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Institutions, Relationships and Bank Competition in Bond Underwriting Markets: An International Comparative Study

by
Ayako Yasuda

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Institutions, Relationships and Bank Competition in Bond Underwriting Markets: An International Comparative Study

Ayako Yasuda
Wharton School
University of Pennsylvania
yasuda@wharton.upenn.edu
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Abstract

This paper addresses the question of whether existing institutional differences in banking systems affect bank competition in capital markets. Post-deregulation competition between entrant commercial banks and incumbent investment banks in the Japanese corporate bond underwriting market is empirically analyzed and compared with the results of the U.S. study in (Yasuda 2001b). I find that the certification effect alone cannot explain both the differences and similarities in the results. Drawing from the comparative banking literature, I interpret these findings as coming from the presence of "betrayal cost" in Japan and its absence in the U.S. These differences in the economic roles of relationships, as shaped by differences in the history of banking and corporate financing institutions, appear to persist in bank competition in the deregulated market.

JEL Classification: G1, G2, G3, L1, L5, P5.

1 Introduction

Interaction of bank relationships with development of and competition in capital markets is an underexplored and increasingly important subject of inquiry. Understanding both the short-term and long-term linkages between relationships, competition, and markets is critically important for comparing policy alternatives for re-designing banking regulation and buildling capital markets in both developed and developing countries. This is especially true today, as the debate has simmered on unresolved for decades on whether there is, has been or will be a global convergence of corporate finance and corporate governance institutions.

Only a decade ago the bank-based systems of Japan and Germany were widely perceived to be the superior ones, and many supporters advocated adaptation of their systems to developing and transforming economies. The Anglo-American model of market principles has then taken over, as Japan sank into a debilitating banking crisis and the emerging markets became the rage among investors. The prospect of a global convergence into the Anglo-American standard of corporate finance and governance has since long been predicted by its proponents.

Curiously, during the same period, U.S. and Japan overhauled their regulation to restore universal banking, a banking system best represented by Germany. Commercial banks in the U.S. and Japan were allowed to enter securities underwriting business to earn fees in capital markets, among other investment banking activities that were hitherto prohibited to them. Debt capital markets grew in these two countries, and consolidation in the industry sped up.

Having the two countries with distinct financial systems thus implementing similar deregulations motivates an interesting question of whether existing institutional differences in banking systems affect bank competition in capital markets. There is also a broader question of whether deregulation of capital markets will lead to disappearance of the institutional differences and convergence of the systems toward a market-based, Anglo-American system. Is the convergence occurring? If so, to what mode of organization are we converging? To the Anglo-American model, or to universal banking, or both? Or are those categorizations becoming less useful to understand the true underlying structure of dynamic relationships between institutions and markets? Financial systems across the industrialized world today continue to be in a state of flux, and this state calls for a new, economic and empirical work to investigate how existing relationships and institutions

interact with policy changes to determine the new mode of competition in marketplace. Findings on this mechanism in the short-run will provide us with underpinnings for the long-run dynamics between relationships, institutions, and markets. This paper investigates these questions by studying post-deregulation competition between entrant commercial banks and incumbent investment banks in the Japanese corporate bond underwriting market and comparing the results with those of the U.S. study in (Yasuda 2001b).

The international comparisons were conducted based on the following two hypotheses. First, the banking literature often emphasizes differences between market-based financial systems of the U.S./U.K. and bank-based financial systems of Japan and Germany. [1] The certification hypothesis predicts that a pre-existing banking relationship affects a firm's demand for underwriting service from a bank positively. The U.S.-Japan contrast suggests that the positive effect of bank relationships on underwriter demand is stronger in Japan than in the U.S.

Second, the Japanese main bank system is characterized by the multi-faceted, state-contingent nature of relationships and reciprocal delegation of monitoring among banks ((Aoki and Patrick 1994)). These institutional features in contrast to the American regime of arm's length banking predicts that Japanese firms are more constrained by the betrayal cost of switching from existing relationship(s) with their banks than American firms. In other words, existence of such a relationship lowers relative demand for underwriting service by rival commercial banks (but not investment banks).

Like the U.S. results, I find that a previous loan relationship affects a Japanese firm's demand for a given bank's underwriting service positively. I also find that issuers with lower credit ratings value bank relationships more, which is qualitatively similar to the U.S. result.

I find that the valuation of bank relationship ($\frac{\beta}{\alpha}$) is not higher in Japan than in the U.S., while the "dissimilarity coefficient" (λ) is lower in the modified nest for Japan but not in the U.S. The certification alone cannot explain both the similarity result (in $\frac{\beta}{\alpha}$) *and* the difference result (in λ). Something more is at work. Drawing from the institutional differences that have been documented in the literature, I interpret these results as coming from the differences in the relative weights on one-shot versus long-term payoffs of having/keeping bank relationships in the

[1] See (Allen and Gale 2000) on the subject of comparing financial systems, and (Roe 1994) and (Aoki and Patrick 1994) for development of banking/financial systems in the U.S. and Japan, respectively.

two countries.

In the U.S. bond underwriting market, the one-time payoff of certification appears to be the first-order economic role of existing relationships, whereas in Japan, the long-term benefit of not switching appears to play an economic role of the same magnitude as the weaker-than-the U.S., (and potentially negative) one-shot payoff of choosing a bank with relationships. Certification alone cannot explain why commercial banks without relationships are significantly worse off when there are other commercial banks with relationships than when they face no rival commercial banks with relationships. In fact, net certification need not be present to explain this negative cross-bank effect *and* the positive own-effect of relationships as long as preservation of long-term relationships value predominates the firm's choice problem. These differences in the economic roles of relationships, as shaped by the differences in the history of banking and corporate financing institutions, appear to persist in bank competition in the deregulated market.

What emerges from the experiences of financial deregulation in the two countries is a picture of the banking industry where imperfect competition is persistent, and where the time-varying values of bank-firm relationships play a pivotal role in determining the nature of competition. It is an industry where the relative values of relationships that firms maintain with both their commercial and investment bankers are co-determined by both the firm-level (time-varying) variations, such as the firms' newness to (and reliance on) the financial markets, and the country-level (also time-varying) variations, such as the degree of reliance on capital markets for external financing by corporate issuers in general. These variations explain why commercial banks made profitable entry into the corporate bond market while second-tier investment banks stayed outside. They also explain why their entry resulted in only modest competitive gain in the market. While the empirical analysis is that of a short-run equilibrium, the results set in the broader context of comparative banking literature suggest long-term path dependence of these international differences in the linkage between institutions, relationships and markets.

The remainder of the paper is organized as follows. Section 2 reviews related branches of the corporate finance literature. Section 3 describes the banking regulation and historical development of the corporate bond underwriting market in Japan. Section 4 explains the empirical specification used to estimate the demand model. Section 5 describes the data and defines the explanatory variables to be included in the estimation, and Section 6 presents the estimation results.

Section 7 interprets and analyzes the economic implications of these demand and price estimates. Section 8 reports a small extension of the analysis of the Japanese data. Section 9 concludes.

2 Prior and Related Literature

2.1 Analysis of the Japanese Banking System

The Japanese financial system has been studied in both banking and corporate governance literature as a major alternative or benchmark to the U.S.-style financial system. See (Aoki and Patrick 1994) for a collective volume of articles on the the subject covering institutional, regulatory, legal and contractual aspects of the so-called Main Bank System in Japan as well as studies comparing it with banking systems of various developing and transforming economies. In the book, the Japanese main bank system is characterized by the multi-faceted, state-contingent nature of relationships and reciprocal delegation of monitoring among banks. [2] Also see (Hoshi, Kashyap, and Scharfstein 90a) and (Hoshi, Kashyap, and Scharfstein 1990) for empirical analyses of Japanese corporate banking relationships, and (Hoshi, Kashyap, and Scharfstein 1993) and (Hoshi and Kashyap 1999) for discussions of financial deregulation and its ramifications.

2.2 Related Literature in Corporate Finance

2.2.1 The Monitoring Role of Commercial Banks

The theory of financial intermediation has stressed the unique monitoring function of commercial banks. A number of papers argue that banks have scale economies and comparative cost advantages over other lenders (including individual bondholders) in producing information about the borrowers. [3] In particular, it has been argued that a bank loan renewal creates two positive externalities for the firm. It enables other fund providers to avoid duplicating the costly evaluation process, and it also provides certification of the firm's payment ability to the public. (James 1987) investigates

[2] See Figure 1 and Table 1, for matrix representation of the main bank system, as well as the taxonomy of banking systems, both from (Aoki and Patrick 1994).

[3] (Leland and Pyle 1977), (Diamond 1984), (Fama 1985). Also, see (Ongena and Smith 1998) for a literature survey on topics involving bank relationships.

		Financial State of the Firm			
		Excellent	Favourable	Normal	Critical
Nature of Main Bank Relations	α		(x)	x	[x]
	β	(x)	x		
	χ	x	x	x	x
	δ	x	x	x	x
	ε	(x)	(x)	x	[x]

α : Bank loans
β : Bond issue related service *
χ : Shareholding
δ : Payment settlement accounts
ε : The supply of management information and resources
x : --indicates this role performed in this financial state
[x] : --indicates this role performed strongly in this financial state
(x) : --indicates this role performed weakly in this financial state

Source: Aoki and Patrick (1994)

* The original table in the source specifies this service as "trustee administrator in the case of domestic issues and co-lead management in the case of Euro issue", reflecting the regulation of the time. Since then banks have been allowed to underwrite domestic issues as well.

Figure 1: The Matrix Representation of Main Bank Relations

Table 1: Typology of Banking Systems

Banking System	Regulatory relationship with securities market	Control of the bank	Bank's role in monitoring	Bank's role in corporate governance
State mono-banking	No security market	The state	No ex ante monitoring, ex post 'soft budgeting'	State planner's intermediary
Exclusive grouping	Market underdeveloped	Government or industrial group	No autonomous ex ante monitoring idiosyncratic risk	Government's or group's common agency
Main bank	Limited equity holding, no underwriting *	Autonomous management, hands-on regulation	Integrated monitoring, reciprocal delegation	Contingent control
Universal banking	Equity holding, underwriting allowed	Automonous management, hands-off regulation	Parallel integrated moniroting	Shared control (German case) or active control (pre-Glass-Steagall US case)
Arm's length banking	Strictly separated *	Market	Decentralized	Hands-off

Source: Aoki and Patrick (1994)

* This statement in the original table reflects the pre-deregulation state of banking systems in Japan and the U.S., respectively. Since then, underwriting has been allowed in both countries.

this idea by measuring the average stock price reaction of firms that publicly announce a bank loan agreement or renewal. Consistent with certification effect of bank loans, he finds that bank loan announcements are associated with *positive* and statistically significant stock price reactions.

Other papers, such as the one by (Chemmanur and Fulghieri 1994), attribute the monitoring ability of banks to their incentive to build their own reputations as lenders. (Chemmanur and Fulghieri 1994) model a firm's choice between bank loans and bonds, allowing for debt renegotiation in the event of financial distress. The main implication of the model is that the desire of the banks to acquire a reputation for making the "right" renegotiation versus liquidation decisions gives them an endogenous incentive to devote more resources towards evaluating a firm's value than bondholders. These papers suggest that commercial banks have closer, longer-term, and more exclusive relationships with their borrowers than other types of lenders. These views support the use of pre-existing relationship variables in my model as a measure of effectiveness in information production as underwriters. In a related empirical study, (Datta, Iskandar-Datta, and Patel 1999) find that the existence of bank debt (with any bank and not necessarily with the underwriting bank) lowers the at-issue yield for first public straight bond offers.

Several papers [4] study the implications of commercial bank underwriting using game-theoretic models. They demonstrate that even with the assumption of rational investors, a potential social cost to the combining of investment banking and commercial banking cannot be ruled out. The existence and magnitude of the conflict of interest problem depends on the cost of information production by the two types of banks, the timing of their access to a firm's private information, investors' beliefs about the quality of the firms underwritten by commercial banks, etc.–none of which are easily measurable. There are also a group of articles which pursue this issue empirically. These articles investigate whether there is a significant difference in the level of the ex post default rate and ex ante yield of bonds between commercial bank underwriters and investment bank underwriters. [5] Their statistical models yield descriptive interpretations of the data. They generally conclude that there is no detectable conflict of interest in the data with the exception of (Hamao

[4] (Kanatas and Qi 1998), (Rajan 1992), (Puri 1999).

[5] See (Ang and Richardson 1994), (Kroszner and Rajan 1994), and (Puri 1994) for default rate studies using pre-Glass-Steagall historical data. See (Puri 1996), (Gande, Puri, Saunders, and Walter 1997), and (Hamao and Hoshi 1999) for studies on ex ante yield.

and Hoshi 1999) and in some cases there is a net certification effect.

2.2.2 A Reputation Model of the Firm's Debt Choice

(Diamond 1991) uses the borrowing firm's reputation in explaining the choice between bank loans and bonds. The main result of the paper is that firm reputation and bank monitoring (of the firm's investment decisions) are substitutes. The intuition for this result is as follows: Young firms and old firms without reputations tend to rely more on bank loans, because they do not have reputations to lose and therefore bank monitoring is needed to enforce efficient investment decisions. Large established firms with good reputations, on the other hand, do have a reputation to lose and therefore have sufficient incentive to choose efficient investment decisions. Bank monitoring is costly, and thus this class of firms will prefer to issue bonds.

The model implies that there is an intertemporal linkage between bank loans today and the firm's decision to issue bonds in the future: "A borrower's credit record acquired when monitored by a bank serves to predict future actions of the borrower when not monitored" (p.690). This suggests that the monitoring of firms by commercial banks in the loan market can become an asset in another market, e.g., when such banks become underwriters in the bond market. [6] Moreover, this substitution between bank monitoring and firm reputation implies that issuers with low reputation value their loan relationship with underwriting banks more than those with high reputation.

