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Credit ratings and IPO pricing☆

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ABSTRACT

We examine the effects of credit ratings on IPO pricing. The evidence from U.S. common share IPOs during 1986–2004 shows that when firms go public, those with credit ratings are underpriced significantly less than firms without credit ratings. Credit rating levels, however, do not have a significant effect on IPO underpricing. The existence of credit rating reduces uncertainty about firm value. It is the value certainty that matters, not the value *per se*. Credit ratings also reduce the degree of price revision during the bookbuilding process and the aftermarket volatility in the post-IPO period. The evidence suggests that credit ratings convey useful information in reducing value uncertainty of the issuing firms as well as information asymmetry in the IPO markets.

1. Introduction

Credit ratings reduce information asymmetry in the financial markets by disseminating important information about firm value to uninformed investors. Sufi (in press) shows that borrowers who obtain syndicated loan ratings by Moody's and Standard & Poor's gain access to the capital of less-informed investors, and they are able to raise more funds in debt financing. Consistent with the notion that credit ratings reduce information asymmetry between the lead arranger and participant lenders in the original syndication, Sufi (2007) finds that lead bank has to retain a larger share of the loan when the borrowing firms do not have credit ratings. In contrast, when the borrowers have credit ratings, the syndicate loans are dispersed among more loan participants. Faulkender and Petersen (2006) show that credit ratings reduce the credit constraints faced by public firms by enabling firms with ratings to raise more debt. Boot et al. (2006) provide a rationale for credit ratings and show in their model that credit ratings serve as a focal point in that all investors rationally base their investment and pricing decisions on the rating.

While many studies have focused on the role of credit ratings in the debt market, Liu and Malatesta (2006) show that credit ratings can facilitate firms' seasoned equity offerings (SEOs) as well. Liu and Malatesta find that SEOs of firms with credit ratings are underpriced significantly less than those without credit ratings. They attribute their findings to the fact that credit ratings reduce information asymmetry in SEOs. We argue that if credit ratings can indeed reduce information asymmetry, then credit ratings should play a more significant role in the initial public offerings (IPOs) market. Because most IPO firms are less known to the

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market than the returning SEO firms, the information asymmetry problem is even more severe in the IPO market than in the SEO market.

The objective of this paper is to examine the effects of credit ratings on IPO pricing. We extend the work of Liu and Malatesta (2006) from the SEO to the IPO markets. Specifically, we investigate whether credit ratings can significantly lower the magnitude of IPO underpricing and price revision by reducing the value uncertainty about the issuing firm, as well as the information asymmetry among the players in the IPO markets.

We examine a sample of U.S. common share IPOs from 1986 to 2004 and report four major findings. First, the IPO firms that have credit ratings when they go public (rated IPOs) are underpriced significantly less than the IPO firms without credit ratings (unrated IPOs). Second, besides the existence of credit ratings, we also test the effects of credit rating levels on IPO underpricing. The results show that credit rating levels do not have a significant effect on IPO underpricing. This finding is consistent with the information asymmetry explanation of IPO underpricing. IPO firms with high credit ratings are not necessarily underpriced less than those with low ratings. The existence of a credit rating reduces uncertainty about firm value. It is the value certainty that matters, not the value *per se*. Third, credit ratings reduce the degree of price revision during the bookbuilding process, which is consistent with the information revelation theory of bookbuilding that is based on the information asymmetry between the informed investors and the underwriter. Last, credit ratings also reduce the aftermarket volatility in the post-IPO period, which supports our conjecture that credit ratings reduce value uncertainty of the issuing firm.

In our analysis, we attempt to control for the endogeneity of the firms' decision to have credit ratings. Firms determine whether they receive credit ratings, and they choose to get ratings when the benefits, such as reduction in future IPO underpricing, outweigh the costs of securing credit ratings. Endogeneity occurs when the firm characteristics affecting the firm's choice of having a credit rating also determine its IPO pricing. We use three alternative econometric methods that account for the endogenous selection of having a credit rating. First, we use the Heckman treatment effect model to control for self-selection bias. Second, we use maximum likelihood estimation to jointly estimate the selection and treatment equations. Third, we use a generated instrumental variable approach to mitigate the effect of endogeneity of having a credit rating. Our evidence verifies the existence of self-selection of rated firms and our results are robust to the three alternative econometric methods. Although we cannot completely rule out alternative explanations of the negative association between credit rating and IPO underpricing, the results are consistent with our conjecture that credit ratings reduce value uncertainty of the issuing firms as well as information asymmetry in the IPO markets.

This paper broadens our understanding of the role played by credit rating in the capital markets by connecting IPO underpricing with credit rating. Our findings suggest that credit rating can significantly reduce the cost of equity for IPO firms. It adds evidence to support the information asymmetry explanation of IPO underpricing.

2. Literature review

A large volume of literature has shown the existence of IPO underpricing, starting from Logue (1973), Ibbotson (1975), Ritter (1984), among others. In general, the literature suggests that many companies leave substantial money on the table when they go public. The shares offered to investors are underpriced compared to the closing price on the first trading day. According to Ljungqvist (2007), the average IPO underpricing has been about 19% in the U.S. since the 1960s.[1]

While there have been several strands of theories to explain IPO underpricing, many of the theoretical explanations relate to the information asymmetry in the capital markets. The first strand of literature is the winner's curse model (Rock, 1986). Rock assumes information heterogeneity among investors: some investors are better informed about the quality of IPO firms. Well-informed investors bid only for attractive IPO firms, leaving uninformed investors bidding for the overpriced IPOs. To ensure continued participation of uninformed investors, IPO firms use underpricing to compensate for losses experienced by uninformed investors due to the winner's curse. Leite (2007) generalizes the informational environment of Rock's model to make it consistent with the empirical results in the IPO literature. Gondat-Larralde and James (2008) show that an underwriter has incentive to preferentially allocate, on average, underpriced shares to a coalition of investors who can acquire information to avoid overpriced IPOs. Thus, information asymmetry in the IPO process is crucial to both share pricing and allocation.

