Exogenous Switching or Endogenous Selection: Using the Bond Issuers' Choice of Underwriters as an Example

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Abstract

Empirical studies on corporate strategies are often concerned with endogenous selection bias. However, overly emphasizing the issue of endogeneity has left another important dimension of selection under-examined, i.e., the selection based on publicly observable characteristics of firms. Such an undue emphasis also leads to the misuse of the Heckman's treatment model. In this paper, I use the bond issuers' choice of commercial bank underwriting versus investment bank underwriting to demonstrate that a more appropriate model to use is "switching regressions with endogenous switching," which provides a more explicit and richer description of the underlying matching process of issuers/underwriters than does the treatment model.

1. Introduction

One of the most popular empirical models in studying corporate strategic choices of firms is the treatment model (Heckman, 1979; Maddala, 1983). As James J. Heckman states in his Nobel Prize Lecture, "The model is designed to ask the following question: What is the effect of a program in place on participants and non participants compared to no program at all or some alternative program? This is what is now called the "treatment effect" problem." This model contains a participation decision equation to indicate the factors that determine the choice (for example, the decision to participate in a job training program) and a consequence equation to measure the treatment effect (for example, the wage rates of workers). However, in many cases, participants are not randomly assigned but choose voluntarily. The observed participants may decide to join the program based on the benefits arising from unobservable factors – the endogenous selection bias. Without controlling for this bias, the treatment effect can be misstated.

Similar to the treatment effect problem, when a firm chooses among different corporate strategies, endogenous selection bias may occur. Therefore, empirical studies in these areas have utilized this treatment model to deal with the endogeneity concern. This paper argues that, in some cases, this is not an appropriate model to use. To make the discussions more concrete, I use bond issuers' choice of commercial bank underwriting versus investment bank underwriting to demonstrate the empirical issues.[1]

[1] In 1987, the Federal Reserve reinterpreted Section 20 of the Glass-Steagall Act and permitted commercial banks to underwrite securities, such as commercial paper, with a revenue limitation. The underwriting subsidiaries of commercial banks were referred to as "Section 20 subsidiaries" later on. Thus, I follow the legal definition to classify the type of underwriting, specifically, if the lead underwriter is a Section 20 subsidiary, then it is considered as commercial bank underwriting because the scope of this study is to focus on the entrant status of commercial banks and to recognize that commercial banks are traditional lenders. The study of investment bank entry in the lending business is beyond the scope of this paper. It would require much recent data since 2000 to make the study meaningful. For discussions on the regulatory environment regarding bank underwriting, such as revenue limitations and firewall restrictions, see J.P Morgan & Co. Inc., The Chase Manhattan Corp., Bankers Trust New

It is discussed in many studies (see, for example, Kanatas and Qi, 1998; Kroszner and Rajan, 1997) that the additional lending arm of commercial banks may reduce information production costs if the information collected from lending is reused in underwriting for the same client, and vice versa. However, such an information advantage is tainted by the potential for conflicts of interest. Having the incentives to recoup bad loans or to recover the loan granting examination costs of rejected clients, commercial banks may misrepresent clients' information and bring these lemon firms to the public market. The reentry of commercial banks into security underwriting at the end of the 1980s has permitted many researchers to pursue the analysis of the differences between commercial bank underwriting and investment bank underwriting.[2] Nonetheless, these empirical studies mismatch the empirical test design and the issue at hand.

Basically, the standard treatment model with a dummy variable indicating having treatment or no treatment and the control for endogenous selection bias does not permit a structural change across different regimes. However, the comparison of different types of underwritings can involve a structural change, i.e., different underwriting technologies have different treatment effects that also interact with issuers' characteristics. Therefore, using only one consequence equation to capture two treatment effects has largely and implicitly ruled out the differences between these two types of underwriters. These undue restrictions also artificially limits the possible outcomes of comparing two treatments into three categories – commercial banks are better than, worse than, or the same as investment banks. They rule out a fourth, alternative possibility, that commercial bank underwriters are better than investment banks at serving some segments of the market, and vice versa. The dominance of commercial

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York Corp., Citicorp, and Security Pacific Corp., Federal Reserve Bulletin 75 (1989): 192-217. With the enactment of the Gramm-Leach-Bliley Act in 1999, commercial banks with underwriting capacity are also allowed to organize as financial holding companies.

[2] See, for example, Gande, Puri, Saunders, and Walter (1997). See also Ang and Richardson (1994) and Puri (1996) for the pre-Glass-Steagall period studies.

banks documented by prior studies is driven by the empirical test design that implicitly allows for only three possibilities. However, using the more general switching regressions model, this paper provides evidence that strongly supports the fourth alternative.

Formally, the model with one decision equation (indicating underwriter selection) and two consequence equations (one to describe commercial bank underwriting technology, the other to describe investment bank underwriting technology) is known as "switching regressions with endogenous switching." Therefore, this is a model that permits structural changes ("exogenous" switching) and endogenous selection simultaneously.[3] Because both underwriting technologies are estimated explicitly, it allows ones to estimate the impacts of different types of underwritings on the same client rather than to compare the bond issues of commercial bank clients versus those of investment bank clients. Given the presence of exogenous switching and endogenous switching, the latter comparison can be meaningless. Furthermore, the analysis of structural changes on observable variables is indeed more informative than the treatment model. In fact, it provides a much richer description of the underlying selection process of strategic decisions.

The above discussion also points out that the matched sample method should be used cautiously. It is a common practice in empirical research to focus on one strategy and match the sample by selecting observations from the other strategy. Given the presence of sample switching, this can be a serious problem if one tries to compare the effects of both strategies fair and square. The one-sided matching based on the characteristics of firms having chosen the focused strategy may overstate the advantage of this strategy. It is because the matching firms that have chosen the other strategy are drawn from the sub-segment where the other strategy has less comparative advantage than the focused strategy in the first place. The results from such a

[3] The model is first proposed by Roy (1951) to study occupational choices. Lee (1978) applies this model to the study of unionism and wage rates and Dunbar (1995) to the choice of underwriter compensation.

one-sided matching cannot provide inferences regarding the other strategy because a substantial segment of firms choosing the other strategy have been left out of the study. Therefore, it is not surprising that one may find that the focused strategy is "better" than the other strategy when in fact both strategies coexist in the market and have been apparently chosen by many firms.

Applying the switching regressions framework to reexamine the differences between commercial bank underwriting and investment bank underwriting, this paper discovers significantly different findings from that of prior studies. Prior research concludes that commercial banks are superior underwriters based on the finding that commercial bank underwritten bonds carry lower net yields than investment bank underwritten bonds. However, I find that, on average, commercial banks obtain lower net yields for their bond issuing clients (those that have chosen commercial banks as their underwriters) than investment banks would, and vice versa. There is no dominance between these two types of underwriters as their unique services are each valued by different clients. Therefore, both commercial banks and investment banks coexist in the market and serve clients with heterogeneous needs. The findings demonstrate that firms select rationally between underwriter types, seeking to minimize the interest costs of bond issuance. It appears that some bond issuers who are more suitable for universal banking services have benefited from the recent commercial bank entry into securities underwriting business. While others continuing to use investment banks as their underwriters are better off staying with investment banks.

The rest of the paper is organized as follows. Section 2 presents the switching regressions model. It also discusses the links between empirical tests and the underlying data generation processes, such as sample truncation, exogenous switching, and endogenous selection. Section 3 presents the data and descriptive statistics. Section 4 reports the

specializations and comparative advantages of different types of underwriters. It also discusses the identification and multicollinearity issues related to the applications and interpretations of the switching regressions model in the context of underwriter selection. Section 5 concludes.

2. Sample truncation, exogenous switching, or endogenous selection

Before proceeding to the switching regressions with endogenous switching model, it would be helpful to discuss some hypothetical scenarios of underwriter selection procedures to demonstrate the possible underlying data generation processes and their links to empirical tests. It is also important to distinguish among sample truncation, exogenous switching, and endogenous selection, so the research agenda can be matched with the appropriate test design.

