RESEARCH IN FINANCE

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ANDREW H. CHEN

Editor

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INTRODUCTION

A total of 12 chapters in this volume represent some current research on important topics in finance and economics. Bajaj et al. demonstrate through a time series analysis that the IPO underwriting spreads seem to be competitive, in contrast to the findings of Chen and Ritter (2000). Sealey argues that it is necessary for the regulator and deposit insurer to be an integral part to mitigate the moral hazard problem in bank regulation. Lee develops a multi-period pricing model to examine the impact of forbearance and potential moral hazard behavior on the cost of deposit insurance. Hao and Roberts show that lead lenders have significant positive influence on loan yield spreads. Daly et al. show that coincident indicators developed to track a state's gross outputs have significant influence on state-level aggregate bank performance.

Some recent studies in global investments are included in this volume. For example, Chiou's empirical results show that investors in the countries of civic-law origin tend to benefit more from global investments than the ones in the common-law states. Schaub et al. examine investor overreaction and seasonality in the stock markets of Korea, Hong Kong and Japan and find little to no reversals following days of excessive increase, but all three indices reversed 35–45% following days of excessive decline.

The contributions to this volume also examine asset allocation of hedge funds, incentive stocks and options, board size and firm performance, impact of higher oil prices on stock market returns and futures hedging effectiveness. For example, Cheung et al. show that a mean-Gini approach is more appropriate than that of mean-variance in asset allocation decisions for hedge funds. Cao and Wei demonstrate that employees' partial hedge can reduce the vesting requirements on stock ownership and incentive options and undermine the incentive effects. Pacini et al. document that, in the post-Financial Services Modernization Act of 2000, there is a significant inverse relation between the publicly traded property-liability insurer performance and board size. O'Neill et al. find that higher oil prices in the recent years have adversely affected the stock market returns in the U.S.A.,

UK and France, but positively affected that in Canada and Australia. Finally, Lien and Zhang show that alternative settlement specifications in futures contracts directly affect the futures prices as well as the liquidity risks on futures hedging.

Andrew H. Chen
Series Editor

COMPETITION IN IPO UNDERWRITING: TIME SERIES EVIDENCE

Mukesh Bajaj, Andrew H. Chen and Sumon C. Mazumdar

ABSTRACT

Chen and Ritter (2000) documented that underwriter spreads for recent US initial public offerings (IPOs) in $20 million range as well as much larger IPOs in the $80 million range are clustered at 7%. This observation has led to a Department of Justice (DOJ) enquiry into potential price fixing by underwriters. We demonstrate through a times series analysis that IPOs have tripled in size and become much riskier over time. A pooled data analysis can therefore mask evidence of competition in the market. We find that spread clustering is not a recent phenomenon. Over time, clustering at 7% has increased as clustering above 7% has declined. IPO spreads have declined significantly over time as the firms going public more recently are riskier, underwriting efforts have increased and recent IPOs are much larger than IPOs in the past. Controlling for time trends, larger IPOs have lower average spreads. The market for underwriting IPOs seems to be competitive with entry of new firms during the hot markets.

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1. INTRODUCTION

A firm's costs of going public entails three types of costs: (a) direct issuing costs which are fixed and largely independent of the underwriter; (b) the underpricing associated with the (positive) first day returns observed relative to offer price; and (c) the "spread" paid to underwriters.[1] The issuer's objective is to minimize the underpricing and spread costs associated with its initial public offering (IPO) of its common equity. More concerted effort by the underwriter or the choice of underwriters could reduce the underpricing costs associated with the offering. For instance, banks that specialize in underwriting firms from certain industries, or bulge bracket investment banks with greater reputation may provide greater certification value for the firm's IPO and hence reduce its underpricing costs.[2] In return, such banks could be expected to demand a higher spread as compensation. The spread could also be a function of the risk associated with the security and the size of the offering among other factors.[3]

Yet, according to Chen and Ritter (2000) by the late 1990s, the underwriting spread paid for all firm commitment IPOs in the US, regardless of offering size and choice of underwriter was almost exclusively clustered at exactly 7% for over 90% of "mid-size" issues. In contrast, in the early 1980s, only about a quarter of the spreads for such IPOs were at exactly 7%. The observation that the spread paid for IPOs of $20 million was exactly the same as the spread paid for offerings four times as large ($80 million) lead to speculation in some quarters that such a "seven percent solution" was indicative of collusion (or price-fixing) by underwriters. Chen and Ritter (2000) themselves characterized their result as consistent with a "strategic pricing equilibrium."

The US Department of Justice (DOJ) launched an investigation into the "alleged conspiracy among securities underwriters to fix underwriting fees." A class action lawsuit was brought against 27 investment banks for not competing on price. The lawsuit and the DOJ inquiry were subsequently dropped following a judge's ruling in favor of the defendants.[4]

Other non-collusion explanations for the "seven percent solution" have been offered recently in the literature. The 7% spread is arguably consistent with efficient contract theory where underwriters compete in pricing 7% IPOs based on their reputation, placement services, and underpricing that complement the 7% spread (Hansen, 2001).[5] The seemingly fixed 7% spread could have emerged as a solution to a double-sided matching mechanism between firms and underwriters in which firms and underwriters pick each other based on criteria other than price (Fernando, Gatchev, & Spindt, 2002).[6] Barondes, Butler, and Sanger (2000) found that the

probability of receiving an offer price that exceeds the initially estimated offer price is significantly correlated with the gross spread. These authors conclude that the degree of marketing service the issuer receives is a function of the compensation it paid to underwriters.

Clustering alone does not necessarily imply lack of competition. Price clustering has been documented earlier in other incontestably competitive financial markets, including AMEX, NYSE, the London Stock Exchange, the London gold market, and the international foreign exchange market.[7] Such clustering is believed to be greater the more difficult it is to value the underlying asset.[8] Also, other things being equal, for high-priced assets, the price grid tends to be coarser. For example, prices of houses are seldom negotiated in increments of $1. Thus, any conclusions from comparisons of the degree of price clustering over a long time period must directly examine *changes* in IPO market conditions, especially in the risk and size of IPOs as well as the level of underwriting efforts undertaken. However, a detailed time series analysis of IPOs' characteristics and their associated spreads has hitherto not been undertaken in the literature.[9]

We address issues regarding competitiveness of IPO underwriting activities and clustering of underwriting spreads by focusing on time series analysis of several characteristics of IPOs and their underwriting spreads. Our main results are summarized below:

1. In general, for the entire period, from 1980 to 1998, we find that (a) relatively smaller IPOs tend to be riskier; and (b) underwriting spreads tend to be more clustered for riskier IPOs.
2. The median size of an IPO has tripled in the last two decades.
3. Recent IPOs have involved considerably more risky firms (as measured by post-IPO price volatility).