Similar to the winner's curse reasoning, Michaely and Shaw (1994) argue that an increase in information homogeneity should mitigate the winner's curse problem, thereby lowering underpricing. They study master limited partnership (MLP) IPOs. Because institutional investors largely avoid IPOs of MLPs for tax reasons, Michaely and Shaw (1994) argue that information is more homogeneously distributed among investors of MLPs. They find that the average underpricing among 39 MLP IPOs completed between 1984 and 1988 is −0.04%, while that of non-MLP IPOs is 8.5% over the same period; a result consistent with the winner's curse model.

Beatty and Ritter (1986) suggest that expected underpricing is positively related to the ex ante uncertainty of investors regarding the IPO firm's value. For investors, the costly information in the IPO process is analogous to a call option on the IPO, with the strike price comparable to the IPO offer price. The value of the call option increases with the level of uncertainty of the issuer's value. Therefore, the greater the uncertainty of the firm's value, the more investors will ask for a lower IPO price to make the value of the call option higher. Thus, the degree of ex ante uncertainty is positively correlated with higher IPO underpricing.

[1] Ritter and Welch (2002) and Ljungqvist (2007) offer comprehensive reviews of the IPO literature.

Schenone (2004) studies the effect of banking relations on the firm's IPO underpricing. She finds that firms with a pre-IPO banking relation with a prospective underwriter, on average, have about 17% less IPO underpricing. Hence, *a prior* banking relations help alleviate the information asymmetry between the IPO firms and the underwriters.

The second strand of the literature examines IPO underpricing from the perspective of the issuer. IPO underpricing is clearly a cost to issuers, and thus, they have an incentive to reduce this cost. Habib and Ljungqvist (2001) model issuers' optimal behavior and show that issuing firms will take costly action to reduce information asymmetry up to the point where the marginal cost of such action equals the marginal benefit. One way to do so is to hire a reputable underwriter. By agreeing to take a firm public, the investment bank puts its own reputation at stake and a prestigious underwriter certifies the quality of the issuing firm. The empirical evidence, however, is mixed. While studies using data from the 1970s and 1980s (e.g., Carter and Manaster, 1990; Megginson and Weiss, 1991) show that more prestigious investment banks are associated with lower underpricing, Beatty and Welch (1996) find a positive relation between underwriter reputation and IPO underpricing based on data from the early 1990s. Loughran and Ritter (2004) argue that the principal–agent conflicts between isssuers and underwriters, as well as investment banks' rent-seeking behavior, cause underwriters to underprice IPOs strategically. Fung et al. (2004) and Leung and Menyah (2006) show that British- and Asian-style IPOs have less underpricing because issuers earn extra interest with prepaid funds from IPO investors in the subscription process.

The third strand of IPO underpricing literature examines the bookbuilding and underwriter relation. The information revelation theory of IPO underpricing focuses on the asymmetric information problem between informed investors and the underwriter, as well as the role of the bookbuilding process in resolving this problem. Underwriters play a vital role in finalizing the issue price and allocating IPO shares. Benveniste and Spindt (1989) show that underwriters use bookbuilding as a mechanism to extract private information from informed investors. Benveniste and Spindt (1989) explain that underwriters can use their discretion over share allocation to induce information revelation from better-informed investors during the bookbuilding process. If an informed investor downplays his true interests in the issue by hiding the positive information about the issuer, the underwriter can punish him by allocating fewer shares. Conversely, investors who truthfully show their private information by bidding aggressively will get more shares. If bookbuilding effectively shows the investors' private information, the empirical implication is that the greater the information asymmetry between the underwriter and the informed investors, the larger the price revision will be during the bookbuilding process.

With respect to the credit rating literature, studies have shown that credit ratings convey information beyond what was incorporated into the price of financial claims. Ederington and Yawitz (1987) state, "the rating agencies claim to receive inside information unavailable to stock analysts such as minutes of board meetings, profit breakdowns by product, and new product plans. They claim that a 'Chinese wall' prevents even their own stock analysts from having access to this information." Hand et al. (1992) find a negative stock market reaction to a bond rating downgrade. Ederington and Goh (1998) further show that the negative market reaction is not due to earlier negative information or current earnings but to the downgrade itself.

Boot et al. (2006) show in their model that credit ratings provide a "focal point" for firms and their investors. Boot et al. explain that by listing firms on credit watch, credit rating agencies play a monitoring role and pressure firms to improve their credit quality. In brief, the information produced by credit rating agencies helps disseminate private information to the market.

3. Hypotheses development

Credit rating agencies provide investors with an independent assessment of firms' risk profiles and help transmit information to uninformed investors. Credit ratings can also convey inside information about the issuing firms that investors cannot obtain from public sources. For instance, corporations often provide rating agencies with their strategic plans and forward-looking projections during the rating process,[2] and hence, credit ratings can incorporate privately disclosed information without fully disclosing specific details.

Since the IPO underpricing phenomenon can be, in part, attributed to information asymmetry in the capital markets, we contend that a fair and trustworthy evaluation of firm performance by major credit rating agencies can alleviate the information asymmetry during the IPO process, and thus reduce IPO underpricing. Our first testable hypothesis is:

H1. Other things being equal, firms with credit ratings when they go public are underpriced significantly less than firms without credit ratings.

Next, we examine the effects of credit rating levels on IPO underpricing. According to the information asymmetry explanation of IPO underpricing, it is the value uncertainty that affects underpricing, not the value *per se*. Credit rating levels describe the financial strength and creditworthiness of rated firms; rating levels may affect the value of the rated firms. However, once rating levels (high or low) are assigned, they should not affect the value uncertainty of the IPO firms differently. Our second testable hypothesis is:

H2. Other things being equal, credit rating levels do not have a significant effect on IPO underpricing.

Investment banks market the IPO issue during the road show and seek to elicit more information about the true value of the issuing firm from investors. Hanley (1993) argues that the degree of price revision can be considered as a measure of information released during the bookbuilding process. To the extent that credit ratings alleviate information asymmetry in the IPO process,

[2] Credit rating agencies are excluded from Regulation FD so they can continue to receive private information from firms.