2.1 Hypothetical underwriter selection problem

2.1.1 Sample truncation

Suppose that a firm may choose from two underwriters A and B to float its bonds. Underwriter A has a better certification capacity but worse distribution ability than underwriter B. Before formally discussing this complicated example, let us simplify the problem for a moment and assume that both underwriters A and B are identical. However, underwriter A has a regulatory distribution constraint that it can only underwrite for a smaller issue size up to a threshold.[4] Therefore, the fact that underwriter A only serves for clients with smaller issue sizes is due to this regulatory sample truncation rule. It has nothing to do with underwriter A's distribution ability. In order to examine if underwriters A and B are indeed different in their distribution capacities, for simplicity, we can formulate the empirical model as follows:

[4] When commercial banks were first allowed to underwrite corporate securities, the Board imposed a 5% revenue limitation, i.e., the revenues received from the newly permitted activities cannot exceed 5% of total revenues of underwriting subsidiary. The revenue limitation was relaxed to 10% in 1989, then 25% in 1996. For discussions on revenue limitations, see Federal Register 61 (1996), 68750-68756. For illustrational simplicity, the example here assumes that underwriter A cannot underwrite for a large issue size over a threshold.

$$\text{Bond net yield}_{Ai} = \alpha_A + \beta_A \text{ Issue size}_i + \varepsilon_{Ai} \quad (1) \text{ (if chose underwriter A)}$$

$$\text{Bond net yield}_{Bi} = \alpha_B + \beta_B \text{ Issue size}_i + \varepsilon_{Bi} \quad (2) \text{ (if chose underwriter B)}$$

If underwriter A has a worse distribution capacity, then β_A should be greater than β_B. The rationale is that, given the inability of A to place a large amount of debt, a large issuer has to pay a higher net yield (receiving a lower bond price) if A is the underwriter. However, we have assumed that both underwriters A and B do not differ in distribution ability. Therefore, β_A and β_B should be the same as shown in Figure 1.

[Figure 1 about here]

In this simple economy, the choice of underwriter is irrelevant. Because of the regulatory capacity limitation imposed only on underwriter A, due to this sample truncation rule, the distribution of bond issuers served by underwriter A has a lower mean issue size measure than those served by underwriter B. However, β_A and β_B should be the same. Therefore, the evidence that firms served by underwriter A appear to have a lower measure of issue size is not enough to indicate that A possesses worse distribution ability than does B.

2.1.2 Exogenous switching

Now suppose that underwriter A does have distributional disadvantage (perhaps A is an entrant to the underwriting market), so $\beta_A > \beta_B$ as shown in Figure 2. However, we also assume that $\alpha_A < \alpha_B$ to capture some benefits of using underwriter A, such as it provides better options of future financing because A also has an extensive lending operation. Such an insurance against possible credit rationing in the future reduces net yields of bonds paid by its clients. Without this condition, underwriter B dominates underwriter A and all the firms should choose underwriter B. The dominance of underwriter B is probably inconsistent with the empirical observation of coexistence of both underwriters, unless underwriter B is the sole decision maker that rejects

some issuing firms. Thus, these firms are forced to be served by underwriter A. Of course, in such a case, the selection issue changes from "how bond issuing firms choose underwriters" to "how underwriter B determines which client it should bring to the bond market." These are fundamentally different questions. It is true that, in some circumstances, we cannot tell who the key decision makers are if it is a mutually beneficial matching.

[Figure 2 about here]

In the economy where underwriters A and B demonstrate comparative advantages as Figure 2 illustrates, firm S (issuing a small amount of debt) should choose underwriter A and firm L (issuing a large amount of debt) should choose underwriter B. Obviously, firm S and firm L are different firms. In order to evaluate the benefit that firm L, which has chosen underwriter B, receives from using underwriter B, one needs to estimate the bond net yield paid by firm L had it chosen underwriter A because it is unobservable.

Since it is easy to measure the size of bond issuance and if there is no omitted variable problem, then this is a standard (exogenous) switching regression analysis. The sorting is only caused by an exogenous variable. There is no need for endogenous selection bias correction. One bond net yield regression with issue size, a dummy variable to indicate underwriter choices and an interaction term between underwriter choice dummy and issue size is sufficient to analyze such an economy. Comparing bond net yields between Firms S and L is not enough to tell the differentiated distribution ability of underwriters A and B. It is the different beta coefficients will supply the needed evidence to derive inferences. The beta coefficient differential on issue size then serves as an explicit and direct test of the worse distribution capacity of underwriter A. However, this important dimension has been ignored in the empirical studies that use treatment model to compare the effects of different corporate strategies.

These discussions also demonstrate that matching firm methodology cannot be used to compare underwriters A and B fairly if one only focuses on constructing a sample that matches the characteristics of firm S. It is because such a one-sided match only draws firm L and alike from a sub-segment where underwriter B does not possess comparative advantage. More seriously, many firms choosing underwriter B are going to be left out in the study due to this one-sided focus. Such a test design is inappropriate to draw inferences about underwriter B. Not to mention if one tries to compare underwriter A to underwriter B impartially.

2.1.3 Endogenous switching

Now, let us add endogenous switching into the picture. For example, if the model should include a material variable that is not measurable (perhaps the level of information asymmetry problem) and this variable is correlated with issue size and bond net yield. In particular, if firms use this information asymmetry problem as a factor to determine the choice of underwriter, then the observed underwriter selection dummy becomes an endogenous variable in the bond net yield regression because it contains the information of information asymmetry problem. The error term in the bond net yield regression also contains the same information asymmetry problem because the regression has an omitted variable issue. In this case, the estimate of the beta coefficient in the bond net yield regression on the underwriter selection dummy variable is inconsistent, so does the beta coefficient estimate on issue size. Therefore, the appropriate model to use is the "switching regressions with endogenous switching" model. Based on the name of the model, one can easily see it is a model attempting to consider two types of switching, exogenous switching and endogenous switching, simultaneously. By analyzing the interactions between the treatment effect and firm characteristics, one can formally test various competing hypotheses explicitly and understand the underlying decision making

process more completely. Such rich information cannot be provided by using only an estimate of the beta coefficient from a treatment dummy or by an endogenous selection bias term.

2.2 Switching regressions with endogenous switching

In this subsection, I formally discuss the switching regressions model in the context of choosing commercial bank (CB) underwriting versus investment bank (IB) underwriting. The same idea applies to many other areas where two strategies are involved in the corporate decision process.[5] Formally, the switching regressions model is as follows:

$$y_{1i} = X_i\beta_1 + u_{1i} \qquad (3) \text{ (for CB underwritten issues)}$$

$$y_{2i} = X_i\beta_2 + u_{2i} \qquad (4) \text{ (for IB underwritten issues)}$$

$$I_i^* = -(Z_i\gamma - \varepsilon_i) \qquad (5) \text{ (underwriter choice equation)}$$

$$COV(u_{1i}, u_{2i}, \varepsilon_i) = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{1\varepsilon} \\ \sigma_{12} & \sigma_{22} & \sigma_{2\varepsilon} \\ \sigma_{1\varepsilon} & \sigma_{2\varepsilon} & 1 \end{bmatrix} \qquad (6)$$

The variables y_{1i} and y_{2i} are the bond net yields of firms underwritten by CB or IB, respectively. The error terms $u_{1i}, u_{2i}, \varepsilon_i$ are assumed trivariate normal with means (0, 0, 0) and the covariance matrix defined in equation (6). This model is more general than the treatment model, therefore, each type of underwriting has its mean, variance and covariance with the choice variable I_i^*. In other words, each type of underwriter has its unique underwriting technology that has distinct interactions with various issuer characteristics. If firm i chooses a commercial bank, then it has y_{1i}. We do not observe y_{2i} because the foregone choice does not occur, therefore, is unobservable. As Heckman points out in his Nobel Prize Lecture, this more general model first

[5] For further discussions and descriptions of estimation procedures, see Chapters 8 and 9 in Maddala (1983), which also provides an excellent collection of models that deal with multiple simultaneous or sequential selection models.

proposed by Roy (1951) is the basis for an entire econometric literature on selection bias in regression functions.

The conditional mean net yields of CB and IB underwritten bonds are given by the following:

$$E(y_{1i} \mid I_i = 1) = X_i\beta_1 + \sigma_{1\varepsilon}\frac{\phi(Z\gamma)}{1-\Phi(Z\gamma)} \tag{7}$$

$$E(y_{2i} \mid I_i = 0) = X_i\beta_2 - \sigma_{2\varepsilon}\frac{\phi(Z\gamma)}{\Phi(Z\gamma)} \tag{8}$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ are, respectively, the standard normal density and distribution functions. The tests of endogenous selectivity bias are tests for $\sigma_{1\varepsilon} = 0$ and $\sigma_{2\varepsilon} = 0$ in equations (7) and (8). As equations (7) and (8) indicate, in order to collapse two bond net yield regressions into one, one must assume that $\beta_1 = \beta_2$ and $\sigma_{1\varepsilon} = \sigma_{2\varepsilon}$. Once we make these assumptions, it becomes the treatment model. So the treatment model is a restricted version of this more general switching regressions model. However, these improper assumptions have assumed away the most interesting point of comparing commercial bank underwriting and investment bank underwriting. Given the pros and cons of commercial bank underwriting, there are comparative advantages between these two types of underwriters. The empirical model should allow for both exogenous switching and endogenous switching and test those formally.

