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If History Could Be Rerun: The Provision and Pricing of Deposit Insurance in 1933

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This paper examines cross-subsidy, moral hazard, and bank liability issues related to the provision of federal deposit insurance by "rerunning" its implementation, i.e., determining fair premium values, over the period 1927–1932. The pre-1933 period was characterized by historically high asset-price volatility, a large number of bank failures, and a weak federal safety net. In this economic context, we find a high degree of self-insurance on the part of the banks in our sample, both in terms of higher overall capital levels and a strong correlation between capital levels and asset volatility. Potentially large, regional cross-subsidies among banks were also found. *Journal of Economic Literature* Classification Number: G21. © 1995 Academic Press, Inc.

1. INTRODUCTION

The passage of the Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991 focused renewed attention on deposit insurance provision and its pricing. Specifically, the "risk-based" deposit insurance premium system, implemented in 1993, is the first major deviation from the

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flat premium schedule since the introduction of federal deposit insurance.[1] Further, the prompt corrective action (PCA) program is a modification of the limited liability rule for banks introduced in 1933 and 1935.[2] These FDICIA initiatives were in response to concerns regarding bank cross-subsidies and moral hazards thought to inhere in fixed-rate deposit insurance.

Similar cross-subsidy, moral hazard, and bank liability issues were actively debated in 1933. At that time, large money-center and Eastern U.S. banks opposed federal deposit insurance on the grounds that stronger banks would be forced to subsidize poorly managed and weaker ones. However, the final legislative outcome was the flat-rate premium schedule that existed until 1993.[3] At the same time, limited liability of bank stockholders replaced the double liability prevalent since the end of the Civil War.[4]

This study examines bank-specific fair premium values as if federal deposit insurance had been in place during the 1927–1932 period. This period, just prior to the passage of deposit insurance legislation in 1933, is of particular interest for two reasons. First, a relatively clean assessment of fair-pricing and cross-subsidy issues can be made at this time, since the confounding effects of mispriced federal deposit insurance were not present. Second, given that the FDIC was established in the aftermath of the banking panic of 1931–1933, our analysis can examine the subsidy and pricing issues from the perspective of the 1933 legislative debate.

To value the deposit insurance contract, the study employs the limited-term option-pricing approach of Marcus and Shaked (1984, hereafter MS) and Ronn and Verma (1986, hereafter RV) and for comparison a modified unlimited-term approach following Merton (1978) and Pennacchi (1987). A correction is made to the original RV formulation so that "put–call parity" is satisfied. In addition, Merton's (1978) unlimited-term model is extended to account for dividend payments.

[1] Under the 1993 risk-based scheme, deposit insurance premia range from 23 bp (basis points) to 32 bp. However, Chan *et al.* (1992) cast doubt on whether a truly fair-priced deposit insurance scheme is possible.

[2] Under PCA, a bank may be closed when its book capital falls below 2% of its assets (with residual capital used to settle postclosure claims). Under pre-1933 double liability rules, bank stockholders also suffered potential postclosure losses. Limited liability was introduced and double liability phased-out starting in the early 1930s. See Macey and Miller (1992) for the legislative history of double liability in banking.

[3] Section 8 of the Banking Act of 1933 created the Federal Deposit Insurance Corporation through an amendment to the Federal Reserve Act. A temporary plan went into effect on January 1, 1934. Initial coverage was limited to $2500, but increased to $5000 on July 1, 1934. The initial assessment rate was 50 bp of insurable deposits. The temporary plan remained in effect until 1935 when the premium was fixed at one-twelfth of 1% (or 8.33 cents per $100 of deposits).

[4] Under double liability, bank stockholders not only lost the value of their common equity invested in the bank, but were additionally (doubly) liable up to the par value of shares held.

Section 2 of the paper briefly discusses the regulatory setting prior to 1933 and the 1933 legislative debate regarding deposit insurance. Section 3 describes the methodology for estimating bank-specific deposit-insurance premia. Section 4 describes data and Section 5 presents the empirical results. A summary and conclusion follows in Section 6.

2. REGULATORY BACKGROUND AND 1933 LEGISLATIVE DEBATE

Prior to federal deposit insurance three "safety nets" protected banks, each with major defects that became apparent in the 1920s. State-sponsored deposit insurance was available in eight states in the 1920s, but these programs were poorly funded and administered (Calomiris, 1992). All collapsed by the end of the 1920s (FDIC, 1984).

Local clearinghouses were a second line of defense. During the panics of 1857 and 1907, these organizations provided liquidity and liability guarantees to troubled member banks (Gorton, 1985a, 1985b). However, clearinghouse guarantees were deployed selectively (Kennedy, 1973).

The third safety net was the lender-of-last-resort facilities of the Federal Reserve System. However, as discussed in Friedman and Schwartz (1963), the Federal Reserve's failure to expand the money base sufficiently and restrictions on its lender-of-last-resort policies contributed to the economic contraction during this period.

In this environment of weak safety nets, bank owners chose to self-insure by operating with less financial leverage. For example, Calomiris (1992) shows that in June 1928 book capital plus surplus of Federal Reserve member banks was 19% of their total assets. This compares to 6% for all U.S. banks in 1990.