Table 1
IPO firms with credit ratings

Year	*N*	Percentage (%)
1986	3	2
1987	5	3
1988	2	1
1989	4	2
1990	3	2
1991	10	6
1992	10	6
1993	20	12
1994	9	6
1995	18	11
1996	16	10
1997	15	9
1998	7	4
1999	12	7
2000	11	7
2001	5	3
2002	3	2
2003	1	1
2004	7	4
Grand total, 1986–2004	161	100

This table shows the time distribution of 161 U.S. IPO firms that have credit ratings before they go to public from 1986 to 2004. Data is obtained from SDC's New Issues Database and Compustat.

there is relatively less information that the investment banks need to extract from investors when setting the issue price for rated IPO firms. Thus, the degree of price revision during the bookbuilding process is smaller for the rated IPOs than the unrated ones. Our third testable hypothesis is:

H3. Other things being the same, the degree of price revision during the bookbuilding process is smaller for rated IPOs than unrated IPOs.

Our last testable hypothesis is about the aftermarket volatility of IPO stocks in the post-IPO period. Ritter (1984), among others, uses aftermarket volatility as a risk proxy for IPO stocks. If credit ratings reduce value uncertainty of the issuing firm as well as information asymmetry in the market, rated IPOs should be less risky and display less aftermarket volatility than the unrated IPOs. Our last testable hypothesis is:

H4. Other things being equal, aftermarket volatility of IPO stocks with credit ratings is significantly less than that of IPOs without ratings.

Table 2
Credit rating level

Credit rating level	Data item 280	*CRLEVEL*	*N*	Percentage (%)
D	27	1		
C	24	2		
CC	23	3		
CCC−	21	4		
CCC	20	5		
CCC+	19	6	3	2
B−	18	7	10	6
B	17	8	18	11
B+	16	9	68	42
BB−	15	10	31	19
BB	14	11	6	4
BB+	13	12	4	2
BBB−	12	13	2	1
BBB	11	14	6	4
BBB+	10	15	1	1
A−	9	16	2	1
A	8	17	4	2
A+	7	18	1	1
AA−	6	19	3	2
AA	5	20	1	1
AA+	4	21	1	1
AAA	2	22		
Grand total			161	100

This table shows the credit rating levels of 161 U.S. IPO firms from 1984 to 2004 reported in SDC. Data item 208 is from Compustat. *CRLEVEL* is a number assigned to each credit rating level. *N* is number of IPO firms with the same credit rating levels.

4. Data

The sample consists of U.S. common share IPOs from 1986 to 2004 reported in Thomson Financial SDC Platinum (SDC)'s New Issues Database. To construct a homogeneous sample, we follow the literature and exclude American depositary receipts (ADRs), closed-end funds, real estate investment trusts, financial institutions (SIC codes 6000–6999), unit offerings, and IPOs with an offer price below $5.00 per share. SDC provides IPO issue data such as offer price, initial filling price, and gross proceeds. Stock price and shares outstanding data are taken from the Center for Research in Security Prices (CRSP).

We obtain accounting and credit rating data from Compustat. The credit ratings used in this study are from Standard & Poor's Long-Term Domestic Issuer Credit Rating (Compustat data item 280). According to Compustat, this rating is a firm's "corporate credit rating," which is a "current opinion on an issuer's overall capacity to pay its financial obligations." Credit rating data is first available in 1985 from Compustat and 1 year of lagged data is required for most tests in this study.

Among all 5141 IPO firms in our initial sample, 161 firms have credit ratings before going public. Table 1 shows the distribution of these rated IPOs over time. The largest number of 20 rated IPOs is in 1993.

Table 2 shows the distribution of the credit rating levels. Among the rated IPOs, 42% are rated B+, 19% are rated BB−, the lowest credit rating is CCC+, and the highest is AA+.

We present the summary statistics of the variables in Table 3. On average, the underpricing is about 22% during this period with a median of about 8%. Because some IPO firms are missing selected financial information, our sample is reduced to 3848 in our analysis. Among the reduced sample, 146 are rated IPOs.

5. Methodology

To examine the effect of having a credit rating on IPO pricing, we estimate the following treatment effect model:

$$Y_i = \alpha + \beta \cdot X_i + \gamma \cdot CRD_i + \varepsilon_i, \tag{1}$$

where Y_i is IPO underpricing (or the degree of price revision). X_i is a set of exogenous explanatory variables, and β is a vector of parameters to be estimated. ε_i is an error term. CRD_i is a dummy variable equal to one if the firm has a credit rating. γ is the parameter of interest, which measures the average treatment effect of having a credit rating on IPO pricing.

The OLS estimate of γ is unbiased only if *CRD* is statistically independent of the potential IPO pricing, as would occur when the assignment of the credit rating is randomized across firms. In reality, firms at least partly determine whether they receive credit ratings, and their decisions are related to the firm-specific benefits of having credit ratings. A firm would choose to get a credit

Table 3
Summary statistics

Variable	*N*	Mean	Median	Std Dev	25th Pctile	75th Pctile
CRD	5140	0.03	0.00	0.17	0.00	0.00
UNDERPRICE	5140	0.22	0.08	0.47	0.00	0.25
REVISION	5132	0.02	0.00	0.27	−0.11	0.10
AGE	4965	14.02	7.00	19.16	4.00	15.00
EXCHANGE	5141	0.78	1.00	0.42	1.00	1.00
LEV	4741	0.39	0.28	0.60	0.07	0.54
LOGSALES	4674	16.60	17.13	3.73	15.91	18.36
LOGPROCDS	5141	17.35	17.32	1.15	16.61	18.01
PRIMARY	5141	0.64	1.00	0.48	0.00	1.00
FLOAT	5141	0.66	0.30	13.30	0.22	0.40
RETNC	5141	0.01	0.01	0.05	−0.01	0.04
RANK	5138	7.36	8.00	2.12	7.00	9.00
GROWTH	4963	1.32	0.00	19.72	0.00	0.13
VENTURE	5141	0.42	0.00	0.49	0.00	1.00
ALTMAN Z	4336	1.31	2.18	5.93	0.57	3.41
INDFRAC	4909	0.11	0.07	0.11	0.03	0.15
TANGIBILITY	4728	0.40	0.29	0.35	0.15	0.55
PROFIT	4656	−0.11	0.12	2.03	−0.14	0.22

