j x_{ij}}{Z_j} \left(\frac{1}{\varepsilon_j} \right)$$

where ε_j is the price elasticity of demand. Unfortunately, because cost data by firm are not available for each sector, we must derive an equation that

[2] Hoshi [1993] and Yafeh [1995], among others, hae shown that firm-bank ties were formed during and immediately after World War II and have remained very stable.

uses production-weighted total marginal cost rather than sectoral marginal cost. Multiplying both sides by x_{ij} divided by total firm sales and summing over all sectors yields

$$\frac{\sum_j p_j x_{ij} - \sum_j c_{ij} x_{ij}}{\sum_j p_j x_{ij}} = \sum_j \left(\frac{1}{\varepsilon_j}\right)\left(\frac{p_j x_{ij}}{\sum_j p_j x_{ij}}\right)\left(\frac{x_{ij}}{Z_j}\right).$$

This equation can be rewritten as

$$PCM_i = \sum_j \beta_j \sigma_{ij} SHR_{ij} \tag{1}$$

where PCM_i is firm i's production-weighted price-cost margin, σ_{ij} is the share of firm i's total sales that arise in sector j, SHR_{ij} is firm i's market share in sector j, and β_j is a constant for each sector j. Equation (1) simply says that for firms competing in several markets, the overall price-cost margin is going to be a weighted average of the Lerner equations in each market.

II(ii). *Collusive Bahavior*

It is often alleged that members of the various Japanese corporate groups do not compete independently but instead collude in their production decisions. In this sub-section we derive mark-ups for firms in a market in which some subset of firms can agree on output levels but the other firms in the sector are not party to the agreement. The starting point for our analysis is the Gaudet-Salant [1991] model that considers how a subset of firms can increase joint profits if they can commit to a certain output level. In this section we consider how control over a certain subset of firms will affect margins as the market share of the colluding firms in the market changes.

Suppose that *keiretsu* firms can collude by agreeing to adjust their output levels relative to those that they would ordinarily produce in a Cournot game. Specifically, assume that *keiretsu* firms can commit to produce an output level of $\gamma_j \bar{x}_{ij}$, where $\bar{x}_{ij}$ is the output level that the firm would have produced under the Cournot conditions of section II(i) and γ_j represents the fraction of output that each firm will produce relative to its output level in section II(i). Non-*keiretsu* firms witness the production decision of the *keiretsu* firms and then simultaneously pick output levels x_{ij} that maximize their profits. This implies that for non-*keiretsu* firms, Equation (1) will bind. *Keiretsu* firms, however, will pick γ_j to maximize joint profits or

$$\max_{\gamma_j} \sum_{i \in KEI} \sum_j (p_j - c_{ij}) \gamma_j \bar{x}_{ij}$$

where KEI is the set of all *keiretsu* firms. The first order condition for profit

maximization implies that

$$(2) \qquad \sum_{i \in KEI} (p_j + \gamma_j \left(\sum_{i \in KEI} \bar{x}_{ij} \right) p_j'(X_j' + 1) - c_{ij})\bar{x}_{ij} = 0 \quad \forall j$$

where P_j' is the derivative of price with respect to output and X_j' is the derivative of total non-*keiretsu* output with respect to total *keiretsu* firm output. Equation (2) implies that

$$p_j - c_{ij} = -\gamma_j \sum_i (\bar{x}_{ij}) p_j'(X_j' + 1) + \frac{\mu_{ij}}{\bar{x}_{ij}} \qquad \forall i \in KEI$$

where μ_{ij} is a firm specific error term and

$$\sum_{i \in KEI} \mu_{ij} = 0.$$

If all firms had the same marginal cost, then the μ_{ij}'s would all equal zero. However, if *keiretsu* firms have different marginal costs, then those firms with low marginal costs are going to have positive μ_{ij}'s, indicating that they would prefer joint output to be greater, but those with higher costs will have negative μ_{ij}'s and would prefer even lower levels of *keiretsu* production. After some algebra it is possible to demonstrate that

$$(3) \qquad PCM_i = \sum_j \left(S_j \sigma_{ij} \frac{X_j' + 1}{\varepsilon_j} \right) + \frac{\sum_j \gamma_j \mu_{ij}}{\sum_j p_j x_{ij}} \qquad \forall i \in KEI$$

where S_j equals the share of the *keiretsu* firms in the market. Equation (3) suggests that in any given market, if firms collude in output, as the share of the colluding firms increases, their markup over cost should also rise. In other words, the ability of a collusive subset of firms to raise margins in a market is proportional to their market share.[3]