These results indicate that a comparison of the degree of clustering in spreads at 7% for $20 million to $80 million IPOs over a two-decade period can lead to a biased conclusion for two reasons. First, keeping issue size constant over this period can lead to comparison of larger IPOs from early years to smaller IPOs of the more recent years. This can mask a decline in average spread over time as well as a negative relationship between the spread and issue size. Second, it would be reasonable to expect that recent IPOs' spreads would be more clustered since these offerings have been riskier. Additionally, we find that:

4. The increased clustering of spreads at 7% is not explained by an increase in spread clusters lower than 7% but because of a reduction in clustering above 7%.

5. Over time, IPO spreads have declined significantly while more risky firms are going public and underwriting efforts, as measured by number of co-managers, have increased.
6. Unlike Chen and Ritter (2000), we do find that average spread declines with increase in issue size.
7. We also document that the market has never been concentrated and that there is entry of lead underwriters when the number of IPOs is large. Overall, like Hansen (2001), we find that the IPO underwriting market is quite competitive.

In Section 2, we describe our IPO dataset, which is similar to that of Chen and Ritter (2000) except that we do not delete IPOs with proceeds less than $20 million. We also discuss some time trends in the IPO market from 1980 to 1998. In particular, we find that market has never been concentrated, with new entry occurring during periods of increased demand for underwriting services. Section 3 provides some size and volatility trends in the IPO market between 1980 and 1998. Specifically, we note that issues' average issue size and issues' aftermarket volatility has increased significantly over time. We document these results and discuss the implications of our time series in Section 4. Section 5 concludes the chapter.

2. SAMPLE DESCRIPTION

Our dataset consists of 5,805 firm commitment IPOs from 1980 to 1998 included in the New Issues database of the Securities Data Company (SDC). We exclude closed-end funds, American depository Receipts (ADRs), real estate investment trusts (REITs), and unit offerings. All proceeds reported exclude underwriter warrants and over-allotment options and are expressed in 1997 purchasing power terms adjusted using the US GDP implicit price deflator.

Table 1 summarizes the number of offerings by year, the average gross spread, direct issuance costs, and underpricing costs. While the number of offerings has varied annually between 1980 and 1998, it has generally trended up. The average gross spread has declined over the same period, from 8.31% in 1980 to 6.94% in 1998. IPO underpricing has increased significantly over the same period after a decline in the second half of the 1980s. Interestingly, IPO underpricing has generally been greater in "hot" IPO markets: Table 1 indicates that, in general, as the number of IPOs increased so did the underpricing. According to Hansen (2001) such

Table 1. Gross Spread, Other Direct Expenses, Underpricing and Book Managers by Year.

Year	Number of Offerings	Gross Spread (%)[a]	Other Direct Expenses (%)[b]	Underpricing (%)[c]	Total Expense (%)[d]	Number of Book Managers	Herfindahl Index for the IPO Underwriting Business
1980	100	8.31	5.33	18.12	30.59	48	467.72
1981	239	8.21	4.62	8.54	21.37	88	523.34
1982	80	7.97	4.84	12.07	24.26	48	773.55
1983	511	7.61	4.14	9.77	20.92	117	474.30
1984	210	7.84	5.51	3.17	16.72	85	412.16
1985	206	7.54	4.18	5.93	13.07	66	745.13
1986	441	7.36	4.11	5.53	16.59	103	568.91
1987	310	7.34	4.43	4.61	16.16	87	808.36
1988	115	7.23	4.53	4.62	16.63	46	906.56
1989	110	7.12	3.48	8.04	19.49	39	1368.67
1990	108	7.13	3.11	9.97	20.21	39	1292.56
1991	274	6.97	3.16	11.24	21.84	55	859.60
1992	386	7.04	3.53	10.18	21.20	86	827.16
1993	475	7.04	3.23	11.89	22.00	105	632.51
1994	363	7.18	4.05	8.50	20.36	111	564.39
1995	431	7.02	3.36	19.72	30.59	93	940.11
1996	683	7.03	3.58	15.19	25.33	118	844.39
1997	477	6.88	3.68	12.77	23.12	124	504.33
1998	286	6.94	4.16	21.25	34.44	94	1073.91

Our dataset consists of 5,805 firm commitment IPOs from 1980 to 1998 included in the New Issues database of the SDC. We exclude closed-end funds, ADRs, REITs, and unit offerings. All proceeds reported exclude underwriter warrants and over-allotment options and are expressed in 1997 purchasing power terms adjusted using the US GDP implicit price deflator.
[a]Gross spread is the gross spread as a percentage of total proceeds, including management fee, underwriting fee, selling concession, and reallowance fee (SDC variable: GPCT).
[b]Other expenses are expenses including registration fee and printing, legal and auditing costs, as a percentage of total proceeds (SDC variable: EXPAMT).
[c]Underpricing is measured by the (positive) first day returns observed relative to offer price.
[d]Total expense is the sum of "Gross Spread (%)" and "Other Direct Expenses (%)".

underpricing varies by issues and across underwriters and is a form of non-price competition. The relationship between the level of underpricing and IPO volume has been analyzed thoroughly by Lowry and Schwert (2002).

Table 1 also presents the number of book managers involved with IPOs during a specific year and the corresponding Hirschman-Herfindahl Index (HHI) that measures the concentration in the IPO-underwriting industry.

The HHI is computed as follows. We first identified the ''book'' or syndicate manager for each IPO for a given year.[10] Each IPO's proceeds were attributed entirely to its book manager. Each book manager's share of the aggregate IPO market for that year was then calculated as its total proceeds divided by the total proceeds of all IPOs that year.[11] The HHI for the IPO-underwriting business, which captures the degree of concentration in this business, was then computed as the sum of the square of each manager's market share (expressed as a percentage).[12] The 1992 DOJ and Federal Trade Commission Horizontal Merger Guidelines categorize a market as ''unconcentrated'' when its HHI is below 1000, ''moderately concentrated'' when its HHI is between 1000 and 1800, and ''highly concentrated'' when its HHI exceeds 1800.