Another advantage of this three-equation model is that we can compare the performance of different underwritings while holding the client constant. If commercial banks can serve firm i better than investment banks in bond pricing, then y_{1i} is less than $E(y_{2i} \mid I_i = 1)$. In other words, the observed mean net yields of commercial bank underwritten bonds are lower than the expected mean net yields had investment bank underwritten the bonds been issued by

commercial bank clients. The net yield differential for firm i underwritten by a commercial bank rather than by an investment bank is given by the following equation:

$$E(y_{2i} \mid I_i = 1) - y_{1i} = X_i \beta_2 + \sigma_{2\varepsilon} \frac{\phi(Z\gamma)}{1 - \Phi(Z\gamma)} - y_{1i} \quad (9)$$

The net yield differential for firm i choosing investment bank underwriting is defined similarly.

3. Data and descriptive statistics

The data used in this paper consist of fixed-rate nonconvertible domestic corporate bond issues from the Thomson Financial Securities Data (SDC Platinum) U.S. Corporate New Issues database. Only non-utility and non-financial firms are used in the analysis. If the lead underwriter is a Section 20 Subsidiary or an affiliate of a financial holding company, the bonds are classified as commercial bank underwriting bonds. The sample period covers January 1, 1991 through December 31, 2000.

The initial data contains 4,592 bond issues of which 3,727 issues contain useful net yield information. All firm variables are constructed from the COMPUSTAT database with the exception of the market value of equity variable, which is obtained from the CRSP daily return database. These variables are measured at the end of the year prior to the bond offerings. The bank loan information is acquired from the DealScan database provided by the Loan Pricing Corporation. The amounts of loan deals are aggregated for each bond issue if the issuing date is between loan origination date and loan maturity date. Loans from all commercial banks with Section 20 subsidiaries and from a specific commercial bank that also underwrite for the firm (underwriter loans) are pro rata based on lender share or loan syndicate size where lender share information is not available.

[Table 1 about here]

Table 1 presents the frequency of bond issues for each year by underwriter type from 1991 to 2000. Commercial banks underwrite 944 issues and investment banks underwrite 3,648 issues. The proportion of bonds underwritten by commercial banks, which is 7.1% in 1991, grows to 43.8% in 2000. Over the 10-year sample period, the average proportion is 20.6%.

[Table 2 about here]

Summary statistics for firm and issue characteristics are reported in Table 2. Compared to the median investment bank client, the median client of commercial banks pays lower underwriting fees, issues a bond with shorter maturity, and issues a smaller amount. However, there is no difference in bond net yields between commercial and investment bank underwritings. There is also no statistical difference in total loans, but commercial bank clients have significantly larger section 20 loans in mean.

The commercial bank median client is significantly smaller than that of investment banks in terms of total assets and market value of equity. Tobin's q, operating income, and leverage of clients of both underwriters do not differ significantly. Compared to investment bank clients, commercial bank clients invest less. Commercial bank clients' cash balance (in mean) and interest expense relative to operating income (in median) are also significantly lower.

[Table 3 about here]

Table 3 presents the selective frequency of issue characteristics. Commercial bank clients reuse their underwriters from prior bond and/or equity issuances less frequently than investment bank clients do. Commercial banks underwrite a lower percentage of non-investment grade issues and issues with the purpose of repaying bank debt. There is no difference in the frequency of clients issuing bonds for the first time in 20 years (new issue).

4. Specializations and comparative advantages of underwriters

There are many forces influencing both the client/underwriter matching process and the net yield that the underwriter can obtain for the client. Various testable hypotheses that emerge from the theoretical literature, however, can be categorized into three groups: (1) the commercial bank distribution disadvantage hypothesis; (2) the commercial bank certification capacity hypothesis, and (3) the commercial bank conflicts of interest hypothesis.

4.1 Commercial bank distribution disadvantage as entrants

The most obvious difference between commercial banks and investment banks is their entrant and incumbent statuses, respectively, during the decades of the 1990s. Investment banks have been in the corporate securities underwriting business for 6 decades without the competition from commercial banks. It would take a while for entrant commercial banks to catch up with incumbent investment banks in establishing distribution channels. In addition, due to the revenue limitation imposed only on commercial banks, the extent that commercial banks can penetrate the market was restricted by such a regulation, which has also changed over time. Therefore, I also conduct subsample analysis. As discussed in Footnote 5, the choice of subsample periods is based on an important revenue limitation change at the end of 1996, which permits commercial banks to enter the market more aggressively since then.

Because of the complication of the revenue limitation, if one observes that commercial banks tend to underwrite smaller issues in a probit regression analysis, it is insufficient to make the claim that commercial banks have a disadvantage in distributing bonds. However, if one also observes that increases in bond net yield is related to increases in issue size for commercial bank underwriting but there is no such a relationship for investment bank underwriting, then one can

interpret this evidence as commerical banks having a distribution disadvantage. Therefore, it is important to allow for such a structural change for different regimes of underwriting. Again, this example demonstrates that using only one net yield regression to pool both commerical bank and investment bank underwritings in a treatment model cannot demonstrate how commercial banks differ from investment banks. In particular, given the regulatory complication, the results from probit analysis along are insufficient to infer the distribution disadvantage of commercial banks.

[Table 4 about here]

Table 4 reports probit estimates of underwriter selection describing the clienteles of different underwritings. The value of the dependent variable is one if the bond issue is underwritten by a commercial bank, zero if by an investment bank. Model (1) uses the subsample from 1991 to 1996, while Model (2) uses the 1997 to 2000 subsample. Model (3) uses full sample. The results across periods are very similar.

The probit estimates on issue size indicate that the issue amount of commercial bank underwritten bonds increases over time. It appears that commercial bank underwritten bonds show no difference in issue size from investment bank underwritten bond in the later period. Nonetheless, a closer look at the net yield regressions in Tables 5 and 6 shows that, larger commercial bank underwritten bonds carry higher net yields than those underwritten by investment banks regardless of subsample periods. These findings are consistent with the notion that commercial banks are entrants and it is not easy to establish distribution channels. Table 7 uses full sample in the net yield regressions. The larger estimate of commercial bank underwriting on issue size further confirms that commercial banks cannot distribute bond issues as effectively as investment banks during the decade of the 1990s.

[Table 5 about here]

[Table 6 about here]

[Table 7 about here]

4.1.1 Identification and multicollinearity of endogenous switching regressions model

Very often, identification is an issue in a simultaneous equations model. However, due to the non-linear form of selection bias control terms, the swtiching regressions with endogenous switching model can be indentified even if the exogenouse variables in the three equations are indentical. However, it does not hurt to include some (instrumental) variables that can determine the selection of underwriters but do not affect bond pricing. For example, because commercial banks are entrants, naturally, commercial bank clients have less tendency to employ these banks for their previous bond issuances. Therefore, in Table 4, the estimates on the dummy variable to indicate if the issuers have used the current underwriters within the past 5 years (the same prior bond underwriter) are all significantly negative. This variable is not included in the net yield regressions during this entry decade because this apprant selection is largely due to a regulatory artifact that commercial banks had been restricted from security underwriting for about 60 years.

Because the estimates of endogenous selection terms in the second stage net yield regressions is obtained from the estimates of the first stage probit regression, which has many overlaping or an identical set of exogenous variables, multicollinearity can be a problem. To alleviate such a problem, in the probit and net yield regressions, the variables for issue size are in different functional forms. Of course, such modifications cannot be arbitrary. Issue size is scaled by total assets in the net yield regressions because the determination of bond price based on issue size is not soly determined by the distribution ability of underwriters but also by the borrowing capacity of issuers, which firm size should play a big role in it. By using this relative measure in the net yield regression, one can control for issuers' borrowing capacity and allow the

beta coefficient to capture the distubution ability of underwriters.

4.2 Commercial bank certification capacity

Superior information and better financing flexibility are the main arguments for commercial bank reentry into the underwriting business. An issuing firm that borrows from a bank may choose the bank to underwrite for them because the bank may reuse the information generated from monitoring the loan, therefore, certify the bond issue more effectively than an investment bank. In addition, the options of future lending or underwriting by commercial banks can provide first-time clients better financing opportunities even though the two parties do not have an existing lending relationship.[6] These benefits should be more relevant for smaller firms or firms with a higher level of information asymmetries (proxied by new issue and Tobin's q), thus, they tend to choose commercial banks as their underwriters. The degree to which commercial banks can alleviate these information costs should lower the net yield of commercial bank underwriting bonds than had these clients underwritten by investment banks.

Consistent with the notion that banks possess information advantage and/or financing flexibility, Table 4 shows that commercial banks specialize in underwriting for clients that are smaller. The smaller magnitude of negative estimates on firm size in the commercial bank regressions relative to that in the investment bank regressions in Tables 5, 6, and 7 indicate that bank underwriting is more beneficial to small firms. The less negative estimates on firm size indicate that, if commercial banks are the underwriter, then the net yields of issuing firms increase less when firm size declines. These findings are consistent with the commercial bank certification hypothesis and this conclusion is robust across time periods.