II(iii). *Bank Influence*

Consider a two-stage game in which in the first stage main banks pick the interest rates r_i that they charge their affiliated firms, and then in the second stage all firms in the market simultaneously choose inputs and outputs. Suppose, further, that managers of *keiretsu* firms do not simply maximize profits but rather maximize a weighted average of the shareholders' and the main bank's utility function. Let a denote the amount that managers weigh shareholder preferences and $(1 - a)$ the amount that they weigh bank preferences. a is assumed to be less than one (and greater than zero) because

[3] Notice that this result holds even if collusion among the *keiretsu* leads to an increase in output relative to Cournot competition. Notice also that while this form of collusion may not be profitable for all firms, it is still the case that, on average, profit margins will increase with the market share of the colluding subset.

of the presence of bank members on the firm's board, the exchange of personnel, and the influence of the bank on firm decisions through loan negotiations. Shareholders of firm i want the managers to pick output levels and choose factors in each market in order to maximize firm profits. This implies that we can write the shareholders' objective function as

$$(4) \qquad \sum_j [p_j f(K_{ij}, L_{ij}) - wL_{ij} - r_i K_{ij}]$$

where w is the wage rate and r_i is the firm's cost of capital. Banks, however, are not concerned with firm profits, but rather with maximizing their profits from loans to the firm subject to the firm's participation constraint

$$(r_i - r^*) \sum_j K_{ij}$$
$$s.t. \quad \Pi_i \geqslant R_{ij}$$

where r_i is the interest rate the bank charges and $r^*(< r_i)$ is the bank's cost of funds. The firm's reservation level of profits is denoted by R_i. This level may be interpreted as the minimum profit level that satisfies shareholders: the profit level at which the benefits from long term relations with a main bank (in the form of access to loans or implicit insurance against bankruptcy) equal forgone profits. As long as profits are not below this level, the firm will not sever its ties with the bank. The bank will set r_i so as to make the constraint hold with equality, taking into account the parameters of the model and the effect of r_i on the firm's output and capital use. We can therefore rewrite the bank's objective function in terms of L_{ij} and K_{ij} as

$$(5) \qquad \sum_j [p_j f(K_{ij}, L_{ij}) - wL_{ij} - r^* K_{ij}] - R_i.$$

Since r_i will, in general, be higher than r^*, equation (5) implies that the bank would like the firm to use capital as if its cost of capital were only r^*.

In modelling bank behavior in this manner, we implicitly make three assumptions about bank-firm relations. First, we assume that a main bank has some market power in terms of the interest rate it charges the firm. Second, we rule out lump sum transfers between the bank and the firm because these types of transfers are difficult to arrange and do not occur in reality. Finally, we assume for simplicity that the bank does not own any shares of the firm, although bank ownership (of less than 100%) will not qualitatively change the results. As for the production technology used, our specification of the bank's objective function implies that capital is used for short run purposes and is not a fixed factor.

On the assumption that managers maximize a weighted average of the bank's and the shareholders' objective functions, the managers' objective function can be written as

$$(6) \qquad \max_{K_{ij}, L_{ij}} \sum_j [p_j f_j(K_{ij}, L_{ij}) - wL_{ij} - (ar_i + (1 - a)r^*)K_{ij}] - (1 - a)R_i.$$

Note that in the managers' objective function the cost of capital, $ar_i + (1\text{-}a)r^*$, is lower than the true cost of capital r_i. This implies that the firm will use more than the profit maximizing level of capital and produce more than the profit maximizing level of output.[4] To show this formally, we take first derivatives in order to yield

$$b_{ij}(p_j + x_{ij}p_j)\frac{x_{ij}}{K_{ij}} - g_i = 0$$

$$b_{ij}(p_j + x_{ij}p_j)\frac{x_{ij}}{L_{ij}} - w = 0$$

where g_i equals $ar_i + (1\text{-}a)r^*$. Multiplying K_{ij}/x_{ij} and L_{ij}/x_{ij}, respectively, summing and rearranging terms produces

$$PCM_i = \sum_j \frac{1}{\varepsilon_j}\sigma_{ij}SHR_{ij} - \frac{(1-a)\sum_j (r_i - r')K_{ij}}{\sum_j p_j x_{ij}}. \tag{7}$$