During 1980–1998, the HHI for the IPO-underwriting business never exceeded the highly concentrated threshold of 1400. In fact, the HHI would be considered indicative of a moderately concentrated business in only three of the 19 years studied, viz., 1989, 1990, and 1998. The IPO market was unconcentrated in 16 of the 19 years studied. Interestingly, industry concentration did not coincide with hot IPO markets. Instead, the moderately concentrated HHI levels between 1986 and 1993 occurred when the IPO markets slumped and there were fewer IPOs to be distributed among the established players. The market was unconcentrated, or had a larger number of underwriter firms participating as book managers in hot IPO markets. This is further evidence of the competitive nature of this business since it suggests that market entry was relatively easy in lucrative times and new underwriters entered the business in response to increase in demand.

Table 2 provides details of certain time-trend analyses concerning three attributes of the IPO market (HHI, the number of IPOs, and the number of book managers) over the 1980–1998 period. As Table 2 indicates, all three attributes of the IPO market have increased over this period. However, only the increase in the number of IPOs over time is statistically significant at the 95% confidence level.

Chen and Ritter (2000) find evidence that the gross underwriting spreads of ''moderately sized offerings,'' which they define to be in the $20 million–$80 million range (in inflation-adjusted dollars) are clustered at 7%. They argue that the 7% spread is above competitive levels and consistent with ''strategic pricing'' by investment bankers.[13] These authors posit that investment bankers use non-price competition, such as the implicit promise of favorable analyst coverage and buy recommendations, as a means of product differentiation, instead of relying on price competition. Chen and Ritter (2000, p. 1106) do say, however, that ideally a test of price

Table 2. Time-Trend Analyses (1980–1998 Period): Correlation of Time and Attributes of IPO Market (Number of IPO Offerings, HHI, and Number of Book Managers).

Coefficient (*t*-Stat)	IPO Offerings	HHI	Number of Managers
Intercept	−30806.62	−34714.42	−4147.56)
	(−2.4774)*	(−1.603)	(−1.8615
Year	15.64	17.84	2.13
	(2.502)*	(1.6384)	(1.8982)
R^2	0.2691	0.1364	0.1749
Adjusted R^2	0.2261	0.0856	0.1263
Observations	19	19	19

*Indicates statistical significance at 95% confidence level.

competition in underwriting should examine whether the gross spreads equaled costs, including the opportunity cost of capital employed. However, in the absence of such proprietary data[14] these authors limit themselves to considering whether gross spreads vary with issue size as they would be expected to do in the presence of fixed underwriting costs and competition among underwriters.

When information pertaining to costs, which is required to directly examine whether there are scale economies in underwriting and whether spreads are set at a competitive level, is unavailable a natural question arises: Is an issue's size the only relevant economic variable that might explain gross spreads, as Chen and Ritter (2000) postulate? We argue that the additional economic variables, such as the IPO's volatility and the degree of underpricing, may in fact affect the gross spreads charged in a competitive market. Since these relevant variables may change over time, in the following section we examine time series trends in various factors that would be relevant in examining whether the observed clustering of spreads indicates a non-competitive market.[15]

3. TRENDS IN IPO CHARACTERISTICS

3.1. Median Issue Size Has More than Tripled between 1980 and 1998 and the Average Issue Size Has Increased More than Five-Fold

Table 3 examines the size of IPOs (measured by the IPO's gross proceeds) on an annual basis over the 1980–1998 period. For each year, various

Table 3. Inflation Adjusted Proceeds by Year (In Millions of Dollars).

Year	Number	Mean	Standard Deviation	75th Percentile	Median	25th Percentile	Percentile for $20 MM	Percentile for $80 MM	Percentile for median $20 MM–$80 MM IPO
1980	100	20.62	25.45	22.83	13.25	7.52	70.00%	96.00%	83.00%
1981	239	18.29	21.97	21.47	11.56	7.10	72.80%	98.33%	85.36%
1982	80	21.63	23.98	24.16	11.61	6.90	68.75%	95.00%	81.25%
1983	511	34.23	51.66	37.77	18.88	9.06	51.86%	91.78%	71.82%
1984	210	18.26	22.04	20.87	11.67	6.27	73.81%	98.10%	85.24%
1985	206	38.01	91.71	33.15	17.00	9.17	55.83%	90.78%	73.30%
1986	441	48.05	125.53	41.97	18.99	11.01	51.02%	87.76%	69.39%
1987	310	51.63	134.33	43.32	23.13	10.66	45.81%	88.71%	66.77%
1988	115	42.40	63.30	52.30	20.89	12.69	46.96%	87.83%	66.96%
1989	110	56.30	122.19	46.37	28.61	16.65	35.45%	84.55%	60.00%
1990	108	44.30	60.67	48.20	29.34	18.50	29.63%	88.89%	59.26%
1991	274	58.94	88.22	56.55	32.95	19.95	25.18%	82.85%	54.01%
1992	386	57.46	86.02	56.66	32.00	17.89	29.79%	82.12%	55.96%
1993	475	63.85	132.39	59.12	32.48	18.95	26.95%	82.32%	54.32%
1994	363	44.30	59.95	44.69	26.62	14.79	37.74%	88.71%	62.81%
1995	431	62.94	98.86	60.86	36.02	23.08	19.72%	82.37%	51.04%
1996	683	66.01	153.58	61.92	35.69	20.74	22.25%	82.43%	52.27%
1997	477	70.79	105.55	70.00	37.20	23.60	19.50%	79.04%	49.27%
1998	286	109.64	325.62	80.09	42.62	23.79	21.33%	74.83%	47.90%

inflation-adjusted statistics are presented concerning a specific year's IPO proceeds (all figures are in 1997 dollars). First, the mean and standard deviation of the proceeds are given, followed by three percentile values: the 75th, median (50th), and the 25th percentile cutoffs (in millions of 1997 dollars).

It is apparent from Table 3 that the average IPO proceeds in 1998 were significantly larger in 1998 compared to 1980, even after accounting for inflation. For example, the median inflation-adjusted size of an IPO more than tripled from $13.25 million in 1980 to $42.6 million in 1998. The mean issue has increased even more, by more than five-fold, from $20.62 million in 1980 to $109.64 million in 1998.