[6] The positive effect of bank relationship has been discussed in numerous studies. See, for example, Fama (1985), Diamond (1991), and James (1987).

The bank certification hypothesis is further supported by coefficient estimates of new issues in all Tables 5, 6, and 7. New issuers using an investment bank underwriter must pay a significantly higher net yield than seasoned issuers do. However, this is not the case for issuing clients of commercial banks. Coefficient estimates of Tobin's q are insignificant in the probit regression and both underwriters' net yield regressions.

The estimates of the endogenous selection terms are mostly insignificant with only one exception in Table 7. This can be driven by the extensive control variables used in the analysis. Thus, there is a less omitted variable problem. The Appendix lists these control variables, which include various issue and firm characteristics, syndicate structure, and issuers' prior securities underwriting activities.

4.3 The conflicts of interest of commercial banks

Potential conflicts of interest are one of the main rationales behind the Glass-Steagall Act. These conflicts may arise if banks discover unfavorable information through loan monitoring but pass the "lemon" firms onto the public market in order to protect their own private loans. This lemon-dumping behavior could also occur for first-time borrowers when banks uncover adverse information during the loan granting examination. There is theoretical and empirical evidence that capital markets rationally discount for conflicts of interest.[7] The implication is that, conditional on commercial bank underwriting, bond net yields will be higher.

Potential conflicts of interest have further implications on underwriter selection. Firms with greater information asymmetries will suffer more from conflicts of interest through a more severe bond price discount. Such firms will in turn have the highest incentive to avoid the

[7] For theoretical work, see Kanatas and Qi (1998). See Kroszner and Rajan (1994, 1997) for empirical studies prior to the Glass-Steagall Act.

conflicts of interest in the first place. Therefore, new issues and Tobin's q will have a negative relation with the selection of commercial banks as underwriters, and firm size will have a positive relation. The effects of bank certification and conflicts of interest work in opposite directions on underwriter selection and bond pricing, so the empirical results are the net effects of both forces. The canceling effect may explain the insignificant results of new issue and Tobin's q in the underwriter selection regression in Table 4.

To more directly examine potential conflicts of interest, the purpose of a bond issue, interest expense relative to operating income (the inverse of coverage ratio), and the lending relationship with commercial bank underwriters and loans from all commercial banks with Section 20 subsidiaries are used as additional proxies. When the purpose of an issue is to refinance bank debt and the coverage ratio is low, the likelihood of conflicts of interest is greater and the price discount should be more severe. Therefore, the probability of choosing a commercial bank as an underwriter should be lower. On the other hand, investment banks should reject firms with unfavorable information. Empirically, these actions may cancel each other out, resulting in no effect on underwriter selection. As Model (1) of Table 4 indicates, estimates on all of the conflict of interest proxies are insignificant for the early entry period.

Unlike underwriter selection, which can be neutralized by conflicting forces, investors will discount the price of commercial bank underwriting bonds when the perceived potential for conflict of interest is high. The significant positive estimates for the interaction between interest expense relative to operating income (inverse of coverage ratio) and the issue purpose to repay bank debt (REFBD) in Tables 5 and 7 are consistent with the conflicts of interest hypothesis.[8]

[8] In Table 6, the effect is captured by the estimate on REFBD, which is highly significantly positive. However, the magnitude is still not large enough to counter the significantly negative estimates on its interactions with underwriter loans and with interest expense relative to operating income. It is possible that, for the 1997-2000 period, the

Therefore, if a firm with a relatively low coverage ratio is underwritten by commercial banks, its bond issue will incur a larger price discount, especially when the issue is to repay bank debt.

Compared to investment bank clients, commercial bank clients pay higher net yields as the proportion of their loans borrowed from all commercial banks with Section 20 subsidiaries increases. The result indicates that a higher percentage of loans from all commercial banks with Section 20 subsidiaries do not better certify an issuing firm when its underwriter is a commercial bank. In fact, such a lending relationship raises general concerns of conflict of interest, which reduces the bond price that client receives. Perhaps investors are concerned about the possibility that bank underwriters can swap clients and underwrite for each other's.

The above discussions highlight the limitation of analyzing underwriter selection only by using probit analysis and ignore the possible structural changes across different underwriting regimes when, in fact, the structural changes in the net yield regressions are more informative. Regarding the control variables, investment bank clients tend to reuse their underwriters' service more frequently partly due to the fact that commercial banks are new entrants into the underwriting business.[9] Commercial bank lead syndicates tend to have fewer other commercial banks participate as co-managers than investment bank lead syndicates. Perhaps the commercial banks' certification enhancing role as co-managers found in Song (2004) is more important in investment bank led syndicates than in commercial bank led syndicates because, in the latter, there is less complement effect.

4.4 Comparing different types of underwritings while holding client constant

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estimates were affected by the Internet bubble frenzy. In other words, investors may not have been concerned with conflicts of interest when the markets were so optimistic.

[9] Model (1) does not control for whether the clients use the same prior equity underwriters because, for commercial bank clients, there are only 6 observations using the same prior equity underwriters during 1991-1996.

Table 8 reports the net yield differentials estimated by subtracting observed bond net yields of selected underwriting from the fitted bond net yields of unselected underwriting. These net yield differentials are derived using estimates from Tables 5, 6, and 7 depending on the sample periods.[10]

[Table 8 about here]

Consistent with the proposition that clients seek to reduce interest costs and select underwriters rationally, the net yield differentials are all significantly positive for both commercial and investment bank underwritings. The results demonstrate that both underwriters serve their clients better than the other would. On average, the client-underwriter matching is efficient in the 1990s. This finding, contrary to the results of prior research that commercial banks are superior underwriters, is consistent with the empirical observation that investment banks are valuable and important underwriters in the industry. In other words, there appears to be no complete dominance between these two types of underwriters as their unique services are each valued by different clients. The puzzle left by the previous studies as to why investment banks, which appeared to be worse underwriters, coexisted with commercial banks is resolved.

Table 8 shows that the net yield differentials of commercial bank underwriting decline from 37.41 basis points to 5.68 basis points following the revenue limitation increase to 25%. On the contrary, investment bank differentials increase. This finding is consistent with the explanation that commercial banks enter the underwriting market by serving firms with the highest net yield differentials – the segment that commercial banks offer the most comparative advantages. The high level of positive differentials could dissipate as commercial banks gradually expand into the territory where they possess less comparative advantages. On the

[10] The estimates do not include bonds with credit ratings of C because commercial banks do not underwrite any bond with C ratings in the final sample.

other hand, as more and more clients who investment banks cannot serve well switch to commercial bank underwriting, the differentials of investment bank underwriting increase.

An interesting feature of the empirical model employed in this paper is that it permits the estimation of unconditional means (on underwriter selections), which may be important under some circumstances. For example, if policy makers desire to "re-regulate" the underwriting market and need to choose only one type of bank to exist in the bond underwriting market, then one should compare the unconditional mean net yields of both underwritings because the benefits of better client-underwriter matching are no longer relevant in this hypothetical economy. I use the regression results from Table 7 to estimate the unconditional means presented in Table 9, thus excluding the effect of endogenous selection.

Table 9 shows that during the 1990s, if only commercial banks had existed in the market, then issuing firms would have paid, on average, 143.3 basis points in bond net yields. On the other hand, if investment banks were the sole choice of underwriters, then the average net yields would have been 136.5 basis points. The results show that investment banks would have been better than commercial banks for this hypothetical economy during the 1990s.

However, the subgroup analysis still demonstrates that commercial banks obtain higher bond prices for clients that have chosen commercial bank underwriting than investment banks do, and vice versa. Commercial bank clients would have paid 9.5 basis points higher in net yields had investment banks underwritten for commercial bank clients. Similarly, investment bank clients are better off having investment banks exist. Without them, they would have paid 11 basis points higher in net yields. Again, Table 9 demonstrates that, from the issuers' view point, the economy is better off having both types of underwriters to coexist.

5. Conclusion

Using bond underwriter selection as an example, this paper demonstrates the benefit of using switching regressions with endogenous switching in studying corporate decisions. It points out the importance of studying structural changes of different corporate strategies because such information offers a more explicit description of the underlying decision making process. Without permitting the possibility of a structural change, one can sometimes rule out the most interesting and crucial points of comparing different strategies. Formally laying out the tests of structural changes based on exogenously observable variables also allows researchers to fine-tune the interpretations of evidence and to rule out competing explanations. This paper also demonstrates that matching sample method should be used cautiously because it may not provide sufficient information to compare two strategies objectively in the presence of sample switching.