3 The Banking Regulation and Historical Development of the Corporate Bond Underwriting Market in Japan

In the literature on comparative financial systems, Japan is categorized as having a bank-based system of relationship finance in contrast to the "spot market" model of anonymous transactions

[6] Alternatively, the lending bank might be chosen as underwriter because the firm prefers to keep a single-bank relationship in all financial services provided by commercial banks. The impact of the multiple- vs. single-bank relationships on credit availability, pricing, and firm performance is mixed. While (Petersen and Rajan 1994) and (Petersen and Rajan 1995) demonstrate that multiple-bank firms are more credit constrained (and face higher interest payments) than single-bank firms, (Houston and James 1996) conclude the opposite.

best represented by the U.S. But less often documented is the fact that Japan has one of the largest capital markets (both stock and bonds) outside of the U.S. [7] as well as a history of banking regulation that at least partially mimicked that of the U.S. following the Second World War. Thus for the purpose of this paper I describe historical development of the present day financial system in Japan which has come to possess substantial elements of both bank-based as well as market-based institutions.

3.1 Historical Overview of the Japanese Financial System

3.1.1 Pre-War Period (1900-1938)

In pre-World War II Japan, a system very different from what is perceived today as the main bank system existed. It is characterized by, on one hand, powerful stockowners, most notably *zaibatsu* families such as Iwasaki (later Mitsubishi), Mitsui, Sumitomo and Yasuda, who controlled their conglomerate corporate groups through private holding companies, and, on the other hand, relatively weak and numerous banks as lenders.

Both *zaibatsu* and non-*zaibatsu* firms relied more heavily on retained earnings and equity than they did on bank loans. Banks were relatively small, numerous and fragile, both because of free entry (until 1933) and the limited diversification of the banks' loan portfolio.

1927 Bank Law led to separation of sales and trading business from banking while still allowing underwriting activities by banks [8] For example, the present-day Big Four securities houses were all created as spin-offs of banks in the pre-war period. [9] These off-shoots of banks obtained underwriting licenses pursuant to the 1938 Underwriting Law.

Meanwhile, the 1927 Bank Law allowed certain securities businesses as auxiliary operations of banks. Thus banks continued to operate some investment banking businesses. [10] For example, these banks were dominant players in underwriting public and corporate bonds. It seems that a territorial division was drawn between bonds and equity, where securities firms specialized in equity

[7] See, for example, (Rajan and Zingales 1995).

[8] See (Ueda 1994), p.15 in (Inoue 1980).

[9] Yamaichi Securities, Daiwa Securities, Nikko Securities and Nomura Securities were spun off from Koike Bank, Fujimoto Building Broker Bank, Industrial Bank of Japan, and Nomura Bank, respectively.

[10] (Inoue 1980).

underwriting and brokerage and banks dominated bond underwriting.

3.1.2 The War Period (1938-1945)

Under the war economy, the government brought about a series of new comprehensive policies which were intended to restructure the free-market economy controlled by stockowners to a highly centralized economy with a greater role played by banks. Two, among the new policies, caused drastic reorganization of the existing financial institutions. One was the deliberate reduction of the number of banks by means of higher capital requirements, forced mergers and acquisition of small banks, and the compulsory guideline that limited the distribution of banks to one per prefecture.

Another significant policy was the Designated Financial Institution System, which matched each existing bank with particular military and other industrial firms. It was designed to guarantee these key companies ample capital resources for their production. At the end of the war, majority of these firms under the Designated Financial Institution System was designated to one of the five major *zaibatsu* banks. [11] These compulsory relationships between firms and banks seemed to have evolved into more self-enforcing main bank relationships after the war.

3.1.3 From Post-War Reforms to Current Deregulation (1945-present)

Various "economic democratization" measures were taken by the U.S. during the occupation period following the end of the World War II. Dissolution of *zaibatsu* was an example of such measures, designed to achieve (1) dispersion of stock-holding among households and (2) separation of ownership and control of large Japanese companies, many of which hitherto were controlled by 10 or so *zaibatsu* families.

According to (Aoki 1989), "Between August 1946 and August 1947, —[m]ost of the shares of the holding companies and *zaibatsu* families were transferred to the Holding Companies Liquidation Commission. The total value of shares transferred under this operation, —amounted to 118.4 billion yen, which was about two-fifths of the total value of stocks outstanding at that time. [12]"

These shares were sold by the Security Liquidation Coordination Council, mostly to small

[11] See (Teranishi 1994).

[12] (Aoki 1989), p.124.

individual stockholders including many of the companies' employees, prior to the opening of the Tokyo Stock Exchange in 1949. As a result, individual holdings reached 61% of the total in 1950 (compared with 23.6% for financial institutions and industrial companies combined) and has been steadily declining since then. [13]

Another important "economic democratization" measure taken was the passage of The Anti- Monopoly Law in 1947. Of note are its Article 9, which bans pure holding companies whose primary business is to own and control other corporations. Also, Article 11 of the law sets a 5% limit on stock-holding by financial institutions. Later in 1953 Article 11 was modified to 10% for banks, securities firms and insurance companies but this change was reversed to 5% for banks and securities firms by the Miki Administration (in the 70's or early 80' s). [14] Article 65 of The 1948 Securities and Exchange Law, which was modeled after The 1933 Glass-Steagall Act, led to separation of banking and securities business for the next 45 years. Also separation of long-term vs. short-term lending between long-term credit banks and city banks, and separation of commercial banking vs. trust banking between city/regional banks and trust banks complemented the above Article 65 to characterize the highly-compartmentalized post-war Japanese financial system. The paragraph below succinctly summarizes the post-war financial system in Japan:

> The post-war Japanese financial system owed much to its early post-war, war-time, and pre-war institutional heritage. The Ministry of Finance opted for a system of bank loan-based finance for industrial corporations. It used regulatory restrictions and economic disincentives to severely inhibit corporate bond issue and the development of a secondary market.—Essentially, only public utilities and long-term credit banks could issue bonds in any quantity, and this was done mainly through non- arm's length placements. Equity issue was expensive for management-controlled firms, both because dividends were paid out of after-tax profits while interest payments were a deductible expense, and because the pre-war custom of new stock issue at par rather than market prevailed well in to the 1970's. The issuance of commercial paper for short-term finance was not allowed until 1987. Business, growing rapidly and always in need of new loans

[13](Niki 1984)

[14](Mabuchi 1996), p.119.

for working capital and fixed investment, had no choice but to borrow from banks. [15]

In the 1970's, the Japanese government debt soared to an unprecedented level. [16] In order to facilitate absorption of this massive amount of government debt in the private sector, sales of Japanese Government Bonds (JGBs) in the secondary markets were allowed for those more than 1 year old since issuance. Furthermore, in 1981 the New Bank Law and the New Securities and Exchange Law were enacted in order to pave the way for banks to selectively enter securities businesses.

In April 1983, the ban on sale of government/semi-government bonds by banks was lifted. Then in June 1984, dealing of these government bonds by banks ("bank dealing") was allowed

Finally, in 1993 banks were allowed to set up subsidiary securities firms to engage in selected securities businesses, most notably underwriting of public/corporate bonds. This was a significant step toward revision of the Article 65 of the Securities and Exchange Law. On a different front, in October 1994, upper limit on duration of bank term deposits was lifted and effectively ended the historical separation of long-term credit banks and commercial banks. [17]

3.2 Overview of the Japanese Domestic Bond Markets

3.2.1 Issuing Methods

Corporate bonds are either issued in public offerings or placed privately. Public offerings are underwritten by a syndicate team of securities firms. In addition to paying underwriting and other service fees to the lead manager and the rest of the syndicate team members, an issuer has customarily hired a bank (typically the issuer's main bank) as principal bond management bank, and paid service fees to the bank for custody and settlement work for the duration of the bond. This custom, which gave main banks lucrative fee business as well as significant power over allocation of bonds, may have come into existence not the least because of historical dominance of banks in bond underwriting business in the pre-war period, as well as the Designated Bank System during the war.

[15] (Patrick 1994), p.371.
[16] (Ueda 1994), pp.104-105.
[17] (Shikano 1996), p.29.

In the 1950's-1970's, when corporate issues were rare and virtually limited to utility companies and a short list of "approved" companies which met stringent eligibility guidelines, terms and allocation of offerings were set in a non-arm's length manner at *kisaikai*, or bond-issuing meetings, attended by the syndicate members and the principal management bank. A significant fraction of these issues were placed among the largest banks, and the company's main bank, serving as principal management bank at *kisaikai*, was quite influential in setting terms, and allocating the issues. The principal management bank charged fees that totalled 2-3% in the course of the maturity of the bond. In effect, the commercial banks *and* the investment banks had together cartelized the corporate financing market. [18] Whether a firm borrowed from a bank or issued a bond, they collected a monopoly rent. Because the commercial banks and investment banks together controlled both markets, the firms could not avoid the monopoly rents in one market by raising funds in the other. [19]

A "proposal method", whereby individual securities firms bid against each other for the lead- manager position by submitting proposals to the prospective issuer, was introduced in 1987 and replaced *kisaikai* by 1988. After the new method experienced problems with discounting sales among underwriters, a "universal price sales method" was introduced in 1991. The newest method, which is employed in the Euro markets as well, restricts all underwriters to sell securities at the issue price during the offering period.

Private placement is allowed as a method of issuing and placing bonds to less than 50 subscribers. Unlike public offerings, it is mostly led by banks and securities firms are not involved in the placement. Historically, it has been *de facto* a variant of syndicated bank loans. The size of this market has increased lately, mostly as a result of relaxation of upper limit on issuance amount.

3.2.2 Eligibility guidelines for Issuers

The origin of eligibility guidelines dates back to the policy measure taken up by the Bank of Japan in the post-war period (1948-1955). As a means of indirect credit provision to large industrial companies, the Bank of Japan screened and selected a list of large companies whose bonds were given high collateral values. This encouraged banks to hold these bonds as assets, as these banks

[18] The equity market was not a significant source of external financing for firms during this period. See Section 3.3.2.

[19] (Ramseyer 1994), pp.237-239.

were heavily dependent on collateral- backed lending from the Bank of Japan at the time. In fact most of these bond issues were purchased by financial institutions such as city banks.

Even after this mechanism was abolished, the guidelines continued to be used by the members of *kisaikai* to rank and screen prospective issuers. The guidelines were initially set for eligibility to issue collateralized bonds.

The first non-collateralized straight bond was issued in Japan in 1979 by Sears, Roebuck. This led to establishment of eligibility guidelines for non-collateralized bond issues by domestic corporations. At the time, only 2 companies met the guidelines.

For example, eligibility guidelines as of 1981 were:

• net asset of more than 6 billion yen

• first-time issuers: more than 10% dividend payout ratio for the past 3 consecutive years

• non-first-time issuers: more than 8% dividend ratio for 3 years or more than 10% for 1 year

• other criteria: net asset ratio, equity ratio, operational profit/gross asset ratio, and interest coverage ratio

Credit ratings assigned to issuers and/or issues by independent agencies were not introduced until the 1980's. By 1985, 4 credit rating agencies were established. Eventually, credit ratings started to first supplement and then replace the guidelines.

Since then, with gradual relaxation of the above guidelines, the number of eligible companies increased from 2 to some 600. [20] However, the number of actual issuers remains a low fraction of those eligible even in the 1990's, and the recent increase in the market size is largely a result of increase in issuance amount per issue. This in return was induced by relaxation in 1991 and subsequently removal in 1993 of upper limit on issuance amount (as a multiple of net assets). [21] Finally, in January 1996, the eligibility guidelines were all together lifted. [22] These restrictions, in place until recently, effectively postponed development of sub-investment grade bond (or so-called junk bond) market in Japan.

[20] See (Tokai Bank Research Monthly 1993), p.14, Table 3.

[21] Ibid., p.6, pp.16-17.

[22] (Finance and Fiscal Affiars (Kinyu Zaisei Jijyou) 1995,).

3.2.3 Size of the Markets

In the latter half of the 1980s, lured by the low issuance cost reflecting the soaring stock prices, Japanese companies issued an unprecedented amount of convertible bonds and bonds with warrants. In 1989, the peak year, the total equity-related bond finance reached 26.5 trillion yen, 6.5 times the level before the boom started in 1985. [23]

Since the bubble economy burst in 1989, issuance of convertible bonds and bonds warrants has all but disappeared, and straight bond issuance has risen both proportionately and absolutely. [24] The main reasons for the recent increase are:

- A series of deregulation measures in the domestic market has made domestic issuance cheaper and simpler than before, making it a comparative option to Euro-yen markets
- Low interest rate
- Refinancing needs for the existing bonds with warrants and convertible bonds

3.3 Overview of the Domestic Equity Markets

3.3.1 Ownership Structure: The Post-war Development

The *zaibatsu* dissolution led to drastic reshuffling of stock ownership into the hands of individual households after World War II [25] Since then, however, the former *zaibatsu* members have regrouped as more informal *keiretsu* groups, and inter stockholding by their members have steadily risen, while individual owners' share declined and institutional investors' share remained more or less flat. This is in sharp contrast to the change that took place in the U.S. or U.K. where the decline in individual owners' share was roughly compensated by the increase in institutional investors' share over the same period. [26]

The 5-10% rule pursuant to Article 11 of the Anti-Monopoly Law meant that for a *keiretsu* group including one city bank, one trust bank, one life insurance company and one casualty insurance company, the group financial affiliates as a whole can own up to 30% of its industrial affiliates.

[23] See (Tokai Bank Research Monthly 1993).
[24] Ibid.
[25] (Aoki 1989), p.125.
[26] See (Niki 1984).

Consequently, the management of many of the *keiretsu* companies was effectively shielded from outsiders and to a lesser degree from demands of their own individual stockowners.

3.3.2 Primary Markets

New equity can be issued in one of the following four methods.
(1) public offerings (at market price)
(2) third-party allotments (such as employees, suppliers, etc.)
(3) allotments to existing shareholders (historically at par, and then more recently at an intermediate value between face value and the market value)
(4) stock split
Among (1)-(3), (3) was the dominant method until the 1970's. Clearly this was not appealing to those companies who had access to low-rate bank loans. Then with the rising stock prices, (1) became the more dominant method. Public offerings was 53.6% of total amount raised (thus excluding stock split) in 1973; in 1980, it was 78.1%.