These data show that it is impossible to give durable definitions to terms such as "small IPO" or "large IPO" based on inflation-adjusted proceed amounts. Consider, for example, Chen and Ritter's (2000) use of the $20 million–$80 million proceed range to define "moderate size IPO." Table 3 indicates that in 1980 a $20 million IPO would have been in the 70% percentile of all IPOs during that year. However, by 1998, a $20 million IPO would have exceeded only 21% of all IPOs in 1998. Similarly, IPOs at the

upper bound ($80 million) of Chen and Ritter's (2000) definition of "moderately sized" IPOs were not moderately sized at all relative to other deals in 1980. In fact, only 4% of the IPOs issued in 1980 had larger proceeds. In contrast, more than 25% of the total IPOs issued in 1998 would have exceeded $80 million. Further, the last column indicates that while 83% of all IPOs issued in 1980 belonged to the $20 million–$80 million range, only 47.9% of all IPOs issued in 1998 belonged to the same proceed range.

Clearly, any analysis of "competitive" behavior that focused on this fixed proceed range for every year from 1980 to 1998 would in effect be comparing the larger IPOs (from the 70th–96th percentile proceed range) of 1980 with moderate-sized IPOs (in the 21st–75th percentile proceed range) of 1998. Inferences drawn from such an analysis could be biased if the size of an IPO is correlated with other characteristics that determine the spread.

3.2. Post-IPO Stock Volatility is Negatively Related to Issue Size and Has Increased Over Time

Two interesting results emerge from our examination of the volatility of IPOs in the aftermarket.[16] First, as shown in Table 4 Panel A, within a given year there is a inverse relationship between the IPO's absolute size and the average aftermarket return volatility except for three of the 19 years in our sample.[17] The average aftermarket return volatility for the smallest issues (less than $20 million) exceeded that of the largest issues for each year of the sample. Similarly, as shown in Table 4 Panel B, within a given year there is also an inverse relationship between the IPO's relative size (or quartile ranking) and the average aftermarket return volatility except for one year (1983). In short, our analysis reveals that in a given year, the average aftermarket return volatility is typically smaller for IPOs that are larger in absolute as well as relative terms.

Second, our analysis reveals that the average aftermarket return volatility for all IPO issues, regardless of size (absolute or relative), has trended upwards between 1980 and 1998. Table 4 Panels A and B also report the results of time-trend analyses. Adjusting for IPO proceeds' absolute size, Table 4 Panel A indicates that IPOs' average aftermarket return volatility has increased over the period. This upward trend over time is most noticeable for IPOs with absolute proceeds in the $20 million–$80 million range. The average after-market return volatility of IPOs with proceeds in this range increased from 3.07% in 1980 to 6.31% in 1998 – an increase of

Table 4. Average Volatility by Year as Function of Proceeds.

Panel A: Categorized by absolute size

Year	Number of Offerings	Proceed Category			
		< $20 MM	$20 MM–$80 MM	> $80 MM	All
1980	103	3.78%	3.07%	2.64%	3.52%
1981	244	3.32%	2.96%	2.52%	3.21%
1982	83	3.40%	2.64%	3.37%	3.22%
1983	515	2.95%	2.82%	2.84%	2.89%
1984	214	2.73%	2.70%	1.90%	2.71%
1985	209	2.98%	2.56%	2.57%	2.67%
1986	444	3.69%	3.13%	2.57%	3.37%
1987	313	5.13%	4.34%	3.34%	4.58%
1988	118	3.18%	2.70%	2.04%	2.85%
1989	113	3.87%	3.28%	2.18%	3.31%
1990	111	4.45%	4.20%	2.46%	4.03%
1991	277	4.75%	4.10%	2.62%	3.99%
1992	389	4.75%	3.96%	2.69%	3.96%
1993	478	4.80%	3.72%	2.46%	3.77%
1994	366	4.30%	3.40%	2.32%	3.63%
1995	434	4.73%	4.29%	2.90%	4.13%
1996	686	5.27%	4.30%	2.93%	4.25%
1997	480	5.04%	4.25%	3.27%	4.21%
1998	289	5.93%	6.31%	4.79%	5.85%

Panel B: Categorized by relative size

Year	Number of Offerings	Proceed Quartile(s)			
		Q1	Q2, Q3	Q4	All
1980	103	4.27%	3.45%	2.91%	3.52%
1981	244	3.65%	3.12%	2.95%	3.21%
1982	83	3.87%	3.21%	2.71%	3.22%
1983	515	3.32%	2.66%	3.01%	2.89%
1984	214	2.84%	2.69%	2.65%	2.71%
1985	209	2.91%	3.03%	2.48%	2.67%
1986	444	3.85%	3.36%	2.87%	3.37%
1987	313	5.25%	4.78%	3.58%	4.58%
1988	118	3.41%	2.82%	2.36%	2.85%
1989	113	3.74%	3.61%	2.29%	3.31%
1990	111	4.23%	4.51%	3.04%	4.03%
1991	277	4.75%	4.18%	2.91%	3.99%
1992	389	4.84%	4.06%	2.96%	3.96%
1993	478	4.83%	3.83%	2.67%	3.77%
1994	366	4.40%	3.72%	2.71%	3.63%

Table 4. (*Continued*)

Panel B: Categorized by relative size

Year	Number of Offerings	Proceed Quartile(s)			
		Q1	Q2, Q3	Q4	All
1995	434	4.69%	4.35%	3.13%	4.13%
1996	686	5.23%	4.38%	3.10%	4.25%
1997	480	4.90%	4.34%	3.22%	4.21%
1998	289	6.20%	6.23%	4.72%	5.85%

Panel C: Time-trend analyses (1980–1998 period) – correlation of time and volatility by relative proceed size quartiles

Coefficient (*t*-Stat)	Q1	Q2, Q3	Q4	All
Intercept	−2.1698	−2.1957	−0.7595	−1.8591
	(−4.1893)*	(−4.2435)*	(−1.8602)	(−3.9457)*
Time	0.0011	0.0011	0.0004	0.001
	(4.2718)*	(4.3171)*	(1.9327)	(4.024)*
R^2	0.5177	0.5230	0.1801	0.4878
Adjusted R^2	0.4893	0.4949	0.1319	0.4577
Observations	19	19	19	19

Note: The table above shows the results of a univariate regression where the dependant variable is average after market return volatiltity in a given year as reported in Table 4B and the independent variable is the given year.
*Indicates statistical significance at 95% confidence level.

105% in the average volatility. Similarly, adjusting for IPO proceeds' relative size, Table 4 Panel B indicates that IPOs' average aftermarket return volatility has increased significantly over the 1980–1998 period. This upward trend over time is most significant for IPOs with proceeds in the second and third quartiles in a given year. The average after-market return volatility of IPOs with proceeds in this range increased from 3.45% in 1980 to 6.23% in 1998 – an increase of 80.5% in the average volatility. Table 4 Panel C indicates the average after market volatility of all quartiles, except Q4, is positively correlated with time in a statistically significant manner at the 95% confidence level.