Equation (7) suggests that if banks exercise a strong degree of influence over *keiretsu* firms, then one should expect a slightly modified version of the Lerner equation to hold in each market. Since the last term in Equation (7) will be strictly positive for firms that are influenced by bank demands, one should expect firms that respond strongly to bank pressures to have lower price-cost margins than firms that simply maximize profits. Since *keiretsu* firms will use more capital and produce higher output levels than other firms in the market with the same cost structure, their connection with banks may provide a basis for the common contention that *keiretsu* firms try to maximize market share rather than profits (Meerschwam [1991] and Teranishi [1993]).

III. THE DATA AND VARIABLES

Our sample consists of 994 Japanese manufacturing firms in the fiscal year 1988. The sample includes nearly all domestic firms listed on the First and

[4] However, this objective function allows for the possibility that firm profits under bank influence will equal (or be higher than) profits under Cournot competition, depending on the value of R_i. This is because firms with a main bank are credibly committed to having a more aggressive best response curve than ordinary Cournot competitors. For example, consider a firm whose reservation profit level R_i equals its Cournot profits given a market interest rate r_m, and assume that $ar_i + (1 - a)r^* < r_m$. Such a firm will over-produce given its true cost of capital, but its profits need not be lower than Cournot profits. This analysis is somewhat similar to Fershtman and Judd's [1987] model where, in the context of competition in quantities, owners induce managers to maximize a weighted average of profits and sales in order to become more aggressive.

Second Sections of the Tokyo Stock Exchange (TSE), accounting for about half of manufacturing sales in Japan. Data on total firm sales and total variable costs of production are taken from the Japan Development Bank Financial Database. Since marginal cost data do not exist, we approximate marginal cost by using the firm's cost of sales, which is defined as:

> Cost of Sales = Value of starting inventory + Labor costs + Raw materials costs + Orders for outside work + Depreciation − Value of ending inventory.

This approximation of marginal cost is appropriate given our specification of a constant returns to scale production function. Note that depreciation is included in our definition of marginal cost, in accordance with our treatment of bank-supplied short term capital as a component of variable costs. We use data from *Nihon Keizai Shinbunsha's* Japan Company Handbook covering the classification of TSE firm sales, to account for the fact that most Japanese firms operate in many markets. These data enable us to classify total firm sales in to each of the approximately 130 3-digit industries. Data from the Census of Manufacturers on aggregate sales in each industry enable the calculation of market shares for firm i in every (3-digit) industry j.

Unlike their prewar counterparts (the *zaibatsu*), the lines of ownership and control in the postwar *keiretsu* firms are not clear cut, and hence we identify main bank clients using two different definitions. Dodwell Marketing Consultants' *Industrial Groupings in Japan* categorizes group-affiliation based primarily on the 'Group's Infuential Power," defined as the percent shares held by group members over shares held by the top ten shareholders. The definition is adjusted according to main bank loans, directors sent to, or coming from group companies, historical background, company attitude toward the group (e.g., participation in a Presidents Club), and the strength of ties with non-group companies. The dummy variable KEI equals one whenever Dodwell classifies a firm as affiliated to some extent with a financial *keiretsu*. The second definition we use is the list of firms affiliated with the "Big Six" bank-centered Japanese groups (*DKB*, *Fuyo*, *Mitsubishi*, *Mitsui*, *Sanwa*, and *Sumitomo*) published in *Keizai Chosa Kyokai's Keiretsu no Kenkyu* (KNK). A firm is classified as group-affiliated with one of the six major groups if at least one of the following conditions holds: (1) A group's main bank is the firm's biggest lender for three consecutive years, and total shareholding by group members exceeds 20%; (2) Main bank loans account for at least 40% of the firm's loans for at least three years; and (3) The firm is historically affiliated with a group. The dummy variable SIX equals one if a firm belongs to a group according to KNK's classification. In addition, KNK provides lists of member firms in the six Presidents Clubs. This is a much smaller and more restrictive measure, in which only the major members

TABLE I
KEIRETSU DEFINITIONS

		Sample Means	
Name	*Source*	*Members in TSE (%)*	*Total Sales in TSE (%)*
KEI	Dodwell	39.2	46
SIX	KNK	47.8	73
PRES	KNK	9.4	40

	Correlation Matrix		
	KEI	SIX	PRES
KEI	1.00	0.31	0.29
SIX	—	1.00	0.26
PRES	—	—	1.00

of each group are listed. Membership in a Presidents Club is described by the dummy variable PRES.