Listing standards [27] for the Tokyo Stock Exchange includes number of shares, number of stockholders, profitability, years since incorporation, etc.[28] There are also active over-the-counter (OTC) markets. [29]

3.4 Deregulation of Euro-Yen Bond Markets

The first Euro-yen bond was a 10 billion yen bond issued by EIB (European Investment Bank) in 1977. It was initially a highly restricted market, where only sovereign and supranational issuers were allowed to raise funds.

In the 1980s, however, rapidly appreciating yen and innovation in currency swap markets induced growth of yen-denominated bond markets from demand and supply side, respectively. In response, the Japanese government started relaxing the regulations governing the Euro-yen markets. In some ways the government used the Euro market as an "experimental laboratory" for deregulation that was slowly taking place back home, and for this reason the deregulation in the

[27] (Matsutani 1995), p.195.
[28] See http://www.tse.co.jp/english/top/eframese.html (Tokyo Stock Exchange).
[29] Ibid., p.199. Also see http://www.jasdaq.co.jp (Japan Securities Dealers Association).

Euro markets typically preceded similar measures subsequently taken in the domestic market (see Section 7 for more discussion on relevance of this market).

Meanwhile, the Article 65 of the Securities and Exchange Law did not prevent Japanese banks from setting up overseas subsidiaries which engaged in securities businesses, for instance, in underwriting offerings by Japanese issuers in the Euro markets (but they were effectively banned from becoming bookrunners).

In April 1984 , the following changes were announced by the government [30]:
(1) public offerings were allowed for the first time to those domestic Japanese corporate issuers who met the eligibility guidelines (see Section 3.2.2).
(2) Eligibility guidelines for foreign issuers were relaxed to allow more non-sovereign issuers.
(3) Foreign underwriters were allowed for the first time to lead-manage an offering (hitherto only allowed to Japanese securities firms). Japanese underwriters which were European subsidiaries of Japanese banks, however, were still not allowed lead-manager positions.

With (1), 30 Japanese issuers were newly eligible for straight bond issues, and 100 for convertible bonds. [31]

Eligibility guidelines continued to get relaxed in incremental manner over the following decade, before they were finally removed in January 1996, the same year that such guidelines were also lifted for the domestic bond markets. [32]

Between 1991 and 1993, domestic issuers' total issuance in the Euro-yen bond markets marked 2-3 trillion yen per year, reflecting the drastic shift away from equity-related finance(convertible bonds and bonds with warrants) into Euro-yen bond finance. After 1994, however, further deregulation in the domestic bond markets created for the first time a head-on competition between the Euro-yen and domestic bond markets. Clearly some of the earlier competitive advantage of the Euro-yen markets was lost with the deregulation and simplification of procedures in the domestic markets.

One of the remaining restrictions in the Euro-yen bond markets for domestic issuers was so-called *kanryu seigen*, or restrictions on return of bonds back into Japan. The restriction was

[30](Finance and Fiscal Affairs (Kinyu Zaisei Jijyou) 1984a,).
[31]See (Akakura 1984), p.50.
[32]For details, see (International Finance (Kokusai Kinyu) 1996,).

intended to make sales of Euro-yen bonds in Japan difficult, thereby minimizing the effect of Euro-yen bond issuance on Japan's current account balance. The restriction period used to be as long as 180 days in the 1980s, was gradually shortened and abolished for the non-Japanese issues in August 1995, and was lifted for Japanese issues as well in April 1998. [33]

3.5 Entry of Bank Subsidiary Securities Firms into the Corporate Bond Markets

The Financial Institution Reform Act (passed June 1992) allowed banks, securities firms, trust banks and insurance companies to reciprocally enter each other's business areas by means of area-specific subsidiaries.

By the Auxiliary Rules of the Act, security firm subsidiaries of banks were initially not allowed to engage in equity brokerage businesses. The reasons given were:
(1) Japanese banks have not historically been involved in equity brokerage business (whereas they were the dominant players in bond underwriting business in the prewar period before Article 65),
(2) a potential conflict of interest arising from the existing stock ownership by the parent banks and brokerage operations at subsidiary level, and
(3) many small- and mid-size brokerage firms relied on equity brokerage fees as main source of profits. [34]

Accordingly, the bank subsidiaries were initially allowed to engage in the following activities:
(1) underwriting/trading of public bonds (sovereign, governmental agencies, etc.)
(2) operations relating to short-term securities and asset finance securities
(3) underwriting of corporate bonds (including convertible bonds (CBs) and bonds with warrants (WBs)) and trading of corporate bonds (excluding CBs and WBs)
(4) operations relating to investment trust business
This means they were excluded from:
(1) underwriting/trading of equity

[33] For details of eligibility guidelines, see (Investment Monthly (Toushi Geppo) 1985,), p.43.
[34] (Kanzaki 1996), p. 97.

(2) trading of CBs and WBs

(3) trading of stock index futures and options

Eventually, with enactment of the Financial System Reform Law on Oct. 1, 1999, the remaining equity-related restrictions were lifted. [35]

The first bank subsidiaries started operations in July, 1993. The following observations and evaluations were found in popular business publications in the first few years of bank subsidiary operations.

(1) Underwriting fees have lowered further since their entry (the fees had been decreasing even before 1993). For example, for a benchmark issue with a particular credit rating and a maturity, it dropped from 1.5 yen per issuance amount of 100 yen (or 1.5%) in 1991 to an average of 0.35-0.55 yen. [36]

(2) There seems to be a high correlation (70-90%) between the subsidiaries being lead manager and the parent banks being the principal bond management bank. The main bank fire wall rule may

[35] In conjunction with the legalization of bank subsidiary securities firms, the following fire-wall rules among others were listed under the Securities and Exchange Law((Kanzaki 1996), pp.,98-99):

(1) Sales of securities issued by borrowers from the parent bank is prohibited if the proceeds was to be used to repay the above borrowings and if the investors were uninformed about such use of proceeds.

(2) Subsidiaries are not allowed to lead-manage issuance by the parent banks unless the offering is rated by a credit rating agency.

(3) "Back-finance" (underwriting a security and subsequently selling it to an investor whose credit is extended by the parent bank within 6 months after the offering) is prohibited.

(4) Subsidiaries cannot provide the parent bank with any confidential information regarding issuers/their clients without their consent.

(5) Arm's length rule

(6) No "contingent" contract (e.g. parent's providing credit to a customer contingent upon its signing a security exchange contract with its subsidiary)

(7) No selling of underwritten securities to the parent banks within 6 months of the offering

(8) Main bank fire wall: Subsidiary firms cannot lead manage a bond offering by issuers with net asset of less than 500 billion yen if the parent bank is its principal bond management bank. They also cannot lead manage a bond/equity offering by issuers if the parent bank has acted as principal bond management bank for more than 2 times out of the latest 3 bond issues (within the past two years).

[36] (Finance and Fiscal Affairs (Kinyu Zaisei Jijyou) 1995b,), p.15.

not be effective. [37]

(3) Main bank relationship is seen as more crucial than expertise in bond sales *per se*.
Evidence: Sanwa Bank, which is a lower-tier city bank, lags behind other upper-tier city banks in underwriting business despite its top bidder position in the Japanese Government Bond market. This is because it has relatively weak main bank ties with the best of blue chip companies [38]. However, in the more recent Nikkei article, Sanwa ranked 5th among the bank subs and 9th among all securities firms, so this claim is not necessarily supported over time.

(4) Electricity companies (which comprise 50% of all straight bond markets by issuance amount) assign underwriters differently from other issuers. That is, they emphasize bond sales capabilities of underwriters rather than their main bank relationships with them. Electricity companies were the first companies to be allowed by the government to issue bonds in the 1950's, and they still are the most frequent and largest-size issuers in the market today. Historically, their lead managership has been rotated among the Big Four (Nomura, Nikko, Yamaichi, Daiwa) securities firms. [39]

It is interesting that (2)-(4) reflect a view that main bank ties contributed to the rapid increase in market shares by entrant banks, while (1) reports a simultaneous drop in price.

3.6 Further Continuation of Financial Deregulation

The financial deregulation in Japan is still ongoing today. A series of new laws and amendments to old laws have been passed since 1993 encompassing such broad areas as expansion of asset investment products, relaxation of stock listing standards, and further dismantling of walls between banks, securities firms and insurance companies. [40]

[37] Ibid., p.22.

[38] (Weekly Diamond (Shuukan Diamond) 1995,).

[39] Ibid.

[40] Some government agencies post and update summaries of these regulatory changes in English. See:
http://www.fsa.go.jp/indexe.html (Financial Services Agency (Kinyu-cho))
http://www.fsa.go.jp/p_fsa/indexe.html (Financial Supervisory Agency)
http://www.fsa.go.jp/p_mof/p_mofe.html (Ministry of Finance (Financial System Planning Bureau))

4 Empirical Specification of the Demand Model

The main part of the empirical model consists of a discrete choice model of a firm's underwriter choice. The approach taken here is transaction-based, rather than capital stock-based. This follows the pecking-order financing model [41] and is consistent with the premises of other debt choice models as well.

4.1 Notation

Let the banks be numbered $1..K$, indexed by k.
Let the firms be numbered $1..N$, indexed by i.

4.2 Model

Based on the model of the underwriting service market described in Section 3 of (Yasuda 2001b), the price (observed or not) offered by bank j to firm i is specified as

$$p_{i,j} = {z_i}^T \gamma_j^1 + {z_{i,j}}^T \gamma_j^2 + \delta_{i,j} \tag{1}$$

where $\delta_{i,j} \sim N(0, \sigma^2)$ iid. (For simplicity of notation, $z^T \gamma_k$ is used to refer to the non-random part of the price from now on.) z_i here capture the reputation/risk characteristics of issuers/bonds which determine the cost of underwriting for the banks as discussed in the previous section. Examples of such characteristics are credit ratings and maturities of bonds. The subscripts in γ_j reflects the implication of the analysis that individual banks price these characteristics of issues/bonds differently. The price equations are thus specified in order to impute the unobserved prices. Imputation methods are discussed in Section 4.4.

Consider a firm i that chooses an underwriter after observing $p_{i,k}$ for $k = 1..K$. The product in this market is differentiated along two dimensions, namely, price and certification ability,

[41] In this well-known partial equilibrium model of the firm's financing behavior, the firm optimizes with respect to each financial transaction, taking its need for external finance as given. The model implies a hierarchical decision tree for the firm, which is easily adaptable in a nested-logit model framework. See (MacKie-Mason 1990); (Helwege and Liang 1996) for use of nested-logit models in testing pecking-order model predictions.

which is measured by pre-existing relationships in the loan market. I specify a nested-logit model according to the nest structure given in Figure 2. The lower nest refers to the choice of a particular underwriting bank, whereas the upper nest refers to the choice between commercial banks and investment banks (indexed by m). The indirect value function for firm i choosing bank j which belongs to upper nest m is given by:

$$\begin{aligned} V_{i,(m,j)} &= \sum_r Y_{i,r} \left[d_j^T \mu + \alpha_r p_{i,j} + \beta_r x_{i,j} \right] + \\ & \quad w_i^T \delta_m + \epsilon_{i,(m,j)} \end{aligned}$$

$p_{i,j}$ is the underwriting fee charged by the bank

$x_{i,j}$ is a prior loan relationship variable

d_j is a bank dummy vector

$Y_{i,r}$ is an indicator variable for the reputation characteristics of the issuer

w_i are the bond/issuer characteristics

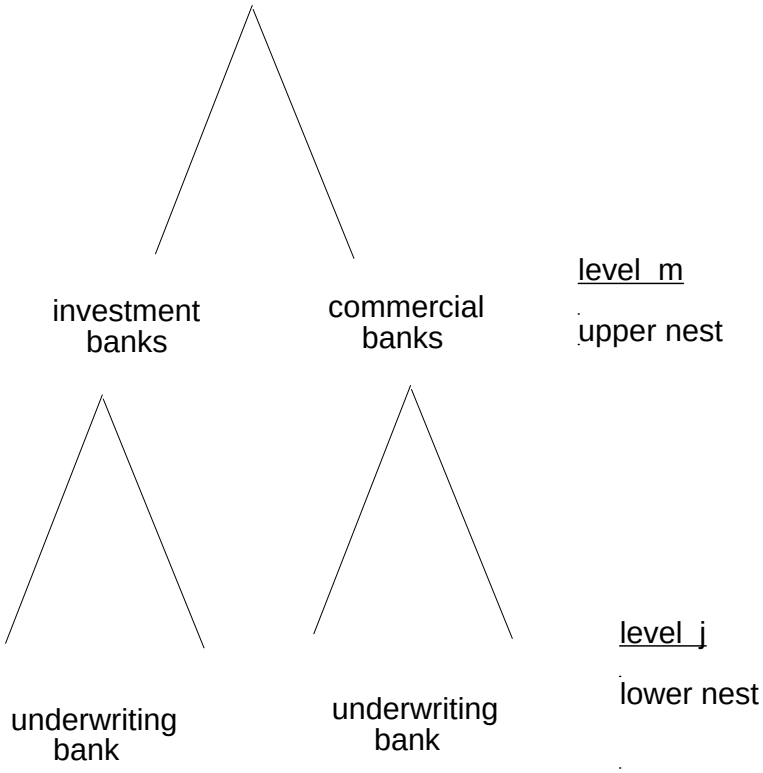
$\epsilon_{i,(m,j)}$ is the idiosyncratic firm-bank error

The multiplication of $[d_j^T \mu + \alpha_r p_{i,j} + \beta_r x_{i,j}]$ by $Y_{i,r}$ and summing over r indicates that coefficients α and β are allowed to vary across the reputation characteristics, which is indexed by r.

I assume that all issuers face the fixed choice set $k = 1..K$. The actual number of underwriting banks in the data sample is only 15, so to assume that issuers know all of them is not unreasonable. I also assume that the constant term and relationship variables sufficiently pick up most of the unobservable quality characteristics of banks so that any unobservable quality terms left in the residual terms are small and can be ignored. The relationships are client-specific qualities of the banks, whereas the constant term captures any fixed quality of banks that all issuing firms perceive identically.