This table shows the summary statistics of the major variables in this study. *CRD* is equal to one if the firm has a credit rating in the year prior to the IPO and zero otherwise. *UNDERPRICE* is the percentage difference between the offer price and the closing price on first trading date. *REVISION* is the percentage difference between the offer price and the midpoint of the initial filling price. *AGE* is the difference between the firm's IPO year and founding year. *LEV* is the debt-to-assets ratio in the year prior to IPO. *EXCHANGE* is equal to one if the firm is listed on Nasdaq and zero otherwise *LOGSALES* is the logarithm of the net sales in the year prior to IPO. *LOGPROCDS* is the logarithm of global proceeds. *PRIMARY* is equal to one if the IPO is purely primary and zero otherwise. *FLOAT* represents the ratio of the number of shares issued to the number of shares outstanding after the offering. *RETNC* represents the cumulative 15-trading day return of the Nasdaq composite index prior to the offer date. *RANK* is the ranking of underwriters based on Loughran and Ritter (2004). *GROWTH* is R&D scaled by sales. *VENTURE* is a categorical variable equal to one if the firm is venture-backed. *ALTMAN Z* is calculated as $Z = 6.56 \cdot$(Working Capital/Total Assets) + $3.26 \cdot$(Retained Earnings/Total Assets) + $6.72 \cdot$(Earnings Before Interest and Taxes/Total Assets) + $1.05 \cdot$(Book Value of Equity/Book Value of Total Liabilities). *INDFRAC* is the log of one plus the fraction of firms in the same three-digit industry that have credit ratings. *TANGIBILITY* is the ratio of the firm's property, plant, and equipment to total assets. *PROFIT* is the ratio of earnings before interest, taxes, depreciation, and amortization to total assets.

rating when the benefits, such as reduction in future IPO underpricing, outweigh the costs of securing a rating. Specifically, we model the firm's decision to obtain a credit rating by:

$$\begin{aligned} CRD_i^* &= \boldsymbol{\omega} \cdot Z_i + \eta_i \\ CRD_i &= 1 \text{ if } CRD_i^* > 0 \\ CRD_i &= 0 \text{ if } CRD_i^* < 0, \end{aligned} \tag{2}$$

where CRD_i^* is a latent variable. Z_i is a set of observable variables influencing the firm's choice of having a credit rating. $\boldsymbol{\omega}$ is a set of coefficients, and η_i is an error term. Firm characteristics affecting the firm's choice of having a rating could also determine its IPO pricing at a later stage. Some of these variables, such as the value of R&D projects, are not observable, and hence, are included in the two error terms: ε_i in Eq. (1) and η_i in Eq. (2). In this case, the correlation between ε_i and η_i will result in the endogeneity in Eq. (1). That is, CRD_i is correlated with ε_i.

To account for the endogenous selection, we use three methods to obtain an unbiased estimator of γ.

5.1. Heckman treatment effect model

We first use the Heckman treatment effect model to control for the self-selection bias. In the first stage, we estimate the selection equation using a probit regression to obtain estimates of $\boldsymbol{\omega}$ in Eq. (2), denoted by $\hat{\boldsymbol{\omega}}$. Based on whether the firm has a rating or not, the self-selection correction term, $\hat{\lambda}$, or the inverse Mills ratio is estimated as follows:

$$\hat{\lambda}_i = \frac{\phi\left(\hat{\boldsymbol{\omega}} \cdot Z_i\right)}{\Phi\left(\hat{\boldsymbol{\omega}} \cdot Z_i\right)} \quad \text{if } CRD_i = 1$$

$$\hat{\lambda}_i = \frac{-\phi\left(\hat{\boldsymbol{\omega}} \cdot Z_i\right)}{1-\Phi\left(\hat{\boldsymbol{\omega}} \cdot Z_i\right)} \quad \text{if } CRD_i = 0$$

where Φ and ϕ denote, respectively, the cumulative and density distribution function of the standard normal distribution.

In the second stage, $\hat{\lambda}$ is added in Eq. (1) and the main regression can be consistently estimated using OLS.

5.2. Maximum likelihood estimation

In addition to the two-stage procedure, we also use maximum likelihood estimation (MLE) to estimate the selection and main equations simultaneously. MLE will be more efficient than the two-stage procedure if the error terms in Eqs. (1) and (2), ε_i and η_i, have a bivariate normal distribution.

Based on the MLE two-equation estimation, we can test the null hypothesis that the two error terms, ε_i in Eq. (1) and η_i in Eq. (2), are independent using a likelihood-ratio test. The appropriate test statistic is asymptotically distributed as chi-square with one degree of freedom. The null can be rejected if the unobservable firm characteristics affecting the firms' choice of having credit ratings also determine their future IPO underpricing.

5.3. Instrumental variable approach

Because the endogenous variable, *CRD*, in the main regression is binary, Eq. (1) is called a dummy endogenous variable model (Heckman, 1978). Wooldridge (2002, p. 623) offers a generated instrumental variable (IV) approach to exploit the binary nature of the endogenous explanatory variable. Specifically, in stage one, we estimate Eq. (2) using probit to obtain the fitted probabilities of having a credit rating. In the second stage, we estimate Eq. (1) by the two-stage least squares (2SLS) using the fitted probabilities from stage one as an instrument for *CRD*. This approach has been used in the finance literature to deal with the endogenous selection issue (e.g., Campa and Kedia, 2002; Faulkender and Petersen, 2006; Lin and Su, 2008).

The generated IV approach has a nice robustness property. Because we use the fitted probabilities as an instrument for *CRD*, the specification of Eq. (2), i.e., the selection equation, does not have to be perfectly correct. This robustness property is important in our case. Because the determinants of having credit ratings are not particularly well-defined in the literature,[3] the generated IV approach will provide a necessary robustness check for the results from the treatment effect models. The generated IV approach requires *Z* to be partially correlated with *CRD*; we will discuss the rating determinants and the probit estimates in more detail in the next section.

6. Probability of a firm having a credit rating

In this section, we estimate the probability of a firm having a rating using a probit model, which is the first-stage regression of both the Heckman treatment effect model and the generated IV approach.

[3] We thank the Editor for making this point.