As the bond underwriter selection example demonstrates, the restrictive assumptions implicit in the prior empirical literature has ruled out the possibility that neither type of underwriters possesses a dominant underwriting technology. The findings in this study strongly support the argument that both types of underwriters coexist because they produce unique services that are each valued by different clients. Commercial bank reentry into the underwriting market is beneficial for those clients switching to commercial bank underwriting. Similarly, investment banks better serve the clients choosing investment bank underwriting. These findings explain why commercial banks could penetrate the underwriting market and coexist with investment banks, while investment banks remained as major players in the 1990s. The evidence in this paper presents a very different and more thorough picture of different types of underwritings from that of prior studies.

Appendix: List of variables

Variable name	Variable definition
Syndicate type	
Commercial bank underwriting	Bonds lead-underwritten by Section 20 subsidiaries or financial holding companies, which are the legal organizational forms that the Federal Reserve Board permits commercial banks to underwrite corporate securities. If more than one underwriter leads the syndicate, then the first underwriter on the list is used to determine underwriter type.
Hybrid syndicate	Equals 1 if current bond issuance is co-led by commercial banks and investment banks; 0 otherwise.
CB-co-manage	Equals 1 if commercial banks participate in the underwriting syndicate as co-managers; 0 otherwise.
Hybrid merger	Equals 1 if the lead underwriter engaged in a merger between a commercial bank and an investment bank during 1990s; 0 otherwise. See Song (2005) for the list of major underwriter merger types.
Issue characteristics	
Net yield (basis point spread)	The premium of the ex-ante yield spread of a bond over the ex-ante yield of a U.S. Treasury security of similar maturity.
Underwriting fees (spread)	Dollars charged per $1,000 of bond issue (includes management fees, underwriting fees, and selling concession).
Issue size	The principal amount of bond issuance (in $MM).
Issue maturity	Number of years to maturity.
New issue	Equals 1 if there is no bond issuance within 20 years prior to the current bond issuance; 0 otherwise.
REFBD	Equals 1 if the purpose of issue is to refinance existing bank debt; 0 otherwise.
Non-callable	Equals 1 if the bond is classified as “Not-callable” or “Noncall life” in SDC Platinum; 0 otherwise.
Shelf-registration	Equals 1 if the bond is classified as shelf-registered in SDC Platinum; 0 otherwise.
Senior	Equals 1 if the bond is classified as senior in SDC Platinum; 0 otherwise.
Non-investment grade	Equals 1 if the Moody’s credit rating for the bond issuance is Ba or below; 0 otherwise.
Credit rating Aa	Equals 1 if the Moody’s credit rating for the bond issue is Aa; 0 otherwise. Other credit rating dummies are defined in a similar fashion.
Period[1997-2000]	Equals 1 if the bond is issued during 1997-2000.

Table 1 (continued)

Variable name	Variable definition
Lending relationships	
Ln(1+total loans)	Log of (one plus existing total bank loans in $MM).
Ln(1+section 20 loans)	Log of (one plus existing loans borrowed from banks with Section 20 subsidiaries in $MM).
Ln(1+underwriter loans)	Log of (one plus existing loans borrowed from commercial bank underwriters in $MM).
Prior securities issuance	
Ln(1+no. of prior bond issues)	Log of one plus total number of bonds issued within the 5-year period prior to the current bond issuance.
Ln(1+no. of prior equity issues)	Log of one plus total number of equity issued within the 5-year period prior to the current bond issuance.
Use same prior bond (equity) underwriter	Equals 1 if a client used the current lead underwriter in prior bond (equity) issuance within the 5-year period; 0 otherwise.
Number of underwriter relationships	Number of different underwriters used in the prior bond and/or equity issuance within the 5-year period.
Firm characteristics	
Tobin's q	(Book value of debt plus market value of equity) divided by total assets.
Interest expense/operating income	Interest expense as a percentage of operating income. (This is the inverse of coverage ratio.)
Other firm characteristics	Cash, capital expenditure, operation income, and total debt are as a percentage of total assets
Endogenous selection terms (inverse Mill's ratio)	$\frac{\phi(Z\gamma)}{1-\Phi(Z\gamma)}$ and $\frac{-\phi(Z\gamma)}{\Phi(Z\gamma)}$ in equations (7) and (8), respectively, used to control for endogenous switching. Estimated by using the results of first-stage probit estimation in Table 4.

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Figure 1

Sample truncation due to a regulatory distribution capacity constraint

This figure shows the hypothetical case that underwriters A and B are identical except for a regulatory distribution capacity constraint imposed only on A. The bond net yield equations of firm i's using different underwriters are as follows:

$$\text{Bond net yield}_{Ai} = \alpha_A + \beta_A \text{ Issue size}_i + \varepsilon_i \qquad (1) \text{ (if select underwriter A)}$$

$$\text{Bond net yield}_{Bi} = \alpha_B + \beta_B \text{ Issue size}_i + \varepsilon_i \qquad (2) \text{ (if select underwriter B)}$$

Since neither underwriter has a better certification or distribution capacity, β_A should be equal to β_B, and α_A should be equal to α_B. However, underwriter A has a regulatory capacity constraint. Firms issue larger sizes have to choose underwriter B, whereas firms issue smaller sizes could randomly pick either A or B. Therefore, the regression line of underwriter A indicated by a solid line is truncated at the threshold. The regression line of underwriter B is indicated by a dashed line.

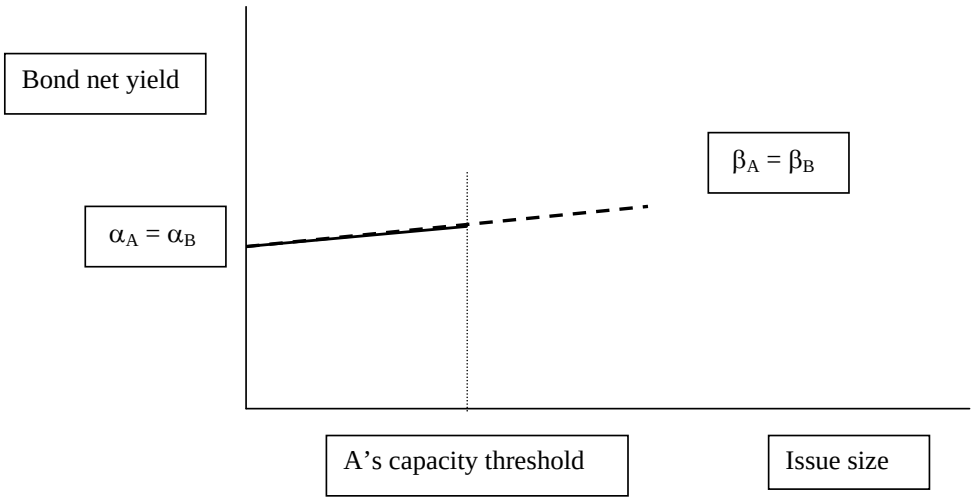

Figure 2

Exogenous switching due to differentiated levels of distribution ability of underwriters

This figure shows the hypothetical case when underwriters A and B have different levels of distribution ability. The bond net yield equations of firm i's using different underwriters are as follows:

$$\text{Bond net yield}_{Ai} = \alpha_A + \beta_A \text{ Issue size}_i + \varepsilon_i \qquad (1) \text{ (if select underwriter A)}$$

$$\text{Bond net yield}_{Bi} = \alpha_B + \beta_B \text{ Issue size}_i + \varepsilon_i \qquad (2) \text{ (if select underwriter B)}$$

Since we assume that underwriter A possesses worse distribution ability, so β_A should be larger than β_B. However, we also assume that α_A is less than α_B to avoid the case of complete dominance by one underwriter. Therefore, the regression line of underwriter A indicated by a dashed line appears to be steeper than that of underwriter B indicate by a solid line. Firm L issues a large amount of debt. Firm S issues a small amount of debt.

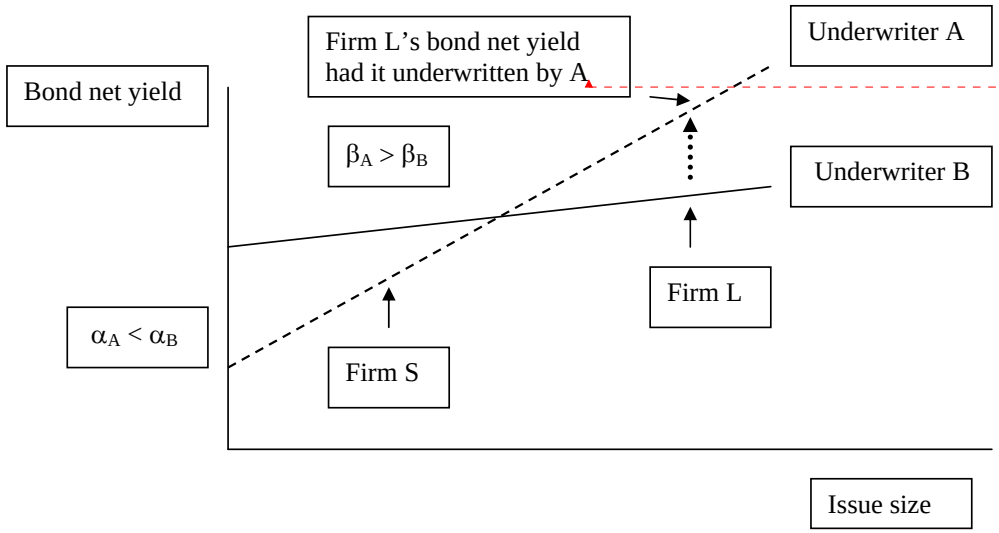

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Table 1
Frequency of issues by year and by underwriter type

The sample consists of 4,592 domestic non-convertible, fixed-rate industrial corporate bond issues from 1991 to 2000. The columns under the heading of "Commercial banks" report bonds lead-underwritten by underwriting subsidiaries of commercial banks or financial holding companies.