Table I contains some descriptive statistics of the *keiretsu* variables based on the different definitions. Clearly, different definitions of *keiretsu* can lead to vastly different interpretations of their importance: While only 9.4% of all listed firms are members of Presidents Club, nearly half are classified as *keiretsu* affiliated by KNK. Furthermore, the correlation between the various definitions is never more than 0.31, suggesting that if *keiretsu* do indeed collude, they may have some difficulty deciding who is party to the agreement.

In the subsequent analysis, we use the KEI, SIX, and PRES dummy variables as alternative measures of the proximity of each firm to a group and a main bank. We find KEI and SIX to be the most plausible because they are defined in a way that emphasizes the importance of financial linkages. The basic difference between these measures is that KEI includes more bank groups but fewer firms per group, while SIX occasionally includes group-affiliated firms with historic ties to a bank even if they have no outstanding bank loans. Both measures suggest that *keiretsu* members constitute approximately half of the firms on the TSE and account for between half to three quarters of total sales. We regard membership in a Presidents Club, PRES, as an inappropriate definition of bank client firms because it is not based on bank ties. However, since Presidents Clubs are often claimed to be a coordination mechanism for group members, we estimate our collusion model based on this measure as well.

Table II presents some general sample statistics. While *keiretsu* firms are, on average, larger, more leveraged and tend to purchase more intermediate inputs from affiliated companies, none of the differences is statistically significant.

TABLE II
SAMPLE STATISTICS

	All Firms		*KEI Firms*		*Non-KEI Firms*	
	Mean	*STD*	*Mean*	*STD*	*Mean*	*STD*
Sales (billion ¥)	97.33	217.51	128.84	227.30	77.08	207.33
Bank Loans (billion ¥)	3.32	9.28	4.72	11.96	2.25	6.36
Bank/Total Loans	0.11	0.16	0.10	0.12	0.12	0.18
Purchases from Affiliates out of Total						
Goods Purchased	0.03	0.14	0.04	0.16	0.03	0.012
Price-Cost Margin	0.226	0.12	0.227	0.11	0.225	0.12

IV. ESTIMATING THE MODELS

Since actual marginal cost data are not available, direct estimation of Equations (1), (3), and (7) is not feasible. The usage of cst of sales data instead of true marginal cost introduces an error in each firm's Lerner equation equal to the difference between our accounting cost and true marginal cost. Fisher [1987] has demonstrated that this error depends on industry and firm specific attributes such as past growth rates and the timing of investments. In estimating the equations, we therefore added a variable equal to the share of a firm's sales in each sector (σ_{ij}), designed to correct for the industry specific error components.[5] Notice that in addition to the accounting error, this variable is likely to capture any industry-specific attributes such as concentration, industry growth rates, etc.

Allowing for the accounting error, we estimate the following equations:
Null Hypothesis:

$$\text{(i)} \qquad PCM_i = \sum_j \alpha_j \sigma_{ij} + \sum_j \beta_j \sigma_{ij} SHR_{ij} + \eta_i$$

Collusion:

$$\text{(iii)} \qquad PCM_i = \sum_j \alpha_j \sigma_{ij} + \sum_j \beta_j \sigma_{ij} SHR_{ij}(1 - GROUP_i) + \delta_1 \sum_j \sigma_{ij} S_j GROUP_i + \eta_i$$

Bank Influence:

$$\text{(vii)} \qquad PCM_i = \sum_j \alpha_j \sigma_{ij} + \sum_j \beta_j \sigma_{ij} SHR_{ij} + \theta GROUP_i + \eta_i$$

[5] If these firms were single product firms, this correction would be equivalent to allowing each industry to have a different intercept.

where GROUP_i is a dummy that equals one if the firm is a member of a *keiretsu*, η_i is the error term, and α_j, β_j, δ_l, and θ are estimated parameters. Under all specifications, β_j should have a non-negative sign, although it might be zero in sectors with high demand elasticities. The collusion hypothesis predicts that margins of *keiretsu* should rise as the share of *keiretsu* firms rises ($\delta_l > 0$). The bank influence hypothesis predicts that *keiretsu* firms should have lower margins than non-*keiretsu* firms ($\theta < 0$).