In short, the results presented in this section indicate that any analysis of underwriting spreads should account for inter-temporal changes in the IPO market. Market conditions such as the demand for equity capital and the

concomitant increase in issue size as well as higher equity volatility must be factored into any analysis of competitive pricing. We do so in the next section.

4. IPO UNDERWRITING SPREADS

4.1. Average Gross Underwriting Spreads Have Declined Keeping Issues' Relative Size Constant

Table 5, Panels A and B describe the gross spread distributions for the "relatively small," and "relatively large" IPOs, respectively (defined as the bottom and top quartiles, respectively, of IPO proceeds for a given year).

The gross spread has declined for relatively small and large IPOs between 1980 and 1998. For example, the average gross spread charged for relatively small IPOs (in the bottom quintile of IPO proceeds in a given year) declined from 9.61% in 1980 to 7.97% in 1998. The average spread for the largest IPOs declined from 6.97% to 5.87% over this period.[18] The time-trend analysis reported in Panel C of Table 5 confirms the statistical significance of this downward trend in spreads. In particular it indicates that while the spreads declined in a statistically significant manner over time for both relatively small and relatively large IPOs (in the first and fourth quartiles, respectively) the downward trend is statistically more significant and larger in magnitude for relatively small IPOs compared to relatively large IPOs.

Moreover, comparing the data reported in Table 5 Panel A to that of Table 5 Panel B for the same year, reveals that spreads are generally inversely related to the IPOs' size. For instance, in 1980 the median gross spread for relatively small IPOs was 10%. In contrast, the median gross spread for relatively large IPOs was 7.14% in the same year – a difference of 2.857%. Such a difference persists across each year in our sample, albeit decreasing over time. In 1998, the median gross spread for relatively large IPOs was only 0.075% smaller than the median gross spread for relatively small IPOs. The trend lines fitted to the data for the 1980–1988 and the 1989–1998 periods shown in Fig. 1 Panels A and B confirm this negative relationship between IPO spreads and proceeds.

4.2. Spread Clustering Has Shifted to Lower Spreads Over Time

Our analysis adjusts for the inter-temporal shift in magnitude of IPOs. The average IPO proceeds have increased significantly in the 1989–1998 period

Table 5. Gross Spread by Year.

Year	Number of Issues	Mean Gross Spread	Standard Deviation	Maximum	75th Percentile	Median	25th Percentile	Minimum
Panel A: Relatively small IPOs (proceed quartile 1)								
1980	25	9.61	0.92	11.40	10.00	10.00	9.00	8.00
1981	59	9.54	0.86	11.50	10.00	10.00	9.00	7.00
1982	19	9.04	0.85	10.00	10.00	9.00	8.44	7.50
1983	124	9.16	1.16	17.00	10.00	9.05	8.00	6.66
1984	53	8.88	1.05	10.00	10.00	9.00	8.00	7.00
1985	51	8.72	1.06	10.00	10.00	8.57	8.00	7.00
1986	110	8.39	1.11	10.00	10.00	8.00	7.50	6.00
1987	77	8.56	1.14	10.00	10.00	8.00	7.56	6.73
1988	28	8.42	1.09	10.00	9.76	8.00	7.61	7.00
1989	27	8.11	1.19	10.00	9.31	7.50	7.00	6.75
1990	27	8.01	1.22	10.00	9.00	7.50	7.00	6.00
1991	69	7.55	1.02	10.00	7.50	7.00	7.00	6.00
1992	97	7.84	1.15	10.14	8.50	7.14	7.00	6.57
1993	120	7.83	1.14	10.00	8.50	7.07	7.00	6.00
1994	89	8.37	1.29	10.00	10.00	8.00	7.00	6.18
1995	107	7.98	1.21	10.20	9.00	7.50	7.00	6.36
1996	170	7.90	1.32	15.00	8.50	7.00	7.00	6.50
1997	119	7.74	1.16	10.00	8.00	7.00	7.00	5.18
1998	71	7.97	1.26	10.00	9.25	7.00	7.00	6.99
Panel B: Relatively large IPOs (proceed quartile 4)								
1980	25	6.97	0.64	8.00	7.25	7.14	6.70	5.00
1981	59	7.08	0.41	8.00	7.27	7.14	6.96	5.87
1982	20	6.95	0.59	7.90	7.23	7.03	6.98	5.00
1983	128	6.65	0.48	7.49	7.00	6.78	6.47	5.00
1984	52	6.98	0.39	7.74	7.14	7.00	6.92	5.83
1985	51	6.62	0.51	7.65	6.99	6.77	6.36	5.24
1986	111	6.55	0.62	8.00	7.00	6.72	6.18	4.71
1987	77	6.41	0.72	7.33	7.00	6.76	5.87	4.25
1988	29	6.40	0.60	7.25	6.89	6.51	6.00	5.02
1989	27	6.33	0.67	7.00	7.00	6.46	5.78	5.00
1990	27	6.45	0.61	7.03	7.00	6.67	5.75	5.00
1991	69	6.32	0.63	7.00	6.90	6.55	5.71	5.00
1992	97	6.31	0.64	7.03	7.00	6.47	5.77	5.00
1993	120	6.31	0.69	7.50	7.00	6.50	5.73	4.00
1994	91	6.37	0.75	7.04	7.00	6.73	6.00	3.35
1995	108	6.19	0.90	7.03	7.00	6.48	5.55	2.80
1996	170	6.25	1.05	7.03	7.00	6.74	6.00	2.25
1997	120	5.94	1.37	7.06	7.00	6.50	5.26	1.50
1998	71	5.87	1.27	7.00	7.00	6.25	5.25	1.13

Table 5. (*Continued*)

Panel C: Time-trend analyses (1980–1998 period) – correlation of time and median gross spread for relatively small (quartile 1) and relatively large (quartile 4) IPOs

Coefficient (*t*-Stat)	Small (Q1)	Large (Q4)
Intercept	323.236	78.091
	(8.629)*	(6.283)*
Year	−0.158	−0.036
	(−8.415)*	(−5.745)*
R^2	0.806	0.660
Adjusted R^2	0.795	0.640
Observations	19	19

*Indicates statistical significance at 95% confidence level.

compared to the 1980–1988 period. As Table 3 indicated, the mean (median) IPO (inflation-adjusted) proceeds have steadily increased from $20.62 million ($13.25 million) in 1980 to $109.64 million ($42.62 million) by 1998. Thus, before any observed spread clustering is considered indicative of collusion it is necessary to examine the manner in which such spread clusters may have moved over time. If underwriters were acting in a collusive manner then one would expect to see spreads being clustered at higher levels over time. In contrast, as Fig. 1 (Panels A and B), which plot the spread–proceed relationships for the two subperiods in our sample (1980–1988 and 1989–1998), indicate the level at which spreads appear to be clustered have declined over time, suggesting increasing competition among underwriters over time. In the 1980–1998 period, the predominant clusters appear to be at 10% and 8%. Clusters at 9, 8.5, 7.5, and 7% spread levels are also noticeable. Clusters at below-7% spreads are not apparent during this early period.