Assume that the error term ϵ follows the Generalized Extreme-Value (GEV) distribution. McFadden(1978 and 1981) showed that the assumption of the GEV distribution implies

Figure 2: Firm's Choice Set



- The lower-nest choice probability:

$$\Pr(j|m,\, Y_{i,r}) = \frac{e^{d_j^T \mu + \alpha_r p_{i,j} + \beta_r x_{i,j}}}{\sum_{k=1}^{K} e^{d_k^T \mu + \alpha_r p_{i,k} + \beta_r x_{i,k}}} \tag{2}$$

- The upper-nest choice probability:

$$\begin{aligned} \Pr(m) &= \frac{e^{w_i^T \delta_m + \lambda I_{i,m}}}{\sum_t e^{w_i^T \delta_t + \lambda I_{i,t}}} \\ \text{where } I_{i,t} &= log(\sum_{l \in L_t} e^{d_l^T \mu + \alpha p_{i,l} + \beta x_{i,l}}) \end{aligned}$$

The inclusive value $I_{i,t}$ measures the expected aggregate value of subset t and the coefficient λ reflects the dissimilarity of alternatives within a specific subset. To be consistent with value maximization, λ must lie within the unit interval. A value of 1 implies that the nest is redundant, whereas value 0 implies that the error terms within the given nest are perfectly correlated.

One implication of multinomial logit models is that the odds ratios between choices exhibit the so-called IIA property. It means that the ratio P_j/P_k for any given choices j and k is independent of the remaining probabilities. Nested-logit models partially relax this restrictive property by allowing flexible substitution patterns between choices *across* nests.

nesting parameter λ. Within the context of the nested-logit model, λ captures the degree to which error terms within the nest are more highly correlated than error terms across the nests. As mentioned in the previous section, there is a logical link through this nesting parameter λ between the two hypotheses examined in the related empirical literature—the "Certification Effect" and "Conflict of Interest" views—and my model here. There are two separate theories that explain how underwriting services performed by commercial banks may be different from underwriting performed by investment banks. If the issuers' valuations of services differ systematically between commercial banks and investment banks, then the presence of *either one or both* of these effects posited in the theories cause λ to tend toward zero. If, on the other hand, implications of neither of these theories are significant enough, then we fail to reject the hypothesis that λ is 1.

4.3 Hypothesis Testing

4.3.1 Basic Model

By applying the empirical specification of the basic demand model to both the Japanese and the U.S. data and comparing their results, I am addressing the following research questions as put forward in Section 1:

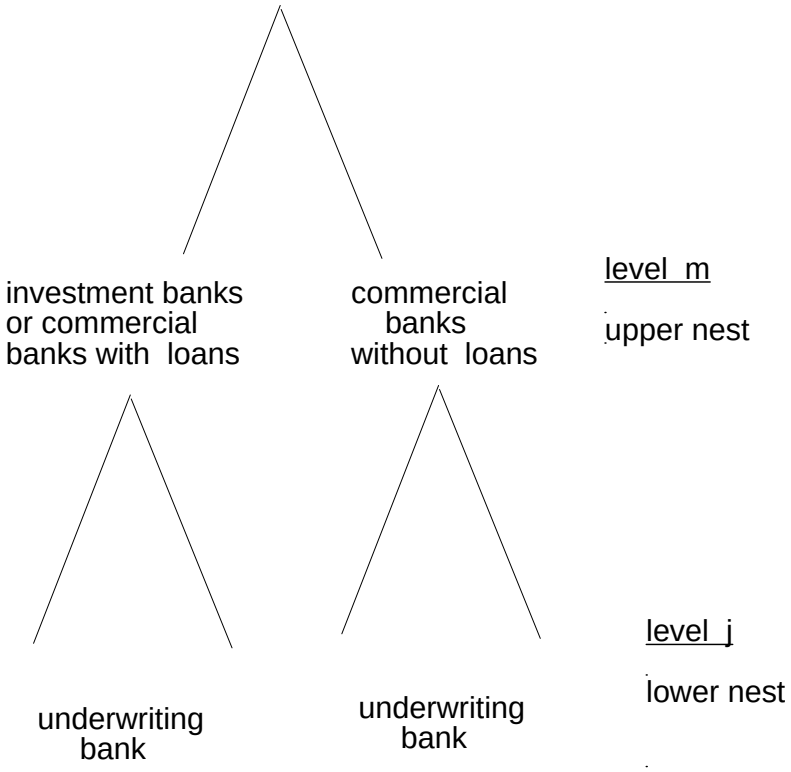
(1a) Do issuing firms value the ability of underwriting banks to certify the issuers for investors? This is captured by the sign of coefficient β in Equation 2.
(1b) Is the certification effect greater in Japan than in the U.S.? This is measured by comparing the value of $\frac{\beta}{\alpha}$ in the two countries.
(2) Does this trade-off vary across the reputation characteristics of the issuing firms in Japan, as it does in the U.S.? This hypothesis is tested by interacting the demand function with the reputation characteristics of the issuers, thus allowing the valuations of relationships and price to vary across these characteristics.

4.3.2 Modified Model

Here I modify the nest structure so that a commercial bank with a banking relationship is moved to the investment bank nest (see Figure 3). This modification corresponds to the last research question, which is:
(3) Do the stylized institutional differences between the Japanese Main Bank system and the less systematically organized U.S. banking system affect the bank competition in the bond markets differently? If so, how?

The rationale for having this "new" nest structure is as follows:
Consider the following scenario—the issuing firm, once having chosen not to hire the commercial bank with which it has a previous banking relationship (for whatever reason), needs to decide between choosing an investment bank and choosing another commercial bank with which it has not had a previous relationship. To the extent that hiring a commercial bank with no previous relationships as underwriter is perceived as betraying the existing bank relationship, a firm which seeks to preserve the value of existing bank relationships prefers an investment bank to a rival

Figure 3: Modified Choice Set



commercial bank. The theoretical, comparative analysis of the Japanese Main Bank System vs. the more arm's-length, U.S. banking system predicts that Japanese firms are more averse to such betrayals than U.S. firms. Further suppose that because of symmetry in the Main Bank system, there is a common betrayal cost associated with choosing any other commercial bank with which it had no relationships. Within the context of the nested-logit model, λ captures the degree to which error terms within the nest are more highly correlated than error terms across the nests. Moving the bank with relationships to the investment bank nest would therefore lower λ in the case of Japan, but not in the case of the U.S. Given this reasoning, we can empirically test this hypothesis with $H_o : \lambda^{Japan}_{modified} < \lambda^{Japan}_{basic}$ and $H_o : \lambda^{U.S.}_{modified} \simeq \lambda^{U.S.}_{basic}$.

4.4 The Estimation Method

A data issue arises in studying this market because prices vary across both issuers and banks, but only one price per issue, that is, the price offered by the bank which is hired to underwrite the bond, is observed. So not only are there missing price data, but there is also a selection-driven endogeneity in the observed price data. Let c_i represent the index of the bank chosen by firm i. Since price enters the value function of the issuing firm negatively, the fact that a given bank was chosen over other banks in the choice set implies that these observed prices, $(p_{i,j}; j = c_i)$, are on average lower than the unconditional distribution of $p_{i,j}$. As a result, if we impute unobserved prices by obtaining estimates of γ from Equation 1 using observed prices as dependent variables, we will be systematically underestimating unobserved prices and biasing the price coefficient α toward zero, or even positive.

To address this selection issue, I estimate the parameters of the lower nest of the underwriter choice model using an EM algorithm framework [42]. The main idea is to estimate price estimates γ, σ and demand estimates α, β, μ jointly in an iterative algorithm where price imputation is done conditional on the information on $c_i, i = 1..N$. The main appeal of using this framework for my data problem is that it provides an iterative procedure where, if not for the systematic absence of some data, the Maximum Likelihood estimation is straightforward. The demand estimates obtained from this estimation method are then used to estimate the upper level of the nested-logit

[42](Dempster, Laird, and Rubin 1977), (McLachlan and Krishnan 1997).

model. Details of this method are found in Appendix.

5 The Data

5.1 Data Sources

I construct the dataset using two data sources. One is the Japan Domestic New Issues Database by Thomson Financial Securities Data which compiles new issues information from company filings, press releases, and news sources. The other is the JDB Database compiled by the former Japan Development Bank, which is a comprehensive database of financial statements information for listed companies in Japan [43] A full list of variables used in the estimation is provided in the Appendix.

5.2 Data Selection

I choose the sample period to be from January 1, 1994 to March 15, 1999—for roughly 5 1/4 years. The criteria I used are as follows. First, the sample should begin after July 1993, when the first commercial bank subsidiary started operations. Second, the economic and regulatory environment surrounding the underwriters and issuers should also remain relatively stable. The decision to omit data after March 1999 is primarily due to the closure in June 1999 of Yamaichi Securities, one of the four incumbent investment houses in the underwriting market. It is not possible to omit *all* mergers and acquisitions activities involving underwriters from any reasonably long sample period. Following the financial deregulation, there have been a number of mergers and acquisitions between major players. Notably, in October 1998 the Long-Term Credit Bank of Japan, the parent bank of the LTCB Securities, Co., Ltd., was placed under temporary nationalization due to its financial condition, and subsequently reorganized as Shinsei Bank in June 2000.

I exclude financial firms and regulated industries from my study. I also concentrate on the top fifteen underwriters[44] of non-convertible corporate debt. For my sample, 11 of the 15

[43] The data is collected from regulatory filings and include all companies (except for those in financial and insurance industry) currently listed on the Tokyo, Osaka and Nagoya Stock Exchanges (both 1st and 2nd Section) as well as OTC(over-the-counter) companies.

[44] The rankings are based on the monetary value of underwritings and full credit is given to the book-runner(s).

underwriters are subsidiaries of bank holding companies. Using the above criteria results in a sample of 1,308 non-convertible, fixed-rate corporate bond issues.

5.3 Variables in the Demand Equation

5.3.1 The Price Variable

The price variable (PRICE) used in the estimation is a gross spread expressed as a percentage of the size of the bond [45]. The gross spread is the fee that underwriters receive, or the difference between the price at which securities are sold to investors and the price paid by the underwriters to the issuing firm. A typical public bond offering consists of multiple underwriters forming a selling syndicate. As shown in Figure 4, one underwriter serves as the book-runner (or the lead-manager) who organizes and managers the deal. I identified the book-runner (or the lead-manager) as the underwriter of a given issue.[46] Given the syndicate and fee structure as illustrated below and shown in Figure 4, this seems to be a reasonable assumption. This rule is also consistent with the perception of practitioners who advertise their bank's market position in terms of "book-runner ranking".

5.3.2 The Loan Variable

I construct dummy variables LOAN1-LOAN15 using balance sheet data from the JDB database. These variables capture the presence of *significant*, pre-existing loan relationships between a given firm and individual commercial banks that were established prior to the entry of the banks into the underwriting market. I treat these relationships as predetermined and exogenous to the transactions in the underwriting market.

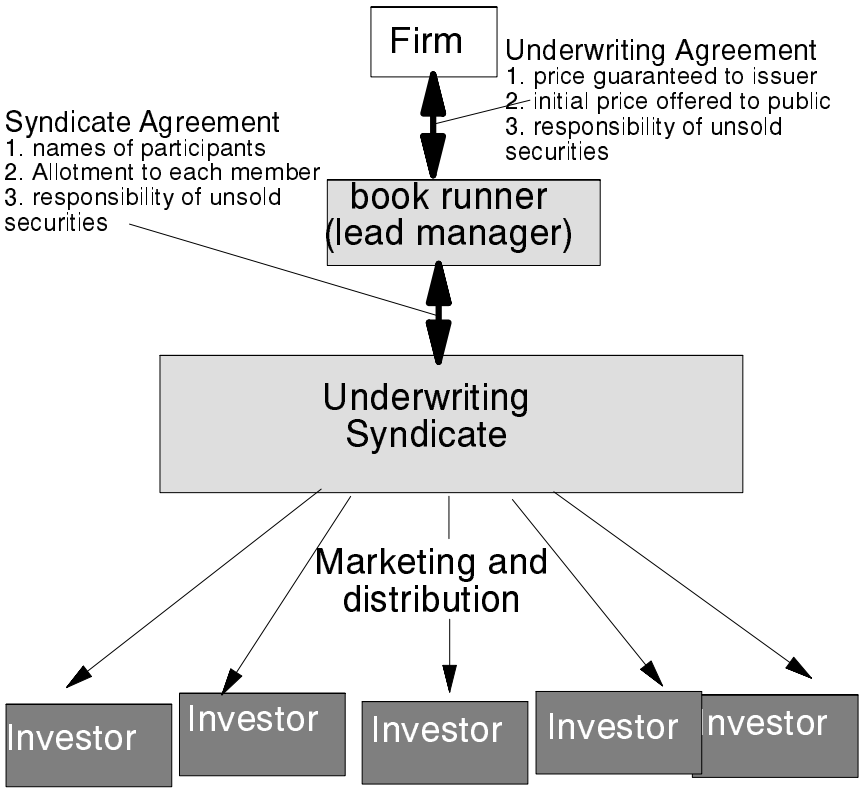
On any given year's balance sheet, a company typically has loans from more than one bank. [47] Since these loans vary in relative sizes as well as in consistency of presence over the years,

[45] The unit is in 10 basis points.

[46] In a small number of cases where there were two co-book-runners, each was counted separately as if they underwrote separate issues.

[47] (Ongena and Smith 1998) reports that multiple-bank relationships are commonly found across a number of countries and data samples.