Apart from the accounting error, one should note another difference between the theoretical equations and the estimated equations. In Equation (3) it is theoretically possible that *keiretsu* shares have a different effect in each sector j. However, in our estimated collusion equation we force the coefficient on S_j to be equal across sectors. This restriction was imposed for expositional clarity and in order to reduce multicollinearity between $\sigma_{ij}S_j$ and the accounting error terms. While forcing the sectoral coefficients to be equal generates a bias in the estimated effect, the actual direction of the bias is toward making δ_l larger rather than smaller.[6] Hence, our estimation of the collusion model is somewhat more likely to accept the collusion hypothesis than would otherwise be warranted. Finally, since we do not have data on each firm's sales to different customers, we are unable to exclude from the collusion model regressions firms that sell mainly to group trading companies. However, Imai [1990] has found that intra-group sales account on average for only 11% of all sales by *keiretsu* firms, and hence the error involved is probably small.

In the bank influence equation, the magnitude of bank pressure should vary across *keiretsu* depending on the intensity with which the firm employs

[6] If we assume that the marginal cost of all firms in equilibrium are the same, then Gaudet and Salant [1991] show that

$$\frac{dq_j}{d\bar{q}_j} = -\frac{m_j}{n_j + \dfrac{1}{\phi_j}}$$

where ϕ_j is some positive parameter of the demand and cost structure, m_j is the number of colluding (*keiretsu*) firms, n_j is the number of non-colluding (non-*keiretsu*) firms, q_j is the output of a non-colluding firm, and $\bar{q}_j$ is the output of a colluding firm. Noting that $m_j\bar{q}_j$ equals total *keiretsu* output and n_jq_j equals total unaffiliated output, we can write

$$x_j' = -\frac{n_j}{n_j + \dfrac{1}{\phi_j}}.$$

Multiplying numerator and denominator by non-*keiretsu* output over total output produces

$$x_j' = \frac{s_{j-1}}{(1 - s_j) + \dfrac{q_j}{z_j\phi_j}}.$$

Clearly this is an increasing function of *keiretsu* share in the sector. Hence, the coefficient on *keiretsu* share is likely to be too large.

capital in each sector. Since we do not have good data on the share of loans used for sales in each sector, we simply include a *keiretsu* dummy to capture the effect and assume that the share of bank loans in revenues is constant

TABLE III
COLLUSION MODEL RESULTS*

Keiretsu *Definition*	*KEI*	*SIX*	*PRES*
δ_1	−0.087	−0.024	−0.015
Standard Error	(0.018)	(0.013)	(0.025)
Adjusted R^2	0.242	0.222	0.218
N:	994	994	994

Note *OLS estimates; heteroskedatic-consistent standard errors in parentheses.

across industries. To the extent that *keiretsu* firms are likely to be located in sectors that use capital very intensely and main banks exacerbate this tendency, our regressions may over-estimate the overall impact of banks on firms.

Table III presents heteroskedastic-consistent OLS estimation results from the full sample of firms. Because the simplest specifications had over 50 coefficients, we only report the estimated *keiretsu* dummy coefficient.[7] In general, about half of the β_j's are positive although relatively few of them are significant, probably due to a high degree of multicollinearity between σ_{ij} and $\sigma_{ij}\text{SHR}_{ij}$, which makes it difficult to estimate the coefficients. The collusion model produces striking results for all definitions of *keiretsu*. In every regression the higher presence of *keiretsu* tended to lower price-cost margins of *keiretsu* firms rather than raise them. Although the market share of Presidents Club members had no significant impact on price-cost margins, the market share of *keiretsu* firms affiliated with one of the big six or listed in the Dodwell survey was significant but of the 'wrong" sign. These results seem to reject the hypothesis that *keiretsu* firms are able to collude successfully.

Table IV presents estimation results of the bank influence equation for the Dodwell classification and the KNK definition. The bank model is clearly supported by the data, regardless of the definition used: the signs on the *keiretsu* dummies are negative and significant for the Dodwell definition. *Keiretsu* firms had margins that were as much as 2.5 percentage points *lower* than non-*keiretsu* firms after accounting for their overall performance. We interpret these results as evidence of bank pressure on *keiretsu* firms to over-produce and to compete more fiercely than non-*keiretsu* firms.