Year	Commercial banks		Investment banks		Full sample
	Number	Percentage	Number	Percentage	Number
1991	26	7.1	338	92.9	364
1992	36	9.6	341	90.5	377
1993	44	9.8	404	90.2	448
1994	26	11.9	192	88.1	218
1995	83	20.3	326	79.7	409
1996	99	18.9	424	81.1	523
1997	127	19.0	542	81.0	669
1998	205	25.8	590	74.2	795
1999	157	33.6	310	66.4	467
2000	141	43.8	181	56.2	322
Total	944	20.6	3648	79.4	4592

Table 2
Descriptive statistics of bond issue and firm characteristics by underwriter type

This table compares mean and median firm and issue characteristics of bonds underwritten by commercial banks to those underwritten by investment banks with the test significance level reported under the heading of "Commercial banks." The sample consists of 4,592 domestic non-convertible, fixed-rate industrial corporate bond issues for the period 1991-2000. The sample size for commercial bank underwriting bonds is 944 and that for investment bank underwriting bonds is 3648 except for bond net yields and underwriting fees. The sample size for bond net yields (underwriting fees) is 775 (663) for commercial banks and 2952 (2895) for investment banks. Net yield is the premium of the ex-ante yield spread of a bond over the ex-ante yield of a U.S. Treasury security of similar maturity. Underwriting fees (spreads) are dollars charged per $1,000 of bond issue, which include management fees, underwriting fees, and selling concession. Issue size is the principal amount of bond issuance. Issue maturity is the number of years to maturity. Total loans are the amounts of loan deals (in $MM) aggregated for each bond issue if the issuing date is between loan origination date and loan maturity date. Section 20 bank loans are loans (in $MM) from all commercial banks with Section 20 subsidiaries. Underwriter loans are loans (in $MM) from commercial banks also underwrite for the bond issuers. Differences in means are tested by *t*-tests and the differences in medians by Wilcoxon rank-sum tests.

Variable	**Commercial banks**		**Investment banks**	
	Mean	**Median**	**Mean**	**Median**
Issue characteristics				
Net yields (basis point spread)	124.28	90.00	130.31	90.00
Underwriting fees ($/$1000)	7.29***	6.25***	8.56	6.50
Issue size ($MM)	161.70	100.00***	169.76	125.00
Issue maturity (years)	9.83***	8.00***	13.05	10.00
Lending relationships				
Ln(1+total loans)	5.91	6.87	5.75	6.80
Ln(1+section 20 bank loans)	5.44*	6.42	5.23	6.37
Ln(1+underwriter loans)	3.46	4.25	-	-
Firm characteristics				
Total assets ($ Bn)	23.48	5.43***	23.48	7.51
Tobin's q	1.36	1.08	1.34	1.08
Interest expense/operating income	18.95	14.96***	23.29	16.24
Cash/total assets	4.17*	2.42	4.61	2.21
Capital expenditure/total assets	7.95***	6.53***	8.62	7.26
Operating income/total assets	14.55	14.21	14.74	15.00
Total debt/total assets	33.12	30.47	33.04	31.16

*, **, *** Significant at the 10, 5, and 1 percent levels, respectively, for a two-tailed test.

Table 3
Bond issue frequency distribution by issue characteristic and by underwriter type

This table compares issue characteristics of bonds underwritten by commercial banks to those underwritten by investment banks with the test significance level reported under the heading of "Commercial banks." The sample consists of 4,592 domestic non-convertible, fixed-rate industrial corporate bond issues from 1991 to 2000. Use same underwriter in prior bond (equity) issuance equals 1 if a client used the current lead underwriter in prior bond (equity) issuance within the 5-year period, 0 otherwise. New issue equals 1 if there is no bond issuance within 20 years prior to the current bond issuance, 0 otherwise. Refinance bank debt equals 1 if the purpose of issue is to refinance existing bank debt, 0 otherwise. Non-investment grade equals 1 if the Moody's credit rating for the bond issuance is Ba or below, 0 otherwise. Differences in percentages are tested by z-statistics with the null hypothesis that the proportions of a particular issue characteristic between underwriters are the same.

Issue types	**Commercial banks**		**Investment banks**	
	Number	**Percentage**	**Number**	**Percentage**
Total	944	100.0	3648	100.0
Use same underwriter in prior bond issuance	511	54.1***	2367	64.9
Use same underwriter in prior equity issuance	73	7.7***	464	12.7
New issue	110	11.7	458	12.6
Refinance bank debt	111	11.8***	670	18.4
Non-investment grade	99	10.5*	466	12.8

*, **, *** Significant at the 10, 5, and 1 percent levels, respectively, for a two-tailed test.

Table 4
Determinants of underwriter selections

This table reports the first-stage probit estimates and the values of z-tests of underwriter selections, i.e., equation (5) in Section 2.2. The dependent variable equals 1 if the lead underwriter is a commercial bank, and 0 if it is an investment bank. The sample consists of 4,592 domestic non-convertible, fixed-rate industrial corporate bond issues from 1991 to 2000. Model (1) contains the subsample for the 10% revenue limitation period (1991-1996). Model (2) uses the subsample for 1997-2000. Model (3) uses the full sample. Issue size is the principal amount (in $MM) of bond issuance. Period [1997-2000] equals 1 if the bond is issued during 1997-2000. Total loans are the amounts of loan deals (in $MM) aggregated for each bond issue if the issuing date is between loan origination date and loan maturity date. Section 20 bank loans are loans (in $MM) from all commercial banks with Section 20 subsidiaries. New issue equals 1 if there is no bond issuance within 20 years prior to the current bond issuance, 0 otherwise. Refinance bank debt equals 1 if the purpose of issue is to refinance existing bank debt, 0 otherwise. Tobin's q is book value of debt plus market value of equity divided by total assets. See Appendix for the definitions of control variables. Yearly dummies and constant terms are included in regressions but estimates are not reported.

Table 4 (continued)

Independent variable	(1) 1991-1996		(2) 1997-2000		(3) Full sample	
	Estimate	z-test	Estimate	z-test	Estimate	z-test
Distribution disadvantage of commercial banks						
Ln(1+issue size)	-0.26	-7.34***	-0.02	-0.76	-0.20	-6.17***
Ln(1+issue size)*period[1997-2000]	-	-	-	-	0.19	4.71***
Certification ability of commercial banks						
Ln(1+market value of equity)	-0.11	-3.08***	-0.06	-2.88***	-0.07	-3.66***
Tobin's q	0.06	1.35	0.004	0.15	0.01	0.45
New issue (indicator variable)	-0.19	-1.59	-0.11	-0.91	-0.08	-0.93
Conflicts of interest of commercial banks						
Refinance bank debt (REFBD: ind. var.)	-0.17	-1.51	-0.08	-0.63	-0.04	-0.52
Interest expense/operating income	-0.001	-0.53	-0.01	-2.66***	-0.002	-1.76*
REFBD*interest expense/operating income	0.001	0.77	0.005	2.16**	0.001	1.19
Ln(1+total loans)	-0.02	-1.30	-0.01	-0.91	-0.02	-1.73*
Section 20 bank loans/total loans	0.12	0.75	0.11	0.80	0.13	1.30
Control variables						
Cash/total assets	-0.03	-2.92***	-0.01	-2.44***	-0.01	-2.75***
Capital expenditure/total assets	-0.02	-3.20***	-0.01	-2.13**	-0.01	-3.55***
Operating income/total assets	0.004	0.6	0.003	0.45	0.001	0.15
Total debt/total assets	-0.003	-1.28	0.01	2.43**	0.002	1.27
Ln(1+no. of prior bond issues)	-0.05	-1.00	0.04	0.91	-0.01	-0.40
Ln(1+no. of prior equity issues)	0.08	0.89	0.12	1.16	0.26	3.67***
Same prior bond underwriter (ind. var.)	-0.46	-5.45***	-0.26	-3.18***	-0.34	-5.74***
Same prior equity underwriter (ind. var.)	-	-	-0.14	-1.04	-0.48	-4.86***
CB-co-manage (indicator variable)	-0.24	-2.42***	-0.16	-1.76*	-0.20	-3.06***
Hybrid syndicate (ind. var.)	-	-	0.75	7.01***	0.75	7.42***
Hybrid merger (ind. var.)	-	-	1.09	14.6***	0.80	14.9***
Issue maturity (years)	-0.005	-1.09	-0.01	-1.82*	-0.01	-2.34**
Non-investment grade (ind. var.)	0.03	0.20	-0.23	-1.39	-0.16	-1.51
Shelf-registration (indicator variable)	-0.02	-0.17	-0.08	-0.61	-0.06	-0.74
Non-callable (indicator variable)	0.36	2.82***	0.05	0.58	0.18	2.61***
Senior (indicator variable)	-0.08	-0.43	-0.34	-1.17	-0.19	-1.25
Pseudo-R^2	0.17		0.16		0.19	
No. of observations	2339		2253		4592	

*, **, *** Significant at the 10, 5, and 1 percent levels, respectively, for a two-tailed test.