Figure 4: Underwriting Mechanism



it is misleading to count all of these banks as having equally important banking relationships with the firm. The literature suggests that firms carefully maintain rankings among these banks for various economic reasons, such as to assure provision of credit liquidity from their top bankers when needed, or to limit sharing of private information about the firm among only the top few banks. Based on this knowledge about multiple bank relationships, we assess that only these top banker relationships have any economic effect on the firm's underwriter choice problem. Thus in order to measure only these "top banker" relationships, I count the top lender in a given year and discard the rest (see Appendix A for the exact variable definitions). [48]

5.4 Variables in the Price Equation

As discussed in Section 1, underwriting fees are determined in part by various costs, including distribution costs, the expected cost of taking market and reputation risks, and information production costs. I estimate my model using various specifications for the price equations. The basic variables that I include are a constant term, AAA (a dummy variable for a AAA credit rating category), and some maturity variables.

Being in the higher credit rating category means issuers have more financial strength and in general are of higher reputation than those in the lower credit rating category. This decreases the risk-related cost for the underwriter. It might also mean that it is less costly to distribute these bonds because the company is better well-known and investors need to be marketed less intensively (which also feeds back to create potentially smaller market risk). For similar reasons, investors require lower yields for higher credit rating bonds.

In general, underwriters also demand higher underwriting fees for longer maturity bonds. This makes sense to the extent that a normal yield curve is also upward sloping; in addition, the secondary market for 30-year corporate bonds is much less liquid than for 30-year government bonds. This is measured by including some stratified dummy variables for maturity.

I also include a variable that represents the previous issue experience of firms in the bond market. From the underwriter's point of view, more experienced or frequent issuers are easier to

[48] Multiple "top" relationships are still possible with this method, since if bank A is the top lender in year t, and bank B is the top lender in year t+1, both will be counted. I also ran the estimation using alternative definitions of loan relationships, and find that our results are robust to specification changes. See Section 8 for details.

market than first-time or infrequent issuers. They are also less likely to lead to failed transactions because the track record of previous issues gives a reputation to the name of the issuer. Thus the price is expected to be decreasing in this variable.

5.5 Descriptive Statistics of the Sample

The tables presented here give descriptive statistics for the sample used in the estimation. In all of these tables, the first two columns segment the data according to whether the underwriter was a commercial bank or an investment bank.

In Table 2 the sample is tabulated by issue size, maturity, and credit rating. Several observations can be made. First, bank-underwritten issues are relatively small compared to investment bank-underwritten issues. Their maturity also tends to be slightly shorter, but no better or worse in terms of credit ratings. There are a few plausible reasons for this. For example, if a smaller, younger firm is more likely to choose the commercial bank with which it had built close ties, the issue size might be proxying for characteristics of that firm. Or if commercial banks have a smaller distribution capability relative to investment banks, the issue size might then be reflecting the supply-side constraint. The commercial bank issues are also smaller than the investment bank issues in the U.S. sample studied in (Yasuda 2001b).

In Table 3, the sample is tabulated first by previous issue experience and then by the issuer's industry code. The portion of first-time issuers (of domestic bonds) is actually lower among commercial bank issues (10%) than among investment bank counterparts (18%). This is in contrast to the U.S. bond market sample studied in (Yasuda 2001b), where first-time issuers were more likely among commercial bank issues. This finding is interesting because it goes against the characterization of commercial bank clients as smaller, younger firms with no or little previous issue experience, which are the case in the U.S. market. Rather, in the Japanese market, commercial banks have cultivated relationships with these firms under the tightly regulated bank-based financing system in the 1950's-70's. Among these firms, many of the blue-chip companies entered the bond market in the 1980's as a result of the issuer-side deregulation measures, but at that time commercial banks were still not allowed to underwrite bonds. [49]

[49] See Section 3 for the timing of various deregulation measures.

Table 2: Sample Summary Statistics

Segment	Bank issues			Investment bank issues			All issues		
	no.	no.(%)	volume (Y bn.)	no.	no.(%)	volume (Y bn.)	no.	no.(%)	volume (Y bn.)
Issue size(Y bn.)									
<=7.5	224	31%	1,055.5	121	21%	552.7	345	26%	1,608.2
7.5< <=15	362	50%	3,807.5	263	45%	2,784.5	625	48%	6,592.0
<15	132	18%	3,906.0	206	35%	6,200.0	338	26%	10,106.0
total	718	100%	8,769.0	590	100%	9,537.2	1,308	100%	18,306.2
Maturity(yr.)									
<=5	362	50%	3,850.0	274	46%	4,085.8	636	49%	7,935.8
5<	356	50%	4,919.0	316	54%	5,451.4	672	51%	10,370.4
total	718	100%	8,769.0	590	100%	9,537.2	1,308	100%	18,306.2
Credit Rating									
AAA	17	2%	227.0	24	4%	746.3	41	3%	973.3
AA	294	41%	4,664.0	221	37%	4,778.9	515	39%	9,442.9
A	375	52%	3,630.0	300	51%	3,478.0	675	52%	7,108.0
Below A	32	4%	248.0	45	8%	534.0	77	6%	782.0
total	718	100%	8,769.0	590	100%	9,537.2	1,308	100%	18,306.2

NOTE:
1$ = 117 yen as of 03/01/01. This makes 1 billion yen approximately equal to $8.5 million.

Table 3: Sample Tabulation by Previous Issue Experience

	Bank issues				Investment bank issues				All issues			
Issuer	no.	no. (%)	volume(Y bn.)	volume(%)	no.	no. (%)	volume(Y bn.)	volume(%)	no.	no. (%)	volume(Y bn.)	volume(%)
First-time	85	12%	862.0	10%	112	19%	1,697.3	18%	197	15%	2,559.3	14%
Seasoned	633	88%	7,907.0	90%	478	81%	7,839.9	82%	1111	85%	15,746.9	86%
Total	718	100%	8,769.0	100%	590	100%	9,537.2	100%	1308	100%	18,306.2	100%

Meanwhile, because sub-investment grade bonds have not been allowed in Japan until very recently (see Section 3.2.2), the Japanese commercial banks have not been able to take advantage of their bank relationships with those firms. These two features of the deregulation process combined might have diminished the value of relationship capital for commercial bank entrants in the bond underwriting market. Also, like in the U.S. sample, there is no meaningful differences between commercial bank and investment bank subsamples in terms of the distribution of issuers across different industries (Table 4).

Table 5 compares Japan and the U.S. in terms of prevalence of previous banking relationships between issuing firms and commercial bank (entrant) underwriters. The average number of banking relationships per issuing firm is 0.3 in the U.S. and 1.6 in Japan, but this difference is somewhat misleading because banking relationships are 4 times more likely to exist between the Japanese issuers and commercial bank underwriters in the sample than their U.S. counterparts. The average number of relationships per issuing firm when there is at least one such relationship is 1.4 in the U.S. and 1.8 in Japan. So the first major differences between the two countries observed in the data is that banking relationships between firms and entrant commercial banks are more pervasive in Japan, even among firms established enough to issue straight public debt. [50]

In Table 6, I report sample statistics of the two data that hint at another important difference in the nature of bank competition between the two countries. The first row compares the collective market shares of incumbent investment bank underwriters in the U.S. and Japan. The larger U.S. share does not imply a higher per bank market share, because there are 11 investment bank underwriters in the U.S. where there are only 4 in Japan. The fourth row reports the probability that an investment bank is chosen, conditional on the number of previous banking relationships being zero. In both countries, the choice probability for investment bank underwriters is unchanged in the absence of bank relationships.

The fifth row reports another conditional probability, namely the probability that an investment bank is chosen when (A) the number of banking relationships is at least 1, and (B) the banks with previous banking relationships are not chosen. This conditional probability crudely

[50] One historical reason for this difference might be the prohibition of interstate banking and the resulting regional fragmentation of commercial banks in the U.S. The U.S. is the only country among developed countries to have imposed interstate banking in recent history.

Table 4: Sample Tabulation by Industry Codes

Issuer's	Bank issues				Investment bank issues				All issues			
industry code	no.	no.(%)	volume(Ybn.)	volume(%)	no.	no.(%)	volume(Ybn.)	volume(%)	no.	no.(%)	volume(Ybn.)	volume(%)
nat. resource	12	2%	88.0	1%	8	1%	62.0	1%	20	2%	150.0	1%
construction	24	3%	289.0	3%	25	4%	323.0	3%	49	4%	612.0	3%
manufacturing	502	70%	6512.5	74%	431	73%	7078.9	74%	933	71%	13591.4	74%
wholesale	88	12%	1097.5	13%	58	10%	1297.0	14%	146	11%	2394.5	13%
retail	42	6%	335.0	4%	36	6%	524.0	5%	78	6%	859.0	5%
restaur./hotel	5	1%	46.0	1%	5	1%	41.0	0%	10	1%	87.0	0%
pers/bus/rep	20	3%	122.0	1%	10	2%	138.0	1%	30	2%	260.0	1%
leisure	1	0%	100.0	1%	0	0%	0.0	0%	1	0%	100.0	1%
unknown	24	3%	179.0	2%	17	3%	73.3	1%	41	3%	252.3	1%
total	718	100%	8769.0	100%	590	100%	9537.2	100%	1308	100%	18306.2	100%

Note: nat. resource = natural resources, restaur. = restaurants, pers/bus/rep = personnel, business and reprensentative service.

Table 5: Prevalence of Previous Banking Relationships with Commercial Bank Underwriters

	U.S.	Japan
At least 1 loan	21%	88%
Number of Commercial Banks	5	11
Number of Investment Banks	11	4
Average Number of loans	0.3	1.6
Average Number of loans when at least 1 loan	1.4	1.8

Table 6: Presence of Banking Relationships and Its Effect on Competition among Banks

	U.S.	Japan
Investment Bank is chosen (A)	86%	45%
Number of Commercial Banks	5	11
Number of Investment Banks (B)	11	4
(A)/(B) Market share per investment bank	8%	11%
I-bank is chosen when issuer has no loan	86%	46%
I-bank is chosen when: (I) issuer has at least 1 loan and (ii) issuer does not choose bank with loan	93%	80%

captures the effect of "betrayal" cost as discussed in Section 4.3.2. According to the theory, one expects this probability to be weakly larger than the unconditional probability reported in the first row, to the extent that choosing another commercial bank with which it had no previous relationships affects the value of existing relationships negatively. [51]

As shown in the fifth row of Table 6, this holds true in the data for both countries, but far more so for Japan than for the U.S. This descriptive observation is consistent with the hypothesis (3) that Japanese firms are more constrained by the betrayal cost of existing banking relationships than the U.S. counterparts.

6 Estimation Results

The estimation results of the base model are presented in Table 7. The base model is the one in which valuations of price and relationship variables are not allowed to interact with the issuer's reputation characteristics.

The price coefficient α is negative and significant, whereas the relationship coefficient β is positive and significant. Thus both price and prior loan relationships are significant determinants of demand in the underwriting market. λ, the dissimilarity coefficient of the nested-logit model, is 0.3142, which is significantly different from one at the 5% significance level. $\lambda \neq 1$ implies that the nesting as specified in Figure 2 is not redundant. Besides the inclusive value variables, I also include issuer and bond characteristics in the upper nest. Since these are chooser-specific variables, parameters are estimated separately for each choice. However, the coefficients for one choice (in

[51] See (Petersen and Rajan 1994) and (Petersen and Rajan 1995) for both empirical and theoretical studies on a closely related topic. The logic is as follows: (Petersen and Rajan 1994) shows empirically that a firm's attempts to widen the circle of relationships by borrowing from multiple leaders increases the price and reduces the availability of bank credit. The firms examined in (Petersen and Rajan 1994) are on average smaller and younger than corporate bond issuers studied in this paper and they rely strictly on bank loans as the source of external finance. Often, as in the case of firms examined in this paper, firms are neither strictly loan-financed nor strictly bond-financed, but are somewhere in the middle. For such firms, the banker choice problem becomes more complex, as they optimally want to maintain good relationships with both their lenders *and* with their investment banks (or whoever provide capital market-related services). This point is explored further in (Yasuda 2001a).

Table 7: Estimation Results (1): Basic Model

Demand estimates

Variable names	**PRICE**	**LOAN**
Variables	a	b
Estimates	**-0.5455**	**2.7994**
Standard errors	(0.1844)	(0.0849)

Variable names	Inclusive Value	Less than 30 Issues	AMOUNT
Variables	λ	δ1	δ2
Estimates	0.3142	0.4613	-0.0256
Standard errors	(0.1175)	(0.0892)	(0.0053)

Price estimates

Variable names	MATURITY >=10	MATURITY > =20	AAA RATING	FIRST TIME	LOAN
investment banks					
Bank1	1.2250	1.6426	-0.7315	-0.0105 *	
Bank2	0.5217	1.4935	-0.6353	-0.0722	
Bank3	0.6201	1.6410	-0.5094	0.0906	
Bank4	0.5561	1.6170	0.0609	-0.0228	
commercial banks					
Bank5	0.5816	1.5227	-0.0493 *	0.4757	0.1344
Bank6	0.6876	1.4513	-0.0757	-0.0332	-0.1657
Bank7	0.6400	1.3499	-0.0034 *	-0.2208	0.0779
Bank8	0.6581	1.7969	-0.3438	0.1538	0.1743
Bank9	0.6198	1.5966	-0.2926	-0.0031 *	-0.1290
Bank10	0.6003	1.6712	-0.5050	0.1284	-0.0208
Bank11	0.6252	1.5403	0.1149	-0.0684	0.0029 *
Bank12	0.6607	1.3732	0.1624	0.0853	-0.1514
Bank13	0.7139	1.6166	-0.0810	-0.0523	-0.1145
Bank14	0.6380	1.4319	-0.1371	0.0638	-0.0488
Bank15	0.6469	1.4722	-0.0408	0.0138	-0.1031

this case investment banks) are normalized to zero, so the reported coefficients are for the choice of commercial banks.

The estimates of equations determining prices, γ, are reported for each bank. Commercial banks and investment banks are listed separately, and within each category the banks are listed in the order of their market shares in the sample. Bank1 is therefore the top-ranking investment bank underwriter and is the top-ranking bank overall, whereas Bank5 is the top-ranking commercial bank underwriter . Coefficients for the maturity and AAA credit rating variables are all positive, whereas those for the past issue experience variables are mostly negative. These findings are consistent with the analysis of price determination in Section 4.2 and with the discussions of variables entering pricing equations in Section 5. Of these four reputation characteristics of issuers/bonds, the coefficients for maturity variables are much larger in absolute values than others.