Table 4
Probit estimates for the probability of having a credit rating

Independent variable	Coefficient	*t*-Statistic
AGED	0.040	0.34
LOGSALES	0.495***	13.04
GROWTH	−1.814	−1.49
TANGIBILITY	−0.123	−0.72
PROFIT	−0.102	−0.26
LEV	1.454***	7.52
ALTMAN Z	0.056***	5.56
INDFRAC	1.414***	2.59
Pseudo-R^2		0.426
Observations		3942

This table reports the results of a probit regression that assesses the probability of having a credit rating for a sample of U.S. IPOs from 1984 to 2004. *AGED* is equal to 1 if the firm was at least five-year old before its IPO and 0 otherwise. *LOGSALES* is the logarithm of the net sales in the year prior to IPO.*GROWTH* is R&D scaled by sales. *TANGIBILITY* is the ratio of the firm's property, plant, and equipment to total assets. *PROFIT* is the ratio of earnings before interest, taxes, depreciation, and amortization to total assets. *LEV* is the debt-to-assets ratio in the year prior to IPO. *ALTMAN Z* is calculated as $Z = 6.56 \cdot$(Working Capital/Total Assets) + $3.26 \cdot$(Retained Earnings/Total Assets) + $6.72 \cdot$(Earnings Before Interest and Taxes/Total Assets) + $1.05 \cdot$(Book Value of Equity/Book Value of Total Liabilities). *INDFRAC* is the log of one plus the fraction of firms in the same three-digit industry that have credit ratings. An asterisk indicates significance at the 10% level; two indicate significance at the 5% level; three indicate significance at the 1% level.

We follow the literature to include the variables in *Z* as the determinants of the existence of a credit rating. Faulkender and Petersen (2006) and Liu and Malatesta (2006) argue that a firm is more likely to have a credit rating when it is larger, older, more profitable, has more tangible assets, and less growth opportunities.

Large firms are more likely than small firms to have credit ratings due to the large fixed cost of issuing public debt and securing credit ratings. We use *LOGSALES*, the log of net sales, as a proxy for firm size.

More mature firms are better known to the financial markets because they have sufficient track records in tapping the public debt market, and hence, they are more likely to obtain credit ratings. To capture the age effect, we include a dummy variable *AGED*, which takes the value of 1 if the firm is at least 5 years old before its IPO.[4] We calculate Age as the difference between the firm's IPO year and its founding year.

Profitable firms are less likely to obtain credit ratings because they have more internal funds and hence less demands for external funds, including public debt. As a proxy for profitability, *PROFIT* is measured by the ratio of earnings before interest, taxes, depreciation, and amortization to total assets.

Because fixed assets can be used as collateral, it may be easier for a firm with more tangible assets to issue public debt, thereby securing a credit rating. *TANGIBILITY* is measured as the ratio of the firm's property, plant, and equipment to total assets.

Previous literature suggests that firms with significant growth opportunities tend to use private debt (e.g., bank loans) rather than public debt. Since the market-to-book ratio is not available in the year prior to IPO, we use a firm's spending on R&D (scaled by net sales) as an alternative control for the firm's growth opportunities.

Additionally, Denis and Mihov (2003) argue that existing leverage indicates the firm's reputation in credit markets. They find that firms with high leverage are more likely to issue public debt. We include *LEV* as the debt-to-assets ratio in the year prior to IPO.

Some of the variables in *Z* are instrumental variables, which mean they correlate to the existence of a credit rating but do not affect the IPO pricing directly. Faulkender and Petersen (2006) demonstrate that a firm is more likely to have a credit rating if a large fraction of firms in the same industry have credit ratings and outstanding public debt. For each firm, we calculate the fraction of firms in the same three-digit industry that have credit ratings and include *INDFRAC*, the log of one plus this fraction, in the probit estimation.[5]

Denis and Mihov (2003) show that credit quality of the issuer is the primary determinant of the debt source, and firms with the highest credit quality issue public debt. We follow Denis and Mihov (2003) and use Altman's *Z*-score as an indicator of default risk. The original Altman's (1968) *Z*-score is designed to predict the likelihood of a public firm going bankrupt within 1 or 2 years. Since the firm was still private in the year prior to IPO, we adopt a modified version of Altman's (2000) *Z*-score for private firms. Specifically, *Z*-score is calculated as follows:

$$\begin{aligned} Z = {} & 6.56 \cdot (\text{Working Capital}/\text{Total Assets}) + 3.26 \cdot (\text{Retained Earnings}/\text{Total Assets}) \\ & + 6.72 \cdot (\text{Earnings Before Interest and Taxes}/\text{Total Assets}) \\ & + 1.05 \cdot (\text{Book Value of Equity}/\text{Book Value of Total Liabilities}). \end{aligned}$$

The higher the *Z*-score, the lower the likelihood of bankruptcy. Both time-fixed effect and industry-fixed effect dummy variables are included in the probit regression. Industry-fixed effect dummy variables are based on the first two digits of a firm's SIC code according to the classification used by Song and Walkling (1993).

Table 4 reports the estimates of the probit coefficients. Consistent with the literature, larger firms and those with better reputations in the debt market are more likely to have credit ratings. Similar to the findings of Liu and Malatesta (2006) and

[4] Other age cut-offs, such as three, seven, and ten, deliver similar results.
[5] We also calculate the sale-weighted and asset-weighted fraction and obtain similar results.

Faulkender and Petersen (2006), more profitable firms and those with more growth opportunities are less likely to have credit ratings. Both instrumental variables are significant at the 1% level. Firms that operate in industries with higher proportions of rated firms and those with higher Altman's *Z*-scores are more likely to have credit ratings. The pseudo-R^2 of the probit regression is 42.6%.

7. Effects of credit ratings on IPO underpricing

In this section, we study the effects of having credit ratings on IPO underpricing.

7.1. Variables specification

The dependent variable *UNDERPRICE* is IPO underpricing estimated as the percentage difference between the offer price and the closing price on the first trading date.

The variable in interest is *CRD*, a binary variable indicating the existence of credit ratings. The estimated coefficient of *CRD* is expected to be negative according to Hypothesis 1, which states that credit ratings reduce information asymmetry, thereby lowering IPO underpricing.

Following the IPO literature, we control for the company characteristics that can drive IPO underpricing. Ritter (1984) shows that market participants demand less underpricing for older firms because they are better known to capital markets. Since reputation may not increase linearly with firm age, we use *LOGAGE*, the log of one plus age, to control for the effect of firm age. Age is the difference between the firm's IPO year and founding year. We follow Loughran and Ritter (2004) by using a firm's incorporated year as its founding year.