[7] Running the regressions with a different elasticity for each three-digit sector results in over 200 regressors, with severe multicollinearity problems. The equations were therefore estimated at a two-digit level. We use only one *keiretsu* variable since allowing the *keiretsu* share coefficients to vary by sector does not change the sign of the coefficients in most cases, though it results in larger standard errors.

TABLE IV
BANK INFLUENCE MODEL RESULTS* (Equation 7)

	All Firms		*Reclassified Sample***		*Restricted Sample****	
Definition	KEI	SIX	KEI	SIX	KEI	SIX
θ	−0.025	−0.001	−0.032	−0.017	−0.021	−0.002
Standard Error	(0.007)	(0.007)	(0.007)	(0.007)	(0.010)	(0.010)
Adjusted R^2	0.231	0.221	0.237	0.226	0.192	0.185
N	994	994	994	994	583	583

Notes * OLS estimates; heteroskedatic-consistent standard errors in parentheses.
** Firms that report no loans from any of the main banks are reclassified as unaffiliated.
*** Firms that report over 10% purchases from affiliated companies are excluded.

In order to examine the robustness of our results, we sharpen the distinction between bank-influenced and unaffiliated firms by reclassifying firms with no bank debt as independent. This change makes our results even more statistically significant, especially for the KNK definition. In addition, when firms that report above 10% purchases from affiliates are excluded from the regressions (in order to address the possibility that large scale purchases from affiliates may affect reported cost data), we find that the results remain virtually unchanged. In Table V we report the results of some additional experiments. In Panel A we include a measure of firm capital intensity (the ratio of fixed assets to sales) in the regression, as suggested by Domowitz, Hubbard, and Petersen [1986] and by Fisher [1987]. This has little effect on the magnitude and significance of the *keiretsu* dummy. In Panel B we use an instrumental variable technique in order to examine if our OLS estimates are biased.[8] Since Japanese firms often retain their empoyees for very long periods of time, we use each firm's share in employment in its sector as an instrument for firm market share. Again, our results seem to be unaffected by this change, and we find no evidence of bias in the coefficients.[9]

Next, we modify Equation (7) in order to estimate the effects of bank influence using a different specification. If we assume that average cost of production is approximately equal across firms, then profit margins can be written as

$$PCM_i = \sum_j \sigma_{ij} \frac{1}{(\eta_j + m_j)\varepsilon_j} - \sum_j \sigma_{ij} \frac{(r_i - g_i)K_{ij}}{p_j x_{ij}} \frac{m_j}{(n_j + m_j)}$$

where m_j is the number of *keiretsu* firms and n_j is the number of non-*keiretsu* firms. This approximation naturally will be more appropriate the smaller

[8] When costs are imperfectly measured, market shares may be correlated with the error term, resulting in biased coefficients. More generally, a bias may be due to the fact that market shares are not exogenously determined.

[9] The collusion equation estimates are not affected by these changes either.

TABLE V
BANK INFLUENCE MODEL: ADDITIONAL RESULTS*

	(A) OLS Estimates		(B) IV Estimates**		(C) Equation 7′		(D) OLS Estimates	
Definition	KEI	SIX	KEI	SIX	KEI	SIX	KEI	KEI
δ_1	−0.025	−0.001	−0.030	−0.007			−0.024	
Standard Error	(0.007)	(0.007)	(0.007)	(0.007)			(0.007)	
δ_2					−0.094	−0.066		−0.100
Standard Error					(0.026)	(0.018)		(0.027)
Capital/Sales	0.051	0.051						
Standard Error	(0.016)	(0.016)						
Asset Growth (1983–88)							0.002	0.002
Standard Error							(0.002)	(0.003)
Adjusted R^2	0.242	0.232	0.247	0.234	0.235	0.231	0.245	0.252
N	990	990	990	990	994	994	946	946

Notes * Heteroskedastic-consistent standard errors in parentheses.
** Employment shares used as instruments for market shares.