Table 8 reports the estimation results of one of the interacted models where price and relationship coefficients are allowed to vary across the reputation characteristics of issuers, namely, credit rating. The criterion I use is whether the issuer's credit rating is AAA or not at the time of the issuance. See Appendix for construction of this credit rating variable. Being in the AAA category means issuers have more financial strength and in general higher reputation than those in the lower rating category. The price coefficient α_1 for AAA (i.e. "high quality") issuers is sharply more negative at -1.938, whereas the price coefficient for non-AAA issuers ("low quality") is negative but a lot smaller in magnitude at -0.240. The loan coefficients β_r are both positive as predicted, and smaller for AAA issuers than for non-AAA issuers, which is also consistent with the prediction.

The dissimilarity coefficient λ is again not significantly different from zero. $\delta 1$ is positive, indicating that first-time issuers are more likely to choose a commercial bank than seasoned issuers. $\delta 2$ is negative. If the issue amount is proxying for the size of the firm, this suggests that smaller firms are more likely to choose a commercial bank underwriter than larger firms. The price estimates presented in Table 8 are qualitatively similar to those in the base model in Table 7.

In Table 9, I report the estimation results of another interaction model, where the trade-off between price and relationship in the demand equation is allowed to vary along newness of the issuers in the corporate bond market. Investors are less likely to be familiar with or even recognize the name of first-time issuers in the market, so these firms are worse off than seasoned issuers

Table 8: Estimation Results (2): AAA vs. non-AAA

Demand estimates

Reputation category	AAA issuers		Non-AAA issuers	
Variable names	**PRICE**	**LOAN**	**PRICE**	**LOAN**
Variables	a1	b1	a2	b2
Estimates	**-1.9376**	**2.4739**	**-0.2401**	**2.806**
Standard errors	(0.6532)	(0.5312)	(0.1755)	(0.0851)

	Inclusive	Less than	
Variable names	Value	30 Issues	AMOUNT
Variables	λ	δ1	δ2
Estimates	0.3158	0.4595	-0.0255
Standard errors	(0.1133)	(0.0892)	(0.0053)

Price estimates

Variable names	MATURITY >=10	MATURITY > =20	AAA RATING	FIRST TIME	LOAN
investment banks					
Bank1	1.2237	1.6310	-0.7043	-0.0062 *	
Bank2	0.5191	1.4977	-0.5339	-0.0694	
Bank3	0.6209	1.6672	-0.4895	0.0880	
Bank4	0.5563	1.6371	0.0901	-0.0224	
commercial banks					
Bank5	0.5809	1.5273	-0.0289 *	0.4773	0.1304
Bank6	0.6885	1.4540	-0.0626	-0.0353	-0.1794
Bank7	0.6341	1.3551	0.0282	-0.2460	0.0942
Bank8	0.6561	1.8099	-0.3268	0.1478	0.1798
Bank9	0.6200	1.6017	-0.2845	-0.0044 *	-0.1302
Bank10	0.6003	1.6888	-0.4816	0.1303	-0.0221
Bank11	0.6225	1.5660	0.1325	-0.0730	0.0104
Bank12	0.6612	1.3720	0.1814	0.0875	-0.1571
Bank13	0.7131	1.6229	-0.0724	-0.0529	-0.1142
Bank14	0.6252	1.4465	-0.1178	0.0679	-0.0554
Bank15	0.6465	1.4775	-0.0259	0.0129	-0.1075

in terms of their market reputation. Seasoned issuers, on the other hand, have a track record of issuing public debt, which contributes positively to their reputation. The price coefficient α_1 for non-first-time (i.e. "high reputation") issuers is negative at -1.527, whereas the price coefficient α_2 for first-time issuers ("low reputation") is negative at -0.038. The loan coefficients β_1 and β_2 are both positive as predicted, though essentially equal in size.

The size of the dissimilarity coefficient λ is close to zero, as in the two previous specifications. Price estimates are also qualitatively similar to the other specifications.

The results of the modified model are reported in Table 10 and Table 11. In Table 10, the first row reports the upper-nest estimates for the Japan sample with the sample specification as in Table 7–9. The dissimilarity coefficient λ is much lower than λ in the base model reported in Table 7. The sign of the next variable, δ_1, for previous issue experience is negative. [52]

The same specification is estimated for the U.S. data and is reported in Table 11. Unlike the case of Japan, the U.S. estimate for the dissimilarity coefficient is high and is not significantly changed from that in the original specification (reported in Table 4 of (Yasuda 2001b)).

7 The Economic Implications of Estimation Results

The demand estimates presented in Table 7–9 are consistent with the predictions of the model. Both relationships and price are significant determinants of underwriter demand in the market. The trade-off between relationships and price indicates that issuers are willing to pay higher price for underwriting services from banks with pre-existing relationships. The trade-off is quantified by the ratio of the two coefficients, $\frac{\beta}{\alpha}$.

In the base model reported in Table 7, this ratio is -5.312. Since the unit price is 10 basis points (a tenth of a percent) and the relationship is an indicator variable, this ratio has a unit of 0.513%. In terms of the underlying demand model, a bank with a relationship can charge a premium of up to 0.805% before an issuer prefers a bank without a relationship (holding all else constant). Evaluated at the sample mean issue size of about yen 14 billion, or approximately $130 million, this translates to about $0.67 million in dollar value. Since the level of the underwriting

[52] Coefficients δ_1 and δ_2 for investment banks are normalized to zero, and what are reported here and in other tables refer to commercial bank underwriters.

Table 9: Estimation Results (3): First-time vs. Seasoned

Demand estimates

Reputation category	Non-first-time issuers		First-time issuers	
Variable names	**PRICE**	**LOAN**	**PRICE**	**LOAN**
Variables	a1	b1	a2	b2
Estimates	**-1.5269**	**2.7887**	**-0.0377**	**2.7532**
Standard errors	(0.2378)	(0.0880)	(0.1974)	(0.1839)

	Inclusive	Less than	
Variable names	Value	30 Issues	AMOUNT
Variables	λ	δ1	δ2
Estimates	0.3485	0.4537	-0.0258
Standard errors	(0.1159)	(0.0894)	(0.0053)

Price estimates

Variable names	MATURITY >=10	MATURITY > =20	AAA RATING	FIRST TIME	LOAN
investment banks					
Bank1	1.2194	1.6472	-0.7381	-0.0256 *	
Bank2	0.5221	1.4832	-0.6354	-0.0927	
Bank3	0.6247	1.6778	-0.5024	0.0677	
Bank4	0.5562	1.6487	0.0572	-0.0533	
commercial banks					
Bank5	0.5870	1.5095	-0.0321 *	0.4586	0.1472
Bank6	0.6885	1.4637	-0.0722	-0.0504	-0.1501
Bank7	0.6340	1.3569	0.0168	-0.2549	0.0994
Bank8	0.6567	1.8179	-0.3261	0.1364	0.1862
Bank9	0.6194	1.6031	-0.2964	-0.0160	-0.1205
Bank10	0.6021	1.7247	-0.5014	0.1182	-0.0142
Bank11	0.6246	1.5644	0.1235	-0.0852	0.0161
Bank12	0.6583	1.3744	0.1733	0.0768	-0.1483
Bank13	0.7127	1.6233	-0.0799	-0.0640	-0.1044
Bank14	0.6263	1.4317	-0.1294	0.0584	-0.0511
Bank15	0.6444	1.4788	-0.0324	0.0008 *	-0.0771

Table 10: Effect of (Presence of) Loan on Substitutability Among Banks in Japan

	Inclusive	Less than	
Variable names	Value	30 Issues	AMOUNT
Variables	λ	$\delta 1$	$\delta 2$
Estimates	-0.4985	-0.2975	-0.0264
Standard errors	(0.1137)	(0.1845)	(0.0051)

	Inclusive		
Variable names	Value	AMOUNT	
Variables	λ	$\delta 2$	
Estimates	-0.3359	-0.0263	
Standard errors	(0.0516)	(0.0051)	

Table 11: Effect of (Presence of) Loan on Substitutability Among Banks in the U.S.

Variable names	Inclusive Value	FIRST TIME	AMOUNT
Variables	λ	$\delta 1$	$\delta 2$
Estimates	0.8275	0.2991	-0.6087
Standard errors	(0.1277)	(0.1446)	(0.0843)

Variable names	Inclusive Value	AMOUNT
Variables	λ	$\delta 2$
Estimates	0.7235	-0.5920
Standard errors	(0.1156)	(0.0827)

fee paid by the issuers in the sample ranges anywhere from several hundred thousand to several million dollars, the value of a relationships implied by the results is quite substantial, and at the same time reasonable.

In Table 8 where this trade-off is allowed to differ between AAA-issuers and non-AAA issuers, the ratios $\frac{\beta}{\alpha}$ are 1.277 and 11.687 for high- and low-quality issuers, respectively. Evaluated again at the mean issue size of \$130 million, the valuation of pre-existing relationships for two classes of issuers are approximately \$170,000 and \$1.52 million, respectively. The 0.128% for high-quality issuers is roughly $\frac{1}{3}$ - $\frac{1}{2}$ of the underwriting fee in that category, whereas 1.169% is on the high end of the range of underwriting fees paid by non-AAA issuers. The large difference in the values of $\frac{\beta_r}{\alpha_r}$ confirms the prediction that there is an inverse relationship between the reputation of issuing firms and their valuation of the ability of underwriting banks to certify them for investors.

Similar implications are obtained from results reported in Table 9, with the ratios $\frac{\beta}{\alpha}$ being 1.826 and 73.029 for non-first-time and first-time issuers, respectively. Evaluated at the mean issue size of \$130 million, the valuation of pre-existing relationships for these two classes of issuers are approximately \$240,000 and \$9.5 million, respectively. However, the price estimate for first-time issuers is not significantly different from zero at 5% significance level, so this ratio does not have the significance level of the other estimates.

In light of the comparative aim of this paper, it is interesting to compare the result in the Japanese market to the estimates from the U.S. sample. Because sub-investment grade bonds comprise only about 5% of the Japanese market, the base model coefficients are roughly comparable to the U.S. estimates for non-junk bond issuers in (Yasuda 2001b)(Table 5) in terms of the reputation characteristics of the issuers.

The ratio $\frac{\beta}{\alpha}$ for the U.S. non-junk bond issuers is 0.501%, which is very similar to that of the Japanese issuers. Despite Japan's heavier reliance on bank-finance and the unique features of its Main Bank System, the valuations of banking relationships as revealed in the demand equations do not appear to vary much between the two countries.

One comparative feature of corporate organizations in the U.S. and Japan might partly be attributable for this result. In the U.S., the junk bond segment was a significant part of the overall market during the sample period. Many of these junk bond issuers are relative young, first-time bond issuers. Relationships with commercial banks may thus have alllowed these new and lower-

rated firms to initiate bond issues earlier than they otherwise could have. In comparison, most of bond issuers in Japan are large, established old corporations. These differences in the compositions of bond issuing firms reflect not only the earlier establishment of junk bond market in the U.S., but potentially also the higher rate of firm creation (as well as destruction) in the U.S. compared to Japan. What this implies is that there is a greater share of U.S. firms who are new to the market and thus can benefit from potential certification. Having lower rate of firm creation thus lowers the positive effect of previous relationships on underwriter demand on average in Japan.

The history of deregulation offers another, related explanation to this similarity result. That is, there might be a relevant difference in the stage of market deregulation between the two countries during their respective sample periods. In the U.S., there has been more new firm formation, and a greater number of new issuers into the market. Development of junk bond market in the 80's has been partly induced by this trend in new firm formation. In Japan, traditionally the focus of finance smooth funding of existing borrowers rather than creation of new firms. This has resulted in delayed development of bond market in general, and of junk bond segment in particular. Furthermore, deregulation of bond markets on the issuer side in the 80's shifted firms away from bank borrowing into bond finance(see Section 3.2 and 3.4), but underwriting by commercial banks was still prohibited by regulation. Thus the value of banking relationships went unexploited, and by the time commercial bank entry, many firms were already seasoned issuers. Thus the value of the relationship has eroded for much of the Japanese firms. What this difference between the two countries implies is that the relationship in Japan might have been more valuable had it not been for the mismatched timing of the bond market deregulation.[53]

In Table 10, the dissimilarity coefficient λ is much lower than λ in the base model reported in Table 7. The negative sign of the previous issue experience variable for commercial banks confirms the economic interpretation that less experienced issues' preference for commercial bank underwriters is directly linked to existence of previous relationships. Given this flip in the sign of the coefficient, I report in the second row another set of estimates when the variable for previous issue experience is excluded. The low dissimilarity coefficient λ implies that cross-elasticity is low across the nests and high within the nest.

[53]However, this does not rule out the possibility that restrictions on bond issuance were binding, i.e. Japanese firms had over-vested in relationships with commercial banks before restrictions were lifted.

The same specification is estimated for the U.S. data and is reported in Table 11. Unlike the case of Japan, the U.S. estimate for the dissimilarity coefficient is high and is not significantly changed from that in the original specification (reported in Table 4 of (Yasuda 2001b)). Thus the nesting is redundant and presence of loan does not affect the substitution patterns between underwriters. The sign of δ_1 for previous issue experience is positive, which is also unchanged from the base model. The second row results are qualitatively similar.

To re-iterate the international comparative results, I find that the valuation of bank relationship ($\frac{\beta}{\alpha}$) is not higher in Japan than in the U.S., while the "dissimilarity coefficient" (λ) is lower in the modified nest for Japan but not in the U.S. Neither the certification nor conflict of interest alone can explain both the similarity result (in $\frac{\beta}{\alpha}$) *and* the difference result (in λ). If there were conflict of interest alone, β for Japan would be negative, and this is inconsistent with the similarity result. And if there were smaller but positive certification effect alone, $\lambda_{modified}$ would not be lower in the modified nest for Japan, and this is inconsistent with the difference result. Something more is at work.