We use *LOGSALES*, the log of the net sales in the year prior to IPO, as a control for firm size. Prior research, such as Ritter (1984) and Arugaslan et al. (2004), shows that larger firms are underpriced less because larger firms face fewer information problems in the market.

VENTURE is a categorical variable equal to one if the firm is venture-backed. Megginson and Weiss (1991) show that venture-backed IPOs are underpriced less because venture capitalists certify the quality of the corporation they are taking public. Lee and Wahal (2004), however, find a positive relation between venture backing and IPO underpricing once the selection bias is addressed.

Besides company characteristics, we also control for offering characteristics that affect underpricing. *REVISION* is the price update during the bookbuilding process. It is calculated as the percentage difference between the offer price and the midpoint of the initial filling price. Hanley (1993) finds that the degree of price revision and underpricing are positively correlated. This so-called "partial adjustment" phenomenon occurs because more money has to be left on the table to compensate informed investors for showing their positive information.

Table 5
Effects of the existence of credit ratings on IPO underpricing

Independent variable	(1) Heckman	(2) MLE	(3) IV
CRD	−0.167**	−0.245***	−0.218**
	(−2.04)	(−5.40)	(−2.29)
VENTURE	0.030**	0.030**	0.030**
	(2.21)	(2.20)	(2.29)
RANK	0.014***	0.014***	0.015***
	(3.65)	(3.56)	(4.12)
RETNC	1.267***	1.260***	1.258***
	(9.87)	(9.83)	(6.72)
LOGPROCDS	−0.020**	−0.018*	−0.020
	(−2.14)	(−1.92)	(−1.50)
LOGAGE	−0.012*	−0.011	−0.011**
	(−1.72)	(−1.58)	(−2.04)
PRIMARY	0.065***	0.066***	0.067***
	(4.90)	(5.01)	(6.85)
LOGSALAES	−0.006*	−0.006	−0.006
	(−1.73)	(−1.56)	(−1.49)
REVISION	0.856***	0.853***	0.851***
	(32.49)	(32.49)	(8.09)
EXCHANGE	0.031*	0.029*	0.025*
	(1.76)	(1.66)	(1.66)
FLOAT	−0.001	−0.001	−0.001
	(−0.48)	(−0.44)	(−1.13)
Observations	3848	3848	3848

This table reports results of regressions of IPO underpricing on *CRD* and control variables for a sample of U.S. IPOs from 1984 to 2004. If a firm has a credit rating, *CRD* has a value of 1, otherwise 0. All other variables are as defined in Table 3. Three estimation procedures are used: Heckman two-stage treatment effect model (column 1), MLE (column 2), and generated IV approach (column 3). Regressions are run with industry-specific and year-specific intercepts. *t*-Statistics are in parentheses. An asterisk indicates significance at the 10% level; two indicate significance at the 5% level; three indicate significance at the 1% level.

LOGPROCDS, measured by the logarithm of global proceeds, is used to control issue size. Beatty and Ritter (1986) find that firms with higher IPO proceeds are underpriced less, consistent with the idea that smaller offerings are more speculative than larger ones.

EXCHANGE is a categorical variable equal to one if the firm is listed on Nasdaq. Issues traded on Nasdaq are expected to be underpriced more than those listed on NYSE and AMEX.

Following Cook et al. (2006), we calculate *FLOAT* as the number of shares issued relative to the number of shares outstanding after the offering. The higher the float, the easier it is to short the stock. We expect float to be negatively related to IPO underpricing because scarcity of securities prevents investors from shorting the stock.

PRIMARY is a categorical variable equal to one if the IPO is purely primary and zero otherwise. Barry (1989) and Habib and Ljungqvist (2001) argue that selling shareholders have more incentive to reduce underpricing because dilution effects hurt them more than retaining shareholders. As a result, pure primary offerings are predicted to be more underpriced than IPOs with secondary shares.

We control for underwriter reputation by including underwriter rank, *RANK*. The ranking of underwriters is from Loughran and Ritter (2004), who follow Carter and Manaster (1990) and rank underwriters based on their position in the underwriting section of the prospectus. The ranking data are converted into integers.

RETNC is a proxy for prior market movements before offer date. Following Bradley and Jordan (2002), we calculate *RETNC* as the cumulative 15-trading day return of the Nasdaq composite index prior to the offer date. The sample statistics in Table 3 suggest that the distribution of *RETNC* is fairly symmetric.

Both time-fixed effect and industry-fixed effect dummy variables are included in all regressions. Cao and Shi (2006) suggest that there is clustering in IPO underpricing in particular industries, and the underpricing is short-lived and sensitive to economic conditions. Thus, we need to control for both time and industry-fixed effects.

7.2. Regression results

Table 5 reports the results of the three estimation procedures: the Heckman two-stage treatment effect model (column 1), the MLE two-equation treatment model (column 2), and the generated IV approach (column 3).

Evidence from three estimation methods verifies the existence of endogenous selection. First, the inverse Mills ratio from the Heckman two-stage model is significant at the 10% level, which underscores the existence of selection bias. Second, the likelihood-ratio test indicates that we can reject the null hypothesis that the two errors terms, ε_i in Eq. (1) and η_i in Eq. (2), are uncorrelated at the 1% level. This evidence suggests that unobservable firm characteristics affecting the firm's choice of having a credit rating also determine its future IPO underpricing. Third, the Hausman test based on the IV approach rejects the null of no endogeneity for the existence of credit ratings in the IPO underpricing regression at the 1% level.[6]

Consistent with Hypothesis 1, the results show that the IPOs with credit ratings are underpriced significantly less than the unrated IPOs. The estimated coefficients of *CRD* are negative in all three estimation methods in Table 5, and they are significant at the 1% or 5% levels. The results suggest that credit ratings reduce information asymmetry and value uncertainty of rated IPO firms, which in turn are underpriced less than the unrated IPO firms.