Table 5
Estimates of net yield regressions by underwriter for subperiod 1991-1996

This table reports the estimates of second-stage net yield (underwriting technology) regressions for both commercial bank and investment bank underwriting, i.e., equations (3) and (4) in Section 2.2. The dependent variable, net yield (basis point spread), is the premium of the ex-ante yield spread of a bond over the ex-ante yield of a U.S. Treasury security of similar maturity. The sample consists of 1,951 domestic non-convertible, fixed-rate industrial corporate bond issues with bond net yield information during the 10% revenue limitation period (1991 to 1996). Endogenous selection terms ($\frac{\phi(Z\gamma)}{1-\Phi(Z\gamma)}$ and $\frac{-\phi(Z\gamma)}{\Phi(Z\gamma)}$ in equations (7) and (8), respectively), used to control for endogenous switching, are estimated by using the results of first-stage probit estimation in Table 4, Model (1). Issue size is the principal amount (in $MM) of bond issuance. Total loans are the amounts of loan deals (in $MM) aggregated for each bond issue if the issuing date is between loan origination date and loan maturity date. Section 20 bank loans are loans (in $MM) from all commercial banks with Section 20 subsidiaries. Underwriter loans are loans (in $MM) from commercial banks also underwrite for the bond issuers. New issue equals 1 if there is no bond issuance within 20 years prior to the current bond issuance, 0 otherwise. Refinance bank debt equals 1 if the purpose of issue is to refinance existing bank debt, 0 otherwise. Tobin's q is book value of debt plus market value of equity divided by total assets. See Appendix for the definitions of control variables. For commercial bank clients, there is no bond issue with credit rating less than B in the final sample. Monthly 3-month T-bill rate, slope of the yield curve (the rate of a 10-year U.S. Treasury security minus that of a 1-year U.S. Treasury security), and credit spreads between BBB and AAA rated bonds are used to control for underlying macroeconomic conditions, but the results are not reported. Credit ratings dummies, yearly dummies, and intercept are included, but the results are not reported. Credit rating dummies include Moody's ratings of Aa, A, Baa, Ba, B, C, and non-rated.

Table 5 (continued)

Independent variable	Commercial bank		Investment bank	
	Estimate	*t*-test	Estimate	*t*-test
Distribution disadvantage of commercial banks				
Issue size/total assets	0.27	2.29**	-0.02	-0.75
Certification ability of commercial banks				
Endogenous selection term	-6.76	-0.63	15.85	1.35
Ln(1+market value of equity)	-10.02	-2.45**	-15.09	-9.37***
New issue (indicator variable)	12.08	1.22	15.24	3.68***
Tobin's q	-9.82	-1.36	2.91	1.15
Conflicts of interest of commercial banks				
Refinance bank debt (REFBD: ind. var.)	-17.77	-1.14	-5.62	-1.63*
Ln(1+underwriter loans)	-6.22	-3.1***	-	-
REFBD*Ln(1+underwriter loans)	5.68	1.79*	-	-
Interest expense/operating income	0.25	0.99	-0.08	-2.20**
REFBD*interest expense/operating income	0.66	2.50***	0.14	2.53***
Ln(1+total loans)	2.04	1.11	0.10	0.15
Section 20 bank loans/total loans	33.01	2.33**	-2.42	-0.39
Control variables				
Cash/total assets	2.42	2.58***	1.11	4.1***
Capital expenditure/total assets	0.88	1.36	0.71	3.27***
Ln(1+number of prior bond issues)	6.50	1.22	11.76	6.24***
Same prior equity underwriter (ind. var.)	-28.84	-1.34	-15.22	-3.87***
Operating income/total assets	0.34	0.35	-1.40	-5.34***
Total debt/total assets	-0.15	-0.61	0.13	1.27
Shelf-registration (indicator variable)	-12.67	-1.37	-26.62	-6.45***
Non-callable (indicator variable)	-40.94	-3.18***	-17.50	-4.59***
Senior (indicator variable)	64.97	3.04***	22.44	3.34***
Issue maturity (years)	1.30	3.01***	0.61	5.25***
Adjusted R^2	0.88		0.84	
No. of observations	250		1701	

*, **, *** Significant at the 10, 5, and 1 percent levels, respectively, for a two-tailed test.

Table 6
Estimates of net yield regressions by underwriter for subperiod 1997-2000

This table reports the estimates of second-stage net yield (underwriting technology) regressions for commercial bank and investment bank underwriting, i.e., equations (3) and (4) in Section 2.2. The dependent variable, net yield (basis point spread), is the premium of the ex-ante yield spread of a bond over the ex-ante yield of a U.S. Treasury security of similar maturity. The sample consists of 1,776 domestic non-convertible, fixed-rate industrial corporate bond issues with bond net yield information from 1997 to 2000. Revenue limitation imposed on commercial bank underwriting was 25% from 1997 to 1999, before the enactment of the Gramm-Leach-Bliley Act. Endogenous selection terms ($\frac{\phi(Z\gamma)}{1-\Phi(Z\gamma)}$ and $\frac{-\phi(Z\gamma)}{\Phi(Z\gamma)}$ in equations (7) and (8), respectively), used to control for endogenous switching, are estimated by using the results of first-stage probit estimation in Table 4, Model (2). Issue size is the principal amount (in $MM) of bond issuance. Total loans are the amounts of loan deals (in $MM) aggregated for each bond issue if the issuing date is between loan origination date and loan maturity date. Section 20 bank loans are loans (in $MM) from all commercial banks with Section 20 subsidiaries. Underwriter loans are loans (in $MM) from commercial banks also underwrite for the bond issuers. New issue equals 1 if there is no bond issuance within 20 years prior to the current bond issuance, 0 otherwise. Refinance bank debt equals 1 if the purpose of issue is to refinance existing bank debt, 0 otherwise. Tobin's q is book value of debt plus market value of equity divided by total assets. See Appendix for the definitions of control variables. For commercial bank clients, there is no bond issue with credit rating less than B in the final sample. Monthly 3-month T-bill rate, slope of the yield curve (the rate of a 10-year U.S. Treasury security minus that of a 1-year U.S. Treasury security), and credit spreads between BBB and AAA rated bonds are used to control for underlying macroeconomic conditions, but the results are not reported. Credit ratings dummies, yearly dummies, and intercept are included, but the results are not reported. Credit rating dummies include Moody's ratings of Aa, A, Baa, Ba, B, C, and non-rated.

Table 6 (continued)

Independent variable	Commercial bank		Investment bank	
	Estimate	*t*-test	Estimate	*t*-test
Distribution disadvantage of commercial banks				
Issue size/total assets	0.80	3.90***	0.09	7.80***
Certification ability of commercial banks				
Endogenous selection term	-32.28	-1.31	2.39	0.27
Ln(1+market value of equity)	-1.99	-0.93	-4.90	-4.38***
New issue (indicator variable)	-23.02	-2.72***	10.59	2.15**
Tobin's q	-2.62	-0.73	0.51	0.74
Conflicts of interest of commercial banks				
Refinance bank debt (REFBD: ind. var.)	39.42	2.59***	-1.65	-0.30
Ln(1+underwriter loans)	0.30	0.19	-	-
REFBD*Ln(1+underwriter loans)	-6.13	-2.15**	-	-
Interest expense/operating income	0.02	0.09	0.26	3.00***
REFBD*interest expense/operating income	-1.49	-3.42***	-0.22	-2.54***
Ln(1+total loans)	-0.28	-0.19	-0.43	-0.58
Section 20 bank loans/total loans	18.46	1.69*	1.09	0.16
Control variables				
Cash/total assets	0.98	2.11**	1.28	5.49***
Capital expenditure/total assets	0.27	0.56	0.53	2.01**
Ln(1+number of prior bond issues)	-2.18	-0.86	-2.88	-1.75*
Same prior equity underwriter (ind. var.)	17.82	2.10**	7.65	1.61
Hybrid merger (ind. var.)	-26.55	-1.44	0.56	0.17
Hybrid syndicate (ind. var.)	-37.08	-2.90***	4.57	0.72
Operating income/total assets	-0.60	-1.02	-1.27	-4.90***
Total debt/total assets	0.05	0.20	0.18	1.42
Shelf-registration (indicator variable)	8.92	0.79	28.98	4.86***
Non-callable (indicator variable)	-12.51	-1.90*	-11.42	-3.20***
Senior (indicator variable)	18.38	0.91	-57.07	-3.85***
Issue maturity (years)	1.37	4.82***	0.83	7.13***
Adjusted R^2	0.75		0.69	
No. of observations	525		1251	

*, **, *** Significant at the 10, 5, and 1 percent levels, respectively, for a two-tailed test.