The difference in empirical results between the two countries can be interpreted as coming from their differences in the relative weights on one-shot versus long-term payoffs. The one-shot pay-off of choosing a particular underwriter (with potential certification or conflict of interest in the presence of relationships) seems to dominate the choice problem that the U.S. issuers face. In other words, the long-term value of relationships with other commercial banks does not appear to affect the choice of a particular commercial bank. Instead, the net certification effect (one-shot positive pay-off) alone explains the choice well. In Japan, on the other hand, the long-term values of relationships with commercial banks appear to have a more dominant effect on the firms' underwriter choice problem. Certification alone cannot explain why commercial banks without relationships are significantly worse off when there are other commercial banks with relationships than when they face no rival commercial banks with relationships. In fact, net certification need not be present to explain this negative cross-bank effect *and* the positive own-effect of relationships as long as preservation of long-term relationships value predominates the firm's choice problem. [54]

[54]This interpretation reconciles our results of underwriter choice model and (Hamao and Hoshi 1999), which analyzes yield differentials in the Japanese data following (Puri 1996) and (Gande, Puri, Saunders, and Walter 1997) and reports a conflict of interest (or discounting by investors) rather than a certification effect for commercial bank

The similarity result (in $\frac{\beta}{\alpha}$) can be due to one-shot payoff that is positive but sufficiently smaller in Japan than in the U.S., or actually negative one-shot payoff (conflict of interest), coupled with long-term positive payoff from not switching, resulting in the net level not higher than that of the U.S. This interpretation is consistent with the difference result (in λ), which is more cleanly indicative of presence of betrayal cost (from switching relationships among commercial banks) for Japanese firms and absence of such cost for American firms. Combined, the two results support existence of betrayal cost for Japanese firms, lack of such cost for American firms, while they also support lower (positive or negative) one-shot payoff for Japanese firms than for American firms of choosing a bank with a relationship. This is admittedly not the only possible interpretation, but an economically plausible one that draws from the two countries' differences in the history of banking and corporate financing institutions (as described in 2.1 and 3).

8 Extension

8.1 Lender Relationship Rankings

Since more comprehensive data on bank-firm relationships are available for the Japanese market than for the U.S. market, I also constructed alternative definitions of lender relationship variables that allowed measurement of rankings among lending banks for a given firm. Objectives of constructing such variables are twofold. First, running alternative specifications using these variables allow us to check the robustness of our main results for the Japanese data. Second, in the broader context of the existing literature on bank relationships, it is quite interesting to investigate whether the relationship between the rankings of banks and the values of their relationships is non-linear, as has been suggested.

8.1.1 The Loan Ratio Variable

The rankings I construct are based on firm-, bank-, and year- specific loan ratio variables. The loan ratio is defined as [bank j's loan to firm i] / [firm i's total bank loan] (multiplied by 100 to

underwriting.

express it in percentage). For each bank-firm pair, I took a 5-year average (from 1988 to 1992) of these loan ratios. [55] [56]

8.1.2 The Lender Relationship Ranking Variable

Using these loan ratio variables, I identify a top lender, second-largest lender, third-largest lender, and the rest of lenders with lower rankings than third, all among the 11 commercial bank underwriters. [57]

8.2 Sample Statistics

Table 12 shows summary statistics for the loan relationship ranking variables. The first column reports the total number of bank-firm relationships in which a given bank is a given firm's top lender, second lender, and so on. The second column shows the number of observations where a top lender was chosen as underwriter, a second lender, and so on. The third column shows the conditional choice probability at which a lender of a given rank is chosen. And the fourth and the

[55] Taking average of these 5 years means that, if loans were present in all 5 years, the average simply smoothes out annual fluctuations. If loans were present in only a subset of these years, then it lowers the average value, thus again measuring a somewhat weaker relationship. Taking average seems reasonable, because I did observe in the data some years where there were no loans by a given bank, which reappears again in subsequent years. Choosing 5 years is to some extent arbitrary of course, with a practical rationale being that most bank-specific data are available for these 5 years.

[56] Another decision I made was to use the sum of bank loans as the denominator, instead of using loan plus public market debt (bonds) as well. By taking a 5-year average, I am trying to measure the relative strength of relationships among banks for a given firm, rather than trying to construct a cardinal value that is comparable across different firms. In other words, my priori is that a ratio of 0.15 may indicate either a strong or a weak relationship depending on who else are also lending to that firm and what their relative importance is. With this reasoning, using only loan seems reasonable, as it is the simplest, and adding more to the denominator does not alter the rankings among banks. (There was no data on who underwrote which portion of bonds outstanding.)

[57] Wherever there is a tie, I count each and all of them as possessing that rank, and assign the next largest lender as having a rank right below them. So two banks with the top share of 0.20 each both get a Top lender position, the next bank with the share of 0.15 gets a Second lender position, and so on. Ties occur in about 5% of the sample for the Top 3 lenders. More details are shown in tables the next section.

final column reports the mean of the loan ratios for top lenders, second lenders, etc. As can be seen here, there is a strong non-linear relationship between the choice probability and the rankings as well as the loan ratios. That is, not only is the choice probability inversely related to the rankings, it is disproportionately high for top lenders even when their higher loan ratios are taken into account. Furthermore, this observation is in support of the use of dummy variables for presence of "top banker" relationships in the main model specification. [58]

8.3 Estimation Results and Interpretations

Given the sample statistics, which gave preliminary support to the view that a lender ranking identifies strength of relationships well, and may be a better comparable measure for strength of relationships across firms and across banks than loan ratios per se, I included 4 dummy variables for the 4 lender ranking categories, to separately estimate the value of pre-existing lending relationships in the underwriter demand model. The results are reported in Table 13. [59] I find that coefficients for all except the lower-ranked lender relationships are positive and significantly different from zero, with the top-lender relationship being the largest (3.2), second lenders the second largest (2.0), and third lenders the smallest (1.2). The coefficient for the lower-ranked relationships is not significantly different from zero. I find that the coefficient for the price variable is negative. The coefficient for the inclusive value variable is 0.24, while the coefficients for previous market exposure and issue amount have the predicted signs (and are the same as the previous model specification result).

The trade-offs between relationships and price, as expressed by $\frac{\beta}{\alpha}$, are 0.894% for top lender relationships, and 0.559% and 0.330% for second and third-lenders, respectively. Up to three top relationships affect the firm's underwriter choice positively, with varying degrees with predicted directions. Having lower-ranked relationships, however, do not have any significant effect on the firm's underwriter choice. This result is consistent with the certification effect of commercial bank underwriting. It is also in support of the view that firms carefully maintain a few key bank

[58] There can be multiple top relationships in the way I constructed the dummy loan variables. See Appendix A for details.

[59] I also tried different specifications, where Loan Ratio variables (both including the lower-ranked lenders and excluding them) were used instead of these lender ranking variables, and find that the results do not change across different specifications.

Table 12: Sample Statistics for Loan Relationship Rankings

(Number of Observations = 1308, Number of commercial banks = 11)

Lender Relationship Ranking	Total Number of Relationships	Number chosen as Underwriter	# Chosen / # of Relationships (%)	Mean Loan Ratio (%)
when bank j is a top lender	1158	388	33.5%	16.2%
when bank j is a second lender	1131	114	10.1%	8.4%
when bank j is a third lender	1018	45	4.4%	3.9%
when bank j is a lower-ranked lender	3034	30	1.0%	1.1%
when bank j is NOT a lender	8047	132	1.6%	0.0%

Table 13: Estimation Results (4): Modified Model

Demand estimates

Variables	Estimates	Std. err.	Est./s.e.	Prob.
Price	**-3.564**	1.851	-1.926	0.054
Top-Lender Relationship	**3.186**	0.108	29.609	0.000
Second-Lender Relationship	**1.991**	0.133	14.980	0.000
Third-Lender Relationship	**1.177**	0.177	6.657	0.000
Lower-ranked Relationship*	**-0.073**	0.189	-0.386	0.699
Inclusive Value	**0.236**	0.113	2.095	0.036
<20 Previous Issues	0.266	0.085	3.147	0.002
Issue Amount	-0.014	0.005	-3.070	0.002

Price estimates

Variables	MATURITY >=10	MATURITY > =20	AAA RATING	FIRST TIME	LOAN
investment banks					
Bank1	0.122	0.164	-0.072	-0.001 *	
Bank2	0.053	0.150	-0.070	-0.007	
Bank3	0.063	0.158	-0.050	0.008	
Bank4	0.058	0.157	0.005	-0.001	
commercial banks					
Bank5	0.058	0.153	-0.001 *	0.051	0.023
Bank6	0.070	0.147	-0.006	-0.002	-0.008
Bank7	0.067	0.133	-0.011	-0.007	0.000
Bank8	0.070	0.164	-0.054	0.017	-0.008
Bank9	0.067	0.160	-0.032	0.002	-0.013
Bank10	0.061	0.156	-0.050	0.010	0.002
Bank11	0.066	0.160	-0.010	-0.002	-0.007
Bank12	0.067	0.147	0.000 *	0.005	-0.010
Bank13	0.070	0.160	-0.012	-0.001 *	-0.013
Bank14	0.068	0.139	-0.007	0.004	-0.006
Bank15	0.066	0.144	-0.007	0.001	-0.010

* indicates t-value is smaller than a 5% significance level.

relationships to protect their long-term payoffs and that this practice persists in the new market when the scope of the existing relationships widen. Combined with the results reported in Table 10 and 11, I interpret these results to suggest that, while either or both of certification and preservation of long-term values can explain this result, in Japan the evidence of the latter is more evident than in the U.S.

9 Conclusion

This paper has examined the question of whether existing institutional differences in the banking systems affect bank competition in capital markets. Behind this question, there is also a broader inquiry on whether development of capital markets will lead to disappearance of the institutional differences and convergence of the systems toward a market-based, Anglo-American system. I investigate these questions by studying post-deregulation competition between entrant commercial banks and incumbent investment banks in the Japanese corporate bond underwriting market and comparing the results with the U.S. study reported in (Yasuda 2001b).

The comparisons were conducted based on the following two hypotheses. First, the banking literature often emphasizes differences between market-based financial systems of the U.S./U.K. and bank-based financial systems of Japan and Germany. The certification hypothesis predicts that a pre-existing banking relationship affects a firm's demand for underwriting service from a bank positively. The U.S.-Japan contrast suggests that the positive effect of bank relationships on underwriter demand is stronger in Japan than in the U.S.

Second, the Japanese main bank system is characterized by the multi-faceted, state-contingent nature of relationships and reciprocal delegation of monitoring among banks ((Aoki and Patrick 1994)). These institutional features in contrast to the American regime of arm's length banking predicts that Japanese firms are more constrained by the betrayal cost of switching from existing relationship(s) with their banks than American firms. In other words, existence of such a relationship lowers relative demand for underwriting service by rival commercial banks (but not investment banks).

A discrete choice model of underwriter demand and a model of issue-specific pricing by individual banks are jointly estimated. Like the U.S. results in (Yasuda 2001b), I find that a previous

loan relationship affects a firm's demand for a given bank's underwriting service positively. I also find that issuers with lower credit ratings value bank relationships more, which is qualitatively similar to the U.S. result.

I find that the valuation of bank relationship ($\frac{\beta}{\alpha}$) is not higher in Japan than in the U.S., while the "dissimilarity coefficient" (λ) is lower in the modified nest for Japan but not in the U.S. Neither the certification nor conflict of interest alone can explain both the similarity result (in $\frac{\beta}{\alpha}$) *and* the difference result (in λ). If there were conflict of interest alone, β for Japan would be negative, and this is inconsistent with the similarity result. And if there were smaller but positive certification effect alone, $\lambda_{modified}$ would not be lower in the modified nest for Japan, and this is inconsistent with the difference result. Something more is at work.

The similarity result (in $\frac{\beta}{\alpha}$) can be due to one-shot payoff that is positive but sufficiently smaller in Japan than in the U.S., or actually negative one-shot payoff (conflict of interest), coupled with long-term positive payoff from not switching, resulting in the net level not higher than that of the U.S. This interpretation is consistent with the difference result (in λ), which is more cleanly indicative of presence of betrayal cost (from switching relationships among commercial banks) for Japanese firms and absence of such cost for American firms. Combined, the two results support existence of betrayal cost for Japanese firms, lack of such cost for American firms, while they also support lower (positive or negative) one-shot payoff for Japanese firms than for American firms of choosing a bank with a relationship. This is admittedly not the only possible interpretation, but an economically plausible one that draws from the two countries' differences in the history of banking and corporate financing institutions.

According to this interpretation, the differences between the arm's length banking regime in the U.S. and the state-contingent, reciprocally supported banking regime in Japan [60] have resulted in the differences in the relative weights on one-shot versus long-term payoffs of having/keeping commercial bank relationships in the two countries. In the U.S. bond underwriting market, the one-time payoff of certification appears to be the first-order economic role of existing relationships, whereas in Japan, the long-term benefit of not switching (or cost of betrayal) appears to play an economic role of the same magnitude as the weaker-than-the U.S., and potentially negative, one-shot payoff of choosing a commercial bank with relationships. These differences in the

[60] See Figure 1 and Table 1 from (Aoki and Patrick 1994).

economic roles of relationships, as shaped by the differences in the history of banking and corporate financing institutions, appear to persist in bank competition in the deregulated market. [61]

Together, this paper and (Yasuda 2001b) provide a collection of new empirical findings and economic arguments about the nature of dynamic interactions between existing bank relationships and institutions, on one hand, and development of and competition in capital markets, on the other. [63] In (Yasuda 2001b), we show that pre-existing relationships enabled entrant commercial banks to compete with incumbent investment banks in the deregulated bond market in the U.S. This led to a greater competition increase in the segments of the market for newer and lower-rated issuers, because these issuers valued the certification benefit of relationships with commercial banks more. In this paper, we find that the differences in the economic nature of bank relationships across the two countries do persist in the ways they affect competition in the deregulated bond markets. The long-term nature of relationships in the Japanese banking system implies that once the banks and firms are committed to each other with sunk investments in the relationship, it is still ex-post optimal to stick to parts of the old relationships that are cheap and beneficial, even after the bond market is developed and incentives are no longer there to credibly commit to a new relationship.