The results of the control variables are mostly consistent with the IPO literature for all three estimation methods. Larger issues are underpriced less, presumably because they are less speculative than smaller issues. As expected, pure primary issues are underpriced more because managers are less concerned about the dilution effects since they are not selling their shares. The positive sign of *REVISION* is consistent with the "partial adjustment" phenomenon (Hanley, 1993). Venture-backed IPOs are underpriced more, consistent with the grandstanding argument of Lee and Wahal (2004). IPO firms listed on Nasdaq are underpriced more because they are, on average, smaller and riskier than those traded on NYSE and AMEX. Consistent with Edelen and Kadlec (2004), we find the estimated coefficient of *RETNC* significantly positive.

8. Credit rating levels and IPO underpricing

The results so far have shown that the existence of credit ratings reduces IPO underpricing. In this section, we examine if the credit rating *levels* also affect IPO pricing. To explore this inquiry, we create a variable *CRLEVEL* based on the credit rating data from Compustat. *CRLEVEL* is a number ranging from 1 to 22, as shown in Table 2. A higher credit rating level corresponds to a larger number. For instance, the *CRLEVEL* is equal to 22 for an AAA rating and 1 for a D rating. Given that the highest rated IPO is AA+ and the lowest rated IPO is CCC+ in the sample, we actually use *CRLEVEL* ranging from 21 to 6. We use two models to examine the impact of credit rating levels on IPO underpricing. The first model uses only *CRLEVEL* as the explanatory variable, while the second model augments the *CRLEVEL* variable with other explanatory variables used in the underpricing regression. We use only the rated IPOs.

Table 6 reports the results of regression equations of IPO underpricing on credit rating levels. Columns 1 and 2 show that *CRLEVEL* is not significant at conventional levels. As an additional check, we also create a dummy variable equal to one if the credit rating is investment grade (BBB− or higher). Again, the investment grade dummy is not significant in the two models in columns 3 and 4.

Consistent with Hypothesis 2, the results suggest that IPO firms with higher credit ratings are not necessarily underpriced less than firms with lower ratings. What matters is the *existence* of credit rating, not the credit rating *level*. This finding supports the

[6] In the interest of clarity in Table 5, we do not report these statistics. They are available from the authors upon request.

Table 6
Effects of credit rating levels on IPO underpricing

Independent variable	(1)	(2)	(3)	(4)
CRLEVEL	0.001	0.003		
	(0.08)	(0.56)		
GRADE			−0.026	−0.062
			(−0.33)	(−0.91)
VENTURE		0.005		0.000
		(0.22)		(0.00)
RANK		0.017		0.015
		(0.64)		(0.57)
RETNC		0.225		0.183
		(1.00)		(0.77)
LOGAGE		0.000		−0.002
		(0.01)		(−0.21)
LOGSALES		0.002		0.010
		(0.17)		(0.86)
REVISION		0.259		0.298*
		(1.45)		(1.92)
EXCHANGE		0.069***		0.066**
		(2.75)		(2.58)
FLOAT		−0.117**		−0.106*
		(−2.17)		(−1.86)
R^2	0.00	0.16	0.00	0.17
Observations	161	146	161	146

This table presents the possible effects of credit rating levels on IPO underpricing for a sample of IPOs with credit ratings in the U.S. from 1984 to 2004. The dependent variable is IPO underpricing. *CRLEVEL* has a value of 6 to 21 (the larger number means higher credit rating) for the rated IPOs, otherwise 0. *GRADE* is a dummy variable that takes a value of 1 for investment grade rating. Definitions of other variables follow Table 3. *t*-Statistics are in parentheses. An asterisk indicates significance at the 10% level; two indicate significance at the 5% level; three indicate significance at the 1% level.

information asymmetry explanation of IPO underpricing. Having a credit rating reduces uncertainty about firm value, thereby lowering IPO underpricing. It is the value uncertainty that matters, not the ranking of value, *per se*.

9. Effects of credit ratings on the degree of IPO price revision

In this section, we further examine the effect of credit ratings on the degree of IPO price revision during the bookbuilding process. The dependent variable in the main regression is *REVISION*, which is estimated as the percentage difference between the offer price and the midpoint of the initial filling price. The variable in interest is *CRD*, a binary variable indicating the existence of credit ratings. The estimated coefficient of *CRD* is expected to be negative according to the information revelation theory of bookbuilding because rated IPOs, on average, have less information to reveal than unrated IPOs.

Table 7
Effects of the existence of credit ratings on the degree of price revision

Independent variable	(1)	(2)	(3)
	Heckman	MLE	IV
CRD	−0.371***	−0.188***	−0.504***
	(−7.59)	(−6.69)	(−5.73)
VENTURE	0.018**	0.019**	0.017**
	(2.13)	(2.30)	(2.13)
RANK	−0.012***	−0.011***	−0.011***
	(−5.01)	(−4.65)	(4.36)
RETNC	0.702***	0.710***	0.674***
	(9.02)	(9.09)	(6.54)
LOGPROCDS	0.111***	0.106***	0.111***
	(20.10)	(19.37)	(13.45)
LOGAGE	−0.012**	−0.013***	−0.009**
	(−2.69)	(−2.98)	(−2.03)
LOGSALAES	−0.006***	−0.008***	−0.005**
	(−2.57)	(−3.62)	(−2.18)
EXCHANGE	0.042***	0.047***	0.027*
	(3.94)	(4.39)	(1.89)
Observations	3848	3848	3848

This table reports results of regressions of the degree of price revision on *CRD* and control variables for a sample of U.S. IPOs from 1984 to 2004. If a firm has a credit rating, *CRD* has a value of 1; otherwise 0. All other variables are as defined in Table 3. Three estimation procedures are used: Heckman two-stage treatment effect model (column 1), MLE (column 2) and generated IV approach (column 3). Regressions are run with industry-specific and year-specific intercepts. *t* statistics are in parentheses. An asterisk indicates significance at the 10% level; two indicate significance at the 5% level; three indicate significance at the 1% level.