Table 7
Estimates of net yield regressions by underwriter type for full sample

This table reports the estimates of second-stage net yield (underwriting technology) regressions for commercial bank and investment bank underwriting, i.e., equations (3) and (4) in Section 2.2. The dependent variable, net yield (basis point spread), is the premium of the ex-ante yield spread of a bond over the ex-ante yield of a U.S. Treasury security of similar maturity. The sample consists of 3,727 domestic non-convertible, fixed-rate industrial corporate bond issues with bond net yield information from 1991 to 2000. Revenue limitations imposed on commercial bank underwriting was 10% during the period of 1991-1996 and was 25% from 1997 to 1999, before the enactment of the Gramm-Leach-Bliley Act. Endogenous selection terms ($\frac{\phi(Z\gamma)}{1-\Phi(Z\gamma)}$ and $\frac{-\phi(Z\gamma)}{\Phi(Z\gamma)}$ in equations (7) and (8), respectively) used to control for endogenous switching are estimated by using the results of first-stage probit estimation in Table 4, Model (3). Issue size is the principal amount (in $MM) of bond issuance. Total loans are the amounts of loan deals (in $MM) aggregated for each bond issue if the issuing date is between loan origination date and loan maturity date. Section 20 bank loans are loans (in $MM) from all commercial banks with Section 20 subsidiaries. Underwriter loans are loans (in $MM) from commercial banks also underwrite for the bond issuers. New issue equals 1 if there is no bond issuance within 20 years prior to the current bond issuance, 0 otherwise. Refinance bank debt equals 1 if the purpose of issue is to refinance existing bank debt, 0 otherwise. Tobin's q is book value of debt plus market value of equity divided by total assets. See Appendix for the definitions of control variables. For commercial bank clients, there is no bond issue with credit rating less than B in the final sample. Monthly 3-month T-bill rate, slope of the yield curve (the rate of a 10-year U.S. Treasury security minus that of a 1-year U.S. Treasury security), and credit spreads between BBB and AAA rated bonds are used to control for underlying macroeconomic conditions, but the results are not reported. Credit ratings dummies, yearly dummies, and intercept are included, but the results are not reported. Credit rating dummies include Moody's ratings of Aa, A, Baa, Ba, B, C, and non-rated.

Table 7 (continued)

Independent variable	Commercial bank		Investment bank	
	Estimate	*t*-test	Estimate	*t*-test
Distribution disadvantage of commercial banks				
Issue size/total assets	0.47	4.33***	0.07	7.13***
Certification ability of commercial banks				
Endogenous selection term	-7.19	-0.65	20.11	1.97**
Ln(1+market value of equity)	-5.72	-3.17***	-8.78	-9.42***
New issue (indicator variable)	-6.55	-1.01	14.02	4.26***
Tobin's q	-3.70	-1.15	-	-
Conflicts of interest of commercial banks				
Refinance bank debt (REFBD: ind. var.)	-11.15	-1.01	-3.61	-1.26
Ln(1+underwriter loans)	-1.96	-1.60	-	-
REFBD*Ln(1+underwriter loans)	-0.86	-0.38	-	-
Interest expense/operating income	0.13	1.02	-0.02	-0.67
REFBD*interest expense/operating income	0.49	2.24**	0.04	1.27
Ln(1+total loans)	0.89	0.76	-0.60	-1.22
Section 20 bank loans/total loans	20.79	2.37**	7.91	1.71*
Control variables				
Cash/total assets	1.01	2.63***	0.79	4.49***
Capital expenditure/total assets	0.33	0.85	0.68	3.94***
Ln(1+number of prior bond issues)	1.62	0.70	3.21	2.56***
Same prior equity underwriter (ind. var.)	1.30	0.15	-6.72	-2.04**
Hybrid merger (ind. var.)	-5.68	-0.70	7.74	1.82*
Hybrid syndicate (ind. var.)	-23.00	-2.82***	15.33	2.26**
Operating income/total assets	-0.10	-0.20	-1.41	-8.10***
Total debt/total assets	-0.18	-1.06	0.23	2.87***
Shelf-registration (indicator variable)	-5.80	-0.78	-13.83	-4.03***
Non-callable (indicator variable)	-21.30	-3.65***	-17.36	-6.47***
Senior (indicator variable)	33.01	2.25**	-	-
Issue maturity (years)	1.25	5.27***	0.67	7.72***
Adjusted R^2	0.78		0.78	
No. of observations	775		2952	

*, **, *** Significant at the 10, 5, and 1 percent levels, respectively, for a two-tailed test.

Table 8
Performance comparisons of commercial bank underwriting versus investment bank underwriting using conditional mean net yield differentials

This table reports the conditional mean net yield differentials between commercial bank and investment bank underwriting. The net yield differential for firm i underwritten by a commercial bank rather than by an investment bank is given by equation (9):

$$E(y_{2i} \mid I_i = 1) - y_{1i} = X_i\beta_2 + \sigma_{2\varepsilon}\frac{\phi(Z\gamma)}{1-\Phi(Z\gamma)} - y_{1i}$$

The net yield differential for firm i choosing investment bank underwriting can be defined similarly. In other words, the net yield differentials are the predicted net yields had the clients used the unselected underwriters minus the observed net yields of bonds underwritten by selected underwriters. Thus, the clients are held constant when comparing between different underwritings. Therefore, a positive number indicates that, for a particular client, the selected underwriter obtains a lower net yield (higher bond price) than the unselected underwriter. The predicted net yields are estimated by using the net yield regressions reported in Tables 5, 6 and 7 depending on the corresponding time periods. The sample consists of domestic nonconvertible, fixed-rate industrial corporate bond issues with the credit ratings of B or above in the period from 1991 to 2000 because there are no bonds underwritten by commercial banks credit ratings below B in the final sample. Net yield (basis point spread) is the premium of the ex-ante yield spread of a bond over the ex-ante yield of a U.S. Treasury security of similar maturity. The t-statistics are reported. The tested null hypothesis is that the differential is equal to zero.

	Clients have chosen commercial banks			Clients have chosen investment banks		
	N	Mean	*t*-test	N	Mean	*t*-test
Full Sample (1991-2000)	775	40.72	21.0***	2947	18.49	9.7***
Subsample (1991-1996)	250	37.41	11.9***	1697	10.26	5.9***
Subsample (1997-2000)	525	5.68	2.26**	1250	47.58	5.6***

*, **, *** Significant at the 10, 5, and 1 percent levels, respectively, for a two-tailed test.

Table 9
Estimates of unconditional mean net yields by client type and underwriter type

This table reports the unconditional mean net yields that are estimated by using the net yield regressions (excluding the endogenous selection terms) reported in Table 7. The numbers reported under the heading of "Having CB underwriting" are estimated using the net yield regression of commercial bank underwriting in Table 7. The numbers under the heading of "Having IB underwriting" are estimated using the net yield regression of investment bank underwriting. The sample consists of domestic nonconvertible, fixed-rate industrial corporate bond issues with the credit ratings of B or above in the period from 1991 to 2000 because there are no bonds underwritten by commercial banks with credit ratings below B. Net yield (basis point spread) is the premium of the ex-ante yield spread of a bond over the ex-ante yield of a U.S. Treasury security of similar maturity. CB stands for commercial bank, IB for investment bank. The difference between the two types of underwriters in means is tested by *t*-test.

	N	Having CB underwriting	Having IB underwriting	Difference between CB and IB underwriting	*t*-test
All Clients	3722	143.3	136.5	6.8	5.1***
Clients have chosen CB	775	**132.5**	142.0	-9.5	-11.3***
Clients have chosen IB	2947	146.1	**135.1**	11.0	6.7***

*, **, *** Significant at the 10, 5, and 1 percent levels, respectively, for a two-tailed test.