These results, when weaved together, give rise to a conceptual query on the global convergence view. The results suggest that it is misleading to equate development of market in Japan with

[61] Furthermore, a firm's valuation of relationships with its investment banks is also a relevant determinant of competition in the markets. Though we did not have the data to measure such relationships to incorporate into our analysis here, it is plausible that, to the extent that commercial banking is arm's length in the U.S., investment banking is hands-*on* and that a large, publicly-traded U.S. firm's primary bank relationship(s) is with an investment bank. In contrast, in Japan, a large, publicly-traded firm's primary banking relationship(s) is with a commercial bank. [62] This difference in relative status of incumbents (investment banks) and entrants (commercial banks) also adds to explain why the betrayal cost of relationships with the entrant seems to be a significant determinant of underwriter choice for Japanese firms but not for American firms.

[63] While we did not study equity markets, it is well-documented that equity is an insignificant source of *net* external financing for firms across economies, even for the U.S. (Mayer 1988), (Mayer 1990), and (Rajan and Zingales 1995) report that across all developed countries, firms rely mostly on retained earnings, much less on external finance, and that within external finance, debt is the dominant form of capital. In fact, equity was a net *negative* source of financing for U.S. firms in the recent years because of the popular use of share buy-backs. From the corporate *financing* perspective, therefore, we can sensibly concentrate on debt markets.

disappearance of institutions in support of economic roles of existing relationships. Institutional arrangements that supported the main bank system do not automatically disappear when capital markets develop, because they support the economic roles of relationships to which both firms and bank have already invested in. Lack of those arrangements prevents this type of long-term relationships from ever forming between U.S. firms and U.S. banks, [64] but this does not imply that when Japanese firms shift weight to bond finance away from loan finance, it is ex post optimal for both firms and banks to abandon those relationships wholesale. It may be too costly to "build" such a relationship in the post-deregulation environment but not too costly to "maintain" one. [65] So it may be economically optimal for them to preserve the value of pre-existing relationships where it is credibly cheap to do so (as not betraying the main bank in the bond underwriting market vis-a-vis other *entrant commercial banks* was). [66] [67] Consequently, the deregulatory measures aimed toward universal banking and equally implemented in the U.S. and Japan have had (and continue to have) path-dependent and non-convergent impacts on their financial systems.

Similarly, it can be deceptive to assume Anglo-American model's market-based-ness to imply institutionless-ness (or relationshipsless-ness). (Yasuda 2001b) shows that relationships with commercial banks may have allowed new and lower-rated firms to initiate bond issues earlier than they otherwise could have, but that investment banks' franchise values are not threatened by the commercial bank entry in the overall U.S. market. In sharp contrast, domestic investment banks no longer dominate the capital markets in Japan after the deregulation. Of the top 4 incumbent investment banks, Nomura remains the only stand-alone investment bank. [68] Meanwhile, the

[64](Ramseyer 1994).

[65](Aoki 2001), Chapter 12.

[66]In contrast, preserving the interlock shareholding may no longer be economically justified, and we observe that it is gradually being dismantled.

[67]In a related theoretical work, (Dinc 1996) formalizes this idea and states that two cases are possible: (1) (Convergence) If relational banking is not feasible with developed bond markets, the relational banking institution disappears after financial ingetration. (2) (Path dependence) If relational banking, once established, is sustainable with developed bond markets, but reputation building costs are low enough in their absence, then the difference in financial institutions between the economies can persist after financial market integration. We interpret our empirical findings from Chapter 3 as consistent with the second case scenario.

[68]Yamaichi Securities has gone bankrupt (and many former-Yamaichi employees were absorbed by Merrill Lynch), Nikko Securities became an affiliate of Citigroup as NSSB (Nikko Salomon Smith Barney), and Daiwa has formed a

Japanese commercial banks have consolidated within themselves to form at least four major banking groups that have the characteristics of broad-based, universal banks. [69]

Put differently, some major institutional features of the American corporate finance and governance, such as existence of specialized investment banks and high-degree of reliance on capital markets for corporate financing and corporate control by large corporates, may be as particular a product of its own banking history as the universal banking system in continental Europe, or the main bank system in Japan. Indeed, U.S. domestic capital markets remain firmly dominated by domestic, *stand-alone* investment banks even after the industry-wide consolidation and the resulting acquisitions of some major U.S. investment banks by both U.S. and European banks. This contrast between the U.S. and Japan suggests that investment banks remain an uniquely American breed of financial institutions. While there are no legal impediments to emergence of elite, specialized stand-alone investment banks in Europe or Japan, our analysis of interactions between institutions, relationships and competition predict that it is unlikely.

Thus, on the query as to if and when of global convergence to the Anglo-American market system, we would argue that the view is questioned on two levels. First, its prediction is questioned because the convergence does not appear to be happening, based on our empirical findings and economic interpretations, and second, its distinction of markets (U.S./U.K.) vs. institutions/relationships (Japan/Europe) is also questioned because it does not help us understand why the convergence may not be happening. Global financial markets will likely be a significant source of external financing for large global corporates originating in any developed country, but these countries' financial systems will likely remain different. U.S. will continue to be predominantly investment bank-based, in the sense that it will be serving as a firm's primary financier at the nexus of transactions between firm insiders, [70] while Japan will likely remain bank-based. Markets and institutions / relationships do not work in mutually exclusive manners as is often

comprehensive alliance with Sumitomo Bank (a domestic commercial bank).

[69] Mitsubishi-Tokyo(Tokyo-Mitsubishi, Mitsubishi Trust and Japan Trust), Mizuho(IBJ, Fuji and DKB), Mitsui-Sumitomo(Sakura and Sumitomo), and UFJ(Sanwa, Tokai and Toyo Trust).

[70] The Silicon Valley model of venture capital finance is an important omission in this discussion, not only because the significance of private equity as source of external financing in the U.S. has grown exponentially in the last decade, but also because it is a model where complementarity between VC-firm relationships and markets (IPOs) via certification is crucial for the success of the model.

casually assumed. Existing relationships and institutions interact with policy changes, may give rise to development of market and affect mode of competition in the new market, market in turn affects economic values of existing relationships that are shaped by institutions. Their co-evolution is empirically found to be often path-dependent. To account for the institutional history underlying existing bank relationships is thus crucial for comparing market policy alternatives and forecasting consequences of policy changes, because its effect on competition outcome and market development appears to be both persistent and of first-order magnitude.

A List of Variables

(A) Dependent Variables

.BOOK:	.Takes a value of i if the issuing firm chooses bank i in the given observation. (i = 1-15)
.BANK_DUM:	.Takes a value of 1 if the chosen bank in the given issue is a commercial bank; 0 otherwise.

(B) Choice Characteristics:

.LOAN1-LOAN15:	.LOAN i Takes a value of 1 if bank i ever was the top lender among banks in any annual period during 1982-1992; 0 otherwise.
.PRICE1-PRICE15:	.PRICE i is the gross spread (expressed as a percentage of the issue amount) charged by bank i for the given issue. The unit is 10 bps.

(C) Issuer/Bond Characteristics:

.FIRST TIME: .Takes a value of 1 if the issuing firm in the given observation never issued a non-convertible bond in the domestic Japanese bond market; 0 otherwise.

.AMOUNT: .The size of the issue in 1 billion yen.

.MAT2: .Takes a value of 1 if the given issue's maturity is equal to or longer than 10 years and shorter than 20 years.

.MAT3: .Takes a value of 1 if the given issue's maturity is equal to or longer than 20 years.

.AAA RATING: .Takes a value of 1 if the given issue's credit rating is AAA based on the average of all credit ratings for a given bond issue by up to 6 rating agencies; 0 otherwise.

(D) Other:

.INC0-INC1: .INC1 is the inclusive value for Commercial Banks at the C-Bank/I-Bank node of the nest. INC0 is the inclusive value for Investment Banks at the C-Bank/I-Bank node.

B List of Credit Rating Agencies

JBRI (Japan Bond Rating Institute)
JCR (Japan Credit Rating Agency, Ltd.)

NIS (Nippon Investors Services)
R&I (Japan Rating and Investment Information, Inc.)
Moody's (Moody's Investors Service)
S&P (Standard & Poor's)

C Estimation Method

In the EM framework, the observed data are viewed as being "incomplete", and are augmented by unobserved data to make up the "complete data". Each EM iteration involves an E-step where the conditional expectation of the complete-data log likelihood given the observed data is computed using the previous estimates $\theta_{(0)}$, and an M-step where the conditional expectation is maximized over θ. This procedure is repeated in an iterative manner until convergence is achieved.
Let c_i represent the index of the bank chosen by firm i.
Let $\theta = \{\alpha, \beta, \mu, \gamma, \sigma\}$.

We observe c_i and p_{i,c_i}, as well as $x_{i,j}$, z_i. The task is to estimate θ according to the maximum likelihood principle. We will do this by an EM-type algorithm, assuming p_{-c_i} to be the "hidden" data and hence $\{c_i, p_{c_i}, p_{-c_i}\}$ to be the complete data. Thus we need to establish $\Pr(c_i, p_{c_i}, p_{-c_i}|\theta)$.

$$\Pr(c, p_c, p_{-c}|\theta) = \Pr(c|p_c, p_{-c}, \theta)\Pr(p_c, p_{-c}|\theta)$$

by Bayes rule. According to the logistic choice model

$$\Pr(c|p_c, p_{-c}, \theta) = \frac{e^{d_c^T\mu+\alpha p_c+\beta x_c}}{\sum_{k=1}^K e^{d_k^T\mu+\alpha p_k+\beta x_k}}$$

According to the iid normal distribution of δ_k, we know that each $p_k \sim N(z^T\gamma_k, \sigma^2)$ independently. Hence

$$\Pr(p_c, p_{-c}|\theta) = \prod_{k=1}^K \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{1}{2\sigma^2}(p_k - z^T\gamma_k)^2}$$

Hence, we have log likelihood of the complete data (of a single firm) as

$$\ln\Pr(c, p_c, p_{-c}|\theta) \quad = \quad -\frac{1}{2\sigma^2}\sum_{k=1}^K (p_k - z^T\gamma_k)^2 - \frac{K}{2}\ln 2\pi\sigma^2 +$$

$$\ln \frac{e^{d_c^T \mu + \alpha p_c + \beta x_c}}{\sum_{k=1}^{K} e^{d_k^T \mu + \alpha p_k + \beta x_k}} \tag{3}$$

In order to implement the E-step, we need to compute

$$\begin{aligned}
& E_{\theta^{(0)}}\left(\ln \Pr(c, p_c, p_{-c}|\theta) \,|\, c, p_c \right) \\
&= \int \ln(\Pr(c, p_c, p_{-c}|\theta))\ \Pr(p_{-c}|c, p_c, \theta^{(0)})\, dp_{-c} \\
&= \left(\int \frac{\prod_{k \neq c} e^{-\frac{1}{2\sigma^{2,(0)}}(p_k - z^T \gamma_k^{(0)})^2}}{e^{\alpha^{(0)} p_c + \beta^{(0)} x_c} + \sum_{k \neq c} e^{\alpha^{(0)} p_k + \beta^{(0)} x_k}} dp_{-c} \right)^{-1} \\
& \quad \int \ln(\Pr(c, p_c, p_{-c}|\theta))\ \left(\frac{\prod_{k \neq c} e^{-\frac{1}{2\sigma^{2,(0)}}(p_k - z^T \gamma_k^{(0)})^2}}{e^{\alpha^{(0)} p_c + \beta^{(0)} x_c} + \sum_{k \neq c} e^{\alpha^{(0)} p_k + \beta^{(0)} x_k}} \right) dp_{-c}
\end{aligned}$$

Note that the first integral term is irrelevant in the M-step because it is a function only of the old parameters $\theta^{(0)}$ and therefore is invariant with respect to new θ. So for the rest of this section I will drop this term from the analysis. What remains inside the second integral term is the product of a log of complete-data likelihood (evaluated at the new θ) and the remaining part of the conditional probability $\Pr(p_{-c}|c, p_c, \theta^{(0)})$, to be evaluated at the old θ.

These are high-dimensional ($K = 14$) integrals over hybrid distributions consisting of normal and logit components and are computationally non-trivial. Neither numerical integration nor Monte-Carlo EM (where the E-step is replaced by a Monte-Carlo process) is trivial nor immediately promising given the high dimensionality. So instead I use what is commonly referred to as an "EM-type algorithm," whereby the single most likely value p_{-c} that maximizes the conditional density above (i.e. only $\Pr(c, p_c, p_{-c}|\theta^{(0)})$) is computed and a probability of 1 is placed on this data. In terms of the underlying economic problem, this part can be described as adjusted price imputation, where instead of using unconditionally imputed prices for unobserved prices, I am replacing them with prices that are adjusted so as to maximize the joint likelihood $\Pr(c_i, p_c, p_{-c})$, using estimates of θ from the previous iteration.

To monitor convergence, we need to evaluate the observed-data likelihood function $L(\theta^{(k)})$ in each (kth) iteration. In my model the incomplete-data likelihood function is expressed as

$$\Pr(c, p_c|\theta) \quad = \quad \int \Pr(c, p_c, p_{-c}|\theta)\, dp_{-c}$$

$$= \int \prod_{k=1}^{K} \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{1}{2\sigma^2}(p_k - z^T\gamma_k)^2} \left(\frac{e^{\alpha p_c + \beta x_c}}{\sum_{k=1}^{K} e^{\alpha p_k + \beta x_k}} \right) dp_{-c}$$

As discussed in the previous section, the integrals above are computationally challenging. Laplace's method provides a useful way of approximating integrals that take the form

$$I(\lambda) = \int_D e^{-\lambda g(x)} f(x)\, dx$$

where λ is a large parameter[71]. I apply this approximation method to evaluate the observed-data likelihood function.

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[71] See pp.545-7 in (Judd 1996).

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