In the later period (Fig. 1 Panel B), the two most prominent clusters are at 10% and 7%. The clustering at 7% has become more pronounced in the midrange of proceeds relative to the early period. This increased prominence does not result from a general dispersal of the cloud that obscured this cluster in the early period. Instead the increased prominence results primarily from a dispersal of the above-7% portion of that cloud. All of the above-7% clusters identified above from the early period are still visible in the late period. However, this late period shows evidence of below-7% clusters that were not apparent in the early period. There are clusters visible at 6.5, 6, 5.5, 5, and even 4.5%.

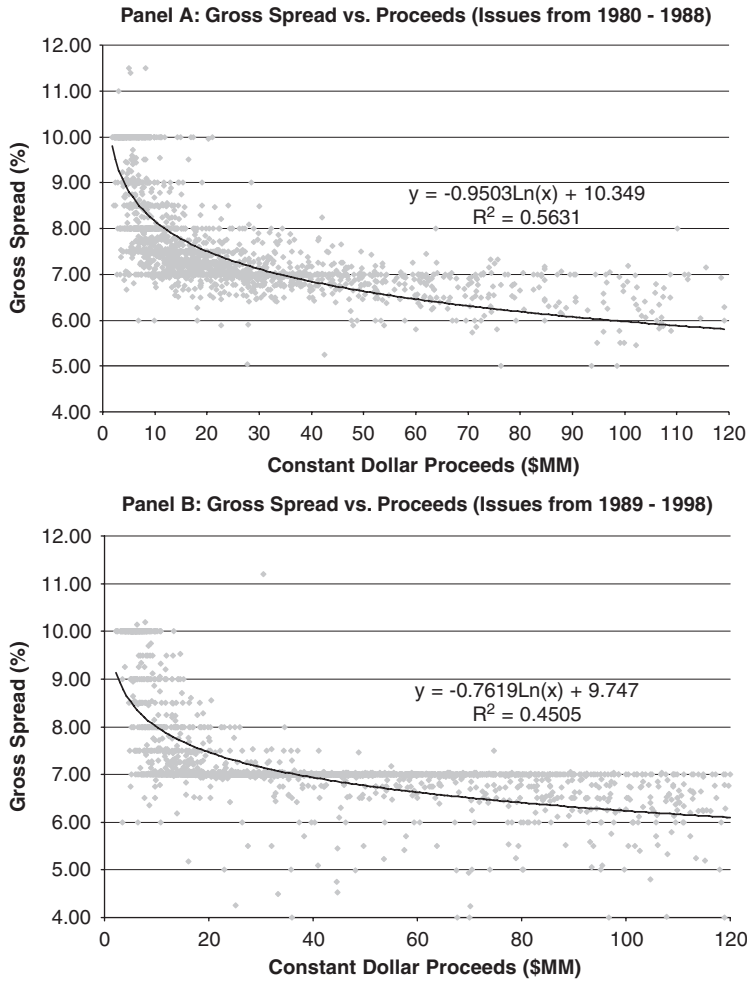

Fig. 1. The Relationship between Gross Spread (%) and Constant Dollar Proceeds ($ millions) in IPOs Completed between (A) 1980 and 1988; and (B) 1989 and 1998.

4.3. Clustering Behavior Varies by Issues' Relative Size

We assigned gross spreads to one of three categories: less than 7%, exactly equal to 7%, or greater than 7%.[19] We then examined the fraction of each year's IPOs which had gross spreads smaller than 7%, equal to 7%, and greater than 7%, respectively, as a function of their relative-size classification.[20]

Initially, the majority of IPOs in each of the three relative-size groups had spreads greater than 7%. However, over time, the spreads for the majority of IPOs in each of the three relative-size groups declined as shown in Table 6. This spread migration first occurred for large IPOs, then for midsize IPOs, and most recently for small IPOs. The spread migration of the majority of small and midsize IPOs increased clustering in the exactly-7%-spread category. The spreads of the majority of large IPOs dropped below 7%, so that their spreads are now predominantly less than 7%.

A relatively small IPO (belonging to the first quartile) was unlikely to have a spread less than 7% even during the early years in our sample. There was not a single year between 1980 and 1998, when more than 5% of relatively small IPOs charged spreads below 7% (see Table 6). Between 1980 and 1990, it was much more likely for a relatively small IPO to have a spread greater than 7% than one exactly equal to 7%. Over 70% of small IPOs had gross spreads greater than 7% during this period. This fraction of above-7% spreads has declined since 1990. Even so, until 1995, with the exception of 1991, it was more likely for a relatively small IPO to have a spread above 7% than to have either a spread that was exactly equal to or less than 7%. For the last three years studied, however, it was actually more common for a small IPO to have a spread exactly equal to 7% than to have a spread above 7%. Even in these past three years, the fraction of small IPOs with spreads of exactly 7% has been no larger than 61%.

Midsized IPOs (belonging to the second and third quartiles of IPOs in a given year) were more likely to having gross spreads below 7% compared to the relatively small IPOs. In general, by mid-1980s, more than 10% of midsized IPOs had spreads below 7% (see Table 6). However, in every year, a below-7% spread was the least likely possibility for a midsized IPO. Like the small IPOs, the majority of midsized IPOs were initially charged spreads greater than 7%. The fraction of midsized IPOs with spreads greater than 7% declined more quickly for midsized IPOs than for small IPOs. By 1987, and ever since, it has been more common for a midsize IPO to have an exactly-7% spread than have spreads either greater or less than 7%. This clustering of spreads for midsize IPOs has become almost complete. In 1980, 98% of midsized IPOs had spreads greater than 7%; in 1998, over 96% of midsize IPOs have spreads of exactly 7%.