Table 8
Comparison of aftermarket volatility for IPOs with credit ratings and matched IPOs without ratings

Variable	Sample	Mean	Difference in means *t*-statistic	Standard deviation	Minimum	Maximum
VOLATILITY (60)	Rated IPOs	0.031	−4.08***	0.014	0.008	0.090
	Matched IPOs	0.040		0.043	0.009	0.101
VOLATILITY (120)	Rated IPOs	0.031	−4.77***	0.016	0.010	0.116
	Matched IPOs	0.042		0.019	0.013	0.112
VOLATILITY (365)	Rated IPOs	0.033	−4.14***	0.017	0.013	0.125
	Matched IPOs	0.043		0.019	0.017	0.107

This table compares the mean, standard deviation, minimum, and maximum of aftermarket volatility for IPOs with credit ratings versus matched IPOs without ratings. *VOLATILITY* (60), *VOLATILITY* (120), and *VOLATILITY* (365) are the standard deviation of daily returns over the periods of 60, 120 and 365 days after the issue, respectively. The first trading week is omitted to avoid extreme volatility. 161 IPO firms in the U.S. from 1984 to 2004 have credit ratings before they go public. The rated IPO sample consists of 109 IPOs with credit ratings, for which we can match by industry (3-digit SIC code), issue time, and issue size from the IPOs without credit ratings. The matched IPO sample consists of 107 distinct IPO firms without credit ratings. *T*-Test is used to compare the mean aftermarket volatility of the two samples. ***Indicates significant difference from zero at the 1% level.

Based on the prior literature (e.g., Cook, Kieschnick, and Van Ness, 2006; Lowry and Schwert, 2004), we control for the following firm and issue characteristics in the price revision regression: firm size, issue size, firm age, venture backing, Nasdaq listing, underwriter reputation, and prior market movements before offer date. All the control variables are defined earlier in Section 7. Both time-fixed effect and industry-fixed effect dummy variables are included in the regressions.

Table 7 reports the results of the three estimation procedures: Heckman two-stage treatment effect model (column 1), MLE (column 2), and generated IV approach (column 3). Similar to the analysis of underpricing, all three procedures find evidence verifying the existence of endogenous selection.[7]

Consistent with Hypothesis 3, the results show that the degree of price revision is significantly smaller for firms with credit ratings. The estimated coefficients of *CRD* are negative across three columns in Table 7, and they are significant at the 1% level. The results are consistent with the information revelation theory of bookbuilding and suggest that credit ratings reduce information asymmetry between the underwriter and informed investors.

As for the control variables, Lowry and Schwert (2004) argue that the more uncertainty regarding the firm value, the more conservative the investment banks are in setting the initial filling price to avoid negative price updates. Consistent with this conjecture, we find that older firms and larger firms have fewer price updates. To the extent that issues traded on Nasdaq and companies backed by venture capitalists are riskier, they have significantly larger degree of price revisions. In addition, consistent with the results of Bradley and Jordan (2002), the coefficient of the *RETNC* is significantly positive.

10. Comparison of aftermarket volatility for IPOs with credit ratings and matched IPOs without ratings

In this section, we examine the aftermarket volatility of the IPO stocks to offer further support for our conjecture that credit ratings reduce value uncertainty of the issuing firm.[8] According to Hypothesis 4, the aftermarket volatility of IPO stocks with credit ratings should be less than that of IPOs without ratings. We use a matched-sample method to compare the aftermarket volatility of IPO stocks with credit ratings vis-à-vis those without ratings because many other factors, such as industry affiliation, issue time, firm size may affect the aftermarket volatility as well. Specifically, we create a matched sample of IPOs without credit ratings during 1986–2004 based on 3-digit SIC code, issue year and IPO proceeds.[9] This matching criteria result in a sample of 109 IPOs with credit ratings which are comparable to one of the IPOs without ratings in the matched sample. With two duplicate matches eliminated, the matched sample consists of 107 distinct IPOs without credit ratings.

Aftermarket volatility, denoted by *VOLATILITY*, is measured as the standard deviation of daily return in the post-IPO period. To get a reliable estimate of the standard deviation, we start with the 60-day period after the issue. As a robustness check, we also calculate the same measure for the periods of 120 and 365 days after the issue. Because IPO stocks tend to be very volatile initially before settling down, we omit the first trading week to avoid extreme volatility. Table 8 compares the mean, standard deviation, minimum, and maximum of aftermarket volatility for the rated IPO sample versus the matched sample. Over all three post-IPO periods, both the mean and standard deviation of *VOLATILITY* for rated IPO sample are lower than those of the matched sample. For example, the cross-sectional mean *VOLATILITY* for the rated sample (at 3.1%) is 26% lower than that for the matched sample (at 4.0%) over the 60-day period after the issue. *t*-Tests comparing the group means verify the significance of the difference, with all three post-IPO periods having *t*-statistics in excess of 4.08.

The large and significant difference in the aftermarket of the IPO firms with credit ratings and firms with no ratings is consistent with Hypothesis 4. This finding provides further support for our conjecture that credit ratings reduce value uncertainty of the issuing firm as well as information asymmetry in the IPO markets.

[7] Again, the statistics are available from the authors.
[8] We thank the Editor for making this suggestion.
[9] Matching criteria using total assets or sales reduces the sample size substantially, due to missing pre-IPO data.

11. Conclusion

Credit ratings convey important information about firm value to the capital markets. The role of credit ratings in the debt markets is well recognized. However, not much has been done regarding the effect of credit ratings in the equity IPO markets. To this end, we study the relation between credit ratings and IPO underpricing.

We examine a sample of U.S. common share IPOs from 1986 to 2004 and find that IPO firms that have credit ratings when they go public are underpriced significantly less than IPO firms without credit ratings. This result is consistent with the conjecture that credit ratings reduce the ex ante uncertainty about the IPO firm's value and information asymmetry among investors in the IPO market. Consistent with the information asymmetry explanation of IPO underpricing, we find it is the *existence* of credit ratings, not the credit rating *level*, that reduces the IPO underpricing. IPO firms with higher credit ratings are not necessarily underpriced less than lower rated firms. It is the value certainty that matters, not the value, *per se*. Furthermore, the existence of credit ratings reduces the degree of price revision during the bookbuilding process, which is consistent with the information revelation theory of bookbuilding that is based on the information asymmetry between informed investors and the underwriter. To the extent that information asymmetry is less severe and investment banks are more certain when setting the issue price, the magnitude of price update should be smaller for rated IPOs during the bookbuilding process.

In our analysis, we attempt to control for the endogeneity of the firms' decision to have credit ratings. Although we cannot completely rule out alternative explanations, the results are robust to three alternative econometric methods and are consistent with our conjecture that credit ratings reduce information asymmetry in the IPO markets.

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