are the differences in average costs across firms. If we measure $1/(n_j + m_j)$ by the share of the firm in the sector and approximate $m_j/(n_j + m_j)$ by the share of *keiretsu* firms in the sector, we have

$$(7') \qquad PCM_i = \sum_j \sigma_{ij} \frac{1}{\varepsilon_j} SHR_{ij} - \sum_j \sigma_{ij} \frac{(1-a)(r_i - r')K_{ij}}{p_j x_{ij}} S_j.$$

Equation (7′) suggests that controlling for sectoral effects, the price-cost margins of *all* firms in the sector should fall as the share of *keiretsu* firms rises. As before, we introduce a correction for the accounting error in costs and force the effects of bank influence to be identical in all sectors. We thus estimate the following equation

$$(vii') \qquad PCM_i = \sum_j \alpha_j \sigma_{ij} + \sum_j \beta_j \sigma_{ij} SHR_{ij} + \delta_2 \sum_j \sigma_{ij} S_j + \eta_i.$$

The results (in Table V, Panel C) are indeed consistent with equation (7′). Regardless of the definition used, δ_2 is negative and significant, suggesting that in sectors where there is relatively high *keiretsu* presence, the mark-ups of all firms, both *keiretsu* and non-*keiretsu*, tend to be lower after controlling for industry effects. In all our regressions, the Dodwell definition seems to yield more significant (and more stable) coefficient estimates than does the KNK definition. Judging from the reclassified sample regressions in Table IV, this superior performance is likely to be due to the fact that, unlike the Dodwell definition, the KNK definition does not draw a clear distinction between firms whose *keiretsu* is bank-centered and those whose primary affiliation is with a manufacturer.

One possible explanation for our results is that firm specific errors in the measurement of the Lerner equation may be correlated with our *keiretsu* variables. For example, Fisher [1987] argues that firms with higher past

growth are likely to have lower measured price-cost margins than similar firms with lower growth. Nakatani [1984], however, demonstrates that *keiretsu* firms actually have lower growth rates than non-*keiretsu* firms. In practice, our results are unchanged when a measure of past growth (asset growth between 1983 and 1988) is included as an additional explanatory variable in either equation 7 or 7′. (Table V, Panel D). Finally, a theoretically possible reason for our results may be that *keiretsu* firms are concentrated in industries with high price elasticities of demand. However, none of the investigations of the formation of main bank relationships during and immediately after World War II mentions any evidence to this effect (Hadley [1970], Hoshi [1993], Yafeh [1995]).

One should be cautious about interpreting our results in terms of the debate over the overall efficiency of Japanese corporate groups. These results seem to be in line with the findings of Caves and Uekusa [1976] and Nakatani [1984] that the overall performance of *keiretsu* firms tends to be poorer than that of the other firms. However, our results are not driven by the fact that *keiretsu* simply have higher costs than non-*keiretsu* firms. Firm sales in each sector should reflect differences in firm cost. The negative coefficient on the *keiretsu* dummy, therefore, should not be interpreted as a measure of the relative efficiency of *keiretsu* firms. Rather, it is a measure of how much the bank induces the firm to over-employ capital. Furthermore, the fact that *keiretsu* market share variables have a negative effect on the margins of other firms indicates that our results are due to *keiretsu* aggressive competition rather than inefficiency.

Our results are also consistent with the claim that imports tend to be lower in sectors where *keiretsu* shares are high. We suggest that the reason for lower imports in sectors where there is a high degree of *keiretsu* presence is not collusion, but intensive competition. Non-*keiretsu* firms, whether they are domestic or foreign, are likely to sell less in markets where margins are being driven down by non-profit maximizing firms.

V. CONCLUSIONS AND DIRECTIONS FOR FURTHER RESEARCH

The evidence presented in this paper suggests that *keiretsu*-affiliated firms are indeed different. Many have claimed in the past that main banks mitigate imperfect information problems between lenders and borrowers and provide affiliated firms with some form of insurance against financial distress. Our results suggest that, in addition, main banks tend also to impose intensified competition in markets where the *keiretsu* are strong. Thus, contrary to popular belief, financial *keiretsu* do not restrain, but instead intensify, competition. Main bank influence, leading to higher output and lower prices, may even be welfare-improving for Japanese consumers.

Further investigations of differences in behavior between *keiretsu* and independent firms are warranted. It would be particulary interesting to

explore differences in production techniques employed by *keiretsu* and independent firms. For example, does the main bank affect the firm's choice of inputs? This is one of the questions that have yet to be answered.

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