The majority of relatively large IPOs were also initially charged gross spreads greater than 7%. However, the popularity of above-7% spreads lasted a much shorter time for these largest IPOs. From 1983 to 1998, it was more common for a large IPO to have a spread less than 7% than a spread equal to or higher than 7%. The only exception to this trend occurred in

Table 6. The Frequency Distribution of IPOs Each Year with Gross Spreads of Less than, Equal to, or Greater than 7% (1980–1998).

Year	Gross Spread Less than 7%			Gross Spread Equal to 7%			Gross Spread Greater than 7%		
	Small IPOs (%)	Mid-Sized IPOs (%)	Large IPOs (%)	Small IPOs (%)	Mid-Sized IPOs (%)	Large IPOs (%)	Small IPOs (%)	Mid-Sized IPOs (%)	Large IPOs (%)
1980	0.00	2.00	32.00	0.00	0.00	8.00	100.00	98.00	60.00
1981	0.00	4.13	23.73	3.39	2.48	20.34	96.61	93.39	55.93
1982	0.00	2.44	20.00	0.00	7.32	35.00	100.00	90.24	45.00
1983	1.61	17.37	65.63	1.61	26.64	24.22	96.77	55.98	10.16
1984	0.00	0.95	28.85	7.55	20.00	44.23	92.45	79.05	26.92
1985	0.00	10.58	68.63	7.84	22.12	25.49	92.16	67.31	5.88
1986	0.91	17.27	68.47	10.91	29.09	21.62	88.18	53.64	9.91
1987	3.90	15.38	64.94	5.19	44.87	29.87	90.91	39.74	5.19
1988	0.00	10.34	75.86	7.14	67.24	20.69	92.86	22.41	3.45
1989	3.70	3.57	66.67	22.22	85.71	33.33	74.07	10.71	0.00
1990	3.70	5.56	70.37	25.93	87.04	29.63	70.37	7.41	0.00
1991	1.45	5.88	76.81	63.77	89.71	23.19	34.78	4.41	0.00
1992	2.06	5.73	70.10	46.39	88.54	29.90	51.55	5.73	0.00
1993	4.17	3.40	68.33	46.67	92.77	30.83	49.17	3.83	0.83
1994	1.12	2.73	58.24	31.46	92.90	41.76	67.42	4.37	0.00
1995	0.93	3.70	66.67	46.73	95.83	33.33	52.34	0.46	0.00
1996	2.94	3.80	60.00	50.59	94.44	40.00	46.47	1.75	0.00
1997	0.84	5.88	64.17	60.50	93.28	35.00	38.66	0.84	0.83
1998	0.00	3.47	69.01	53.52	96.53	30.99	46.48	0.00	0.00

"Small", "Mid-Sized", and "Large" IPOs are defined to be all IPOs in the first, or the second and third, or fourth quartiles by constant dollar proceeds of all IPOs in the specified year, respectively. The percentage shown in each cell indicates the fraction of similar-sized IPOs in the specific year with gross spreads of less than, equal to or greater than 7%. Thus, adding the three percentages reported for all "small IPOs" across the same row (i.e., holding the IPO Year constant) adds up to 100%. Similarly, the three percentages reported for all mid-sized IPOs across the same row (i.e., holding the IPO Year constant) adds up to 100% and the three percentages reported for all large IPOs across the same row (i.e., holding the IPO Year constant) adds up to 100%.

1984, when clustering at 7% was the most common category. Despite the dominance of below-7% spreads through 1998, clustering at 7% has not completely disappeared. Since 1981 at least 20% of all large IPOs in the year had spreads of exactly 7%. In contrast, above-7% spreads have largely disappeared for large IPOs. Only two such deals appear in our sample between 1990 and 1998.

This analysis reveals that relative size is a useful concept to help discuss the shifts in gross-spread categorization of IPOs. In particular, once we divided the IPOs into three relative size groups, it is apparent that their clustering behavior over time has been significantly different.

4.4. IPO Underwriting Spreads are Negatively Related to IPO Size

In this subsection, we focus on the main claim made by Chen and Ritter (2000). These authors observe that by the mid-1990s, underwriting spread paid for all firm commitment IPOs in the US, *regardless of offering size* and choice of underwriter was almost exclusively clustered at exactly 7% for over 90% of "mid-size" issues. Such clustering of spreads is considered indicative of possible collusion among underwriters or consistent with a "strategic pricing equilibrium" (Chen & Ritter, 2000). Our analysis provides evidence to the contrary.

Regressing the Underwriter's *Gross Spread* (as a percentage) against the natural logarithm of the IPO's "constant" (inflation adjusted) dollar proceed (*IPO Size*) reveals a statistically significant negative correlation between spreads and proceeds in both the subperiods in our sample [the earlier period (1980–1988) and the later period (1989–1998)]. This result suggests that, in general, over the entire range of observed IPO proceeds, percentage underwriting spreads do decline with IPO proceeds. This finding is consistent with the hypothesis that underwriters' information production costs include a fixed cost, and there are economies of scale in such costs (i.e., the fixed component of information gathering cost declines as percentage of IPO proceeds as IPO proceeds increase) and percentage spreads decline concomitantly, as they are expected to in a competitive underwriting market.

We also conducted a piecewise linear regression over each of the two subperiods, as described in Morck, Shleifer, and Vishny (1988), to further examine the impact of economies of scale on underwriting spreads. In order to motivate the empirical results of this regression let us consider a simple analytical model. Suppose underwriters' total spreads are a (linear) function of total information production costs, which include a fixed and

a variable component. Let us denote such total costs, $TC = a + bQ$, where a, b, and Q denote the fixed cost, the per proceed dollar variable cost, and the total proceeds from an IPO, respectively. The average cost per IPO proceeds dollar can then be expressed as $AC = a/Q + b$. Differentiating AC with respect to Q, indicates the percentage spread is a decreasing function of Q,[21] and twice differentiating AC with respect to Q indicates that the negative relationship between spread and proceeds decreases as Q, the proceeds (or IPO Size) increases.[22] That is, economies of scale eventually become insignificant for the largest IPOs.

In our piecewise linear regression, we regressed *IPO Size* against *Gross Spread*, controlling for the IPO's relative (decile-based) size. Our piecewise linear regression may be expressed formally as:

$$S = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10}$$

where S and X denote the *Gross Spread* and the *IPO Size*, respectively, and $X_1, \ldots, X_{10}$ are transformations of the proceeds into 10 decile-based categories as defined below.

$$X_1 = \begin{cases} X & \text{if } X < D_1 \\ D_1 & \text{if } X \geq D_1 \end{cases}$$

$$X_2 = \begin{cases} 0 & \text{if } X < D_1 \\ X - D_1 & \text{if } D_1 \leq X \leq D_2 \\ D_2 - D_1 & \text{if } X \geq D_2 \end{cases}$$

$$X_3 = \begin{cases} 0 & \text{if } X < D_2 \\ X - D_2 & \text{if } D_2 \leq X \leq D_3 \\ D_3 - D_2 & \text{if } X \geq D_3 \end{cases}$$

$$\vdots$$

$$X_9 = \begin{cases} 0 & \text{if } X < D_8 \\ X - D_8 & \text{if } D_8 \leq X \leq D_9 \\ D_9 - D_8 & \text{if } X \geq D_9 \end{cases}$$

$$X_{10} = \begin{cases} 0 & \text{if } X < D_9 \\ X - D_9 & \text{if } X \geq D_9 \end{cases}$$

where the upper bound of the first through the ninth proceeds deciles are denoted by $D_1, \ldots, D_9$.

Our piecewise linear regression results shown in Table 7 are consistent with such a model in both subperiods. The estimated coefficients of the transformed IPO relative size variables $X_1, \ldots, X_{10}$ are generally negative and statistically significant in both the 1980–1988 and the 1989–1998

Table 7. Piecewise Regression Results (Gross Spread against IPO Relative Size) and Decile Characteristics.

Independent Variables	Coefficient	*t*-Statistic	Decile Charateristics			
				Mean spread (%)	Mean proceeds ($MM)	Upper bound of proceeds decile ($MM)
Panel A: "Early" period (1980–1988)						
Intercept	10.801	56.576*				
X_1	−0.351	−7.881*	D_1	9.43	3.90	5.25
X_2	−0.147	−2.936*	D_2	8.81	6.27	7.27
X_3	−0.269	−5.518*	D_3	8.42	8.29	9.33
X_4	−0.160	−5.205*	D_4	7.80	10.97	12.59
X_5	−0.068	−2.473*	D_5	7.47	14.36	16.14
X_6	−0.016	−0.701	D_6	7.32	18.12	20.42
X_7	−0.036	−2.175*	D_7	7.17	23.12	26.42
X_8	−0.003	−0.264	D_8	7.04	30.23	35.07
X_9	−0.013	−2.500*	D_9	6.93	43.53	53.67
X_{10}	−0.007	−3.142*	D_{10}	6.61	77.72	119.04
R^2	0.6181					
Adjusted R^2	0.6162					
Observations	2,112					
Panel B: "Later" Period (1989–1998)						
Intercept	11.345	114.19*				
X_1	−0.349	(26.72)*	D_1	9.05	6.74	9.75
X_2	−0.137	(14.14)*	D_2	7.40	13.20	16.07
X_3	−0.005	(0.41)	D_3	7.09	18.42	20.77
X_4	−0.013	(1.02)	D_4	7.01	23.39	25.68
X_5	0.004	0.38	D_5	7.02	28.55	31.05
X_6	−0.012	(1.04)	D_6	6.96	33.55	36.27
X_7	0.000	(0.04)	D_7	6.97	39.74	43.87
X_8	0.000	0.07	D_8	6.93	48.61	54.57
X_9	−0.010	(3.31)*	D_9	6.87	63.25	74.53
X_{10}	−0.010	(5.33)*	D_{10}	6.56	93.25	120.00
R^2	0.6277					
Adjusted R^2	0.6265					
Observations	3,217					

*Indicates statistical significance at 95% confidence level.

subperiods. That is, the spread–proceeds relationship is negative (indicative of economies of scale) for IPOs that are of similar size (within the same decile). Importantly, our piecewise linear regression confirms that the negative relationship between spread and proceeds is larger and statistically more significant for relatively smaller IPOs compared to larger IPOs as the benefits of economies of scale decline after IPO size exceed a certain threshold. This analysis reveals why a comparison of the spread charged on a typical IPO in the early period, which was relatively small, to a typical IPO in the later period, which was relatively large, may be potentially misleading. In the former instance, the percentage spread charged would be largely based on the fixed component of the underwriter's information gathering costs. Thus, small changes in proceeds would result in significant changes in such average information gathering costs and the resultant spread determined in a competitive equilibrium.

Fig. 2, lines A and B plot the estimated piecewise linear regression coefficients against the "constant" (inflation adjusted) dollar IPO proceed for the early and later subperiods (1980–1988 and 1989–1998, respectively). Both lines have steep negative slopes initially (for smaller IPOs), indicating that the gross spread declines significantly as small IPOs get marginally

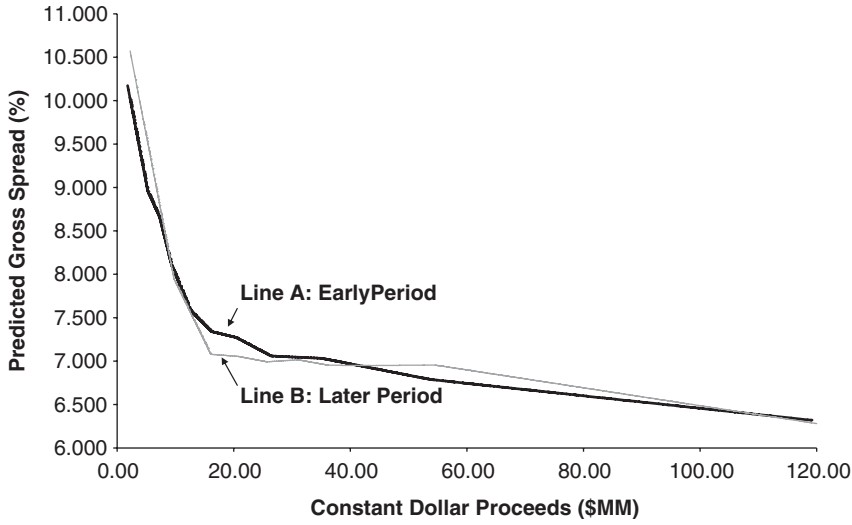

Fig. 2. Predicted Values of Piecewise Regression (1980–1988 "Early" Period vs. 1989–1998 "Later" Period).