Double liability of stockholders, together with the weakness of the safety net, motivated greater monitoring by stockholders. Double liability was legislated in the National Bank Act of 1863 for national banks, and was adopted in some form by all but 10 states. Under double liability, each shareholder could be additionally assessed up to the par value of shares he (or she) held, so as to satisfy postclosure creditor claims. This extended liability gave bank stockholders greater incentives to control risk.[5]

While federal deposit insurance had been included in the Senate version of the Federal Reserve Act of 1914, it was eventually eliminated in a joint House and Senate conference. The idea resurfaced during the banking panic of the early 1930s, but the cross-subsidy concerns of large banks

[5] Winton (1993) observes that double liability can introduce adverse selection effects as well as costs associated with monitoring other stockholders' personal wealth.

impeded its serious consideration until the national "bank holiday" in March 1933.[6]

The cost of providing deposit insurance was an additional concern. Historically, depositor losses at national banks had averaged 14 bp (basis points) since the passage of the National Banking Act, 19 bp since the passage of the Federal Reserve Act, and 70 bp in 1931, all as a percentage of deposits (Congressional Record, p. 3839). The 8.33 bp flat premium eventually adopted reflected regulators' expectations of increased banking stability with federal deposit insurance.

Finally, the advent of federal deposit insurance signaled the end of double liability. Congressional disenchantment with double liability was threefold. First, it had failed to bolster public confidence and thereby prevent bank panics. Second, those left holding bank stock in failed banks were often the most unsophisticated investors. Finally, double liability hampered bank recapitalizations.

3. DEPOSIT INSURANCE PRICING METHODOLOGY

To value deposit insurance, we utilize both the limited-term put–option model, developed in Merton (1977), MS (1984), and RV (1986), and the unlimited-term put-option model developed by Merton (1978), Pennacchi (1987), and Cooperstein *et al.* (1995).[7] As a special case, we extend the limited-term model to account for double liability.

The limited-term model is appealing as a model of the initial federal deposit insurance contract, since considerable controversy accompanied its introduction. Indeed, deposit insurance legislated in the Banking Act of 1933 was temporary, pending permanent legislation in the Banking Act of 1935. However, the 8.33 bp assessment established in 1935 did remain in effect without revision until 1950 when rebates were introduced.[8] Thus, post-1935 federal deposit insurance behaved more like an unlimited-term contract.

Details of the limited-term model are given in Appendix A. Appendix

[6] Eastern bankers fears of cross-subsidies to weaker banking regions were reinforced by the Michigan banking crisis. The Michigan bank holiday, declared on February 14, 1933, has been credited as the regional crisis that helped to precipitate the national banking collapse in March 1933 (Colt and Keith, 1933).

[7] Under a limited-term contract, the deposit insurer resets premia at the start of each contract period (or forces an equivalent change in a bank's capital ratio). In contrast, with an unlimited-term contract the deposit insurer charges a single, time-invariant deposit insurance rate over the life of the contract.

[8] Further, capital ratios were largely unregulated during this period. However, to qualify for a charter, national banks were required to have at least $50,000 in paid-up capital. State bank capital requirements differed, but $15,000 and $20,000 minimums were typical.

B extends Merton's (1978) unlimited-term approach to allow for dividend payments.

4. DATA

Weekly bank stock data for New York City banks were obtained from the *Commercial and Financial Chronicle.* Cash dividend, stock dividend and stock split data are from *Moody's Manual of Investments.* Using the average of the reported bid and ask prices, a weekly stock return series for each bank, adjusted for dividends and stock splits, was compiled. Estimates of σ, the annualized standard deviations of return on bank equity, was obtained from these time series.

To analyze the cross-subsidy issue, the monthly stock price series, reported in the *Bank and Quotation Record*, was used. This sample included major banks from each banking region in the country. These data covered some 1900 banks, but lack of monthly trading for many banks reduced the usable sample to 550 banks. Bank stock returns were then calculated for each year, 1927–1932, and the final sample of banks was selected under a criterion that their stock had traded for at least 8 months in each year considered for inclusion in the data set.

Annual data on bank deposits and other bank liabilities were collected from various issues of *Rand McNally Bankers Directory.* Par values and the number of shares outstanding were also obtained from *Moody's Manual of Investments.*

5. RESULTS

5.1. *Summary Statistics*

Table I shows the sample size of banks (N), total deposits (D), deposit-weighted average equity volatility (σ_E), deposit-weighted average implied asset volatility (σ_v) and deposit-weighted average market equity-to-asset ratio (κ). The sample size varied from 303 banks in 1929 to 122 banks to 1932. Variations in sample size are due to changes in trading activity, mergers, closures, and voluntary liquidations.

Total deposits for the sample of banks varied across regions from the relatively large New York City (NYC) banks, with total deposits of \$6.4 billion in 1929 to the District of Columbia (DC) with total deposits of \$0.20 billion. The sample deposit total for 1929 was \$17.5 billion, representing 28.8% of total national deposits.[9]

[9] The national deposit base, as given in *Rand McNally Bankers Directory* (1927–1932), was 45.7, 58.1, 61.0, 60.7, 59.0, and 50.1 (billions of dollars) in the years 1927 to 1932, respectively.

TABLE I
SUMMARY STATISTICS AGGREGATED BY REGION AND TOTAL SAMPLE

	NYC[a]	PHIL	CHI	GNY	INE	IMW	OMW	DC	SE	WC	TOTAL
						1927					
N	47	8	33	20	11	20	10	12	30	18	209
D	5.3	0.29	1.59	0.77	1.04	1.04	0.33	0.17	0.56	0.90	12.0
σ_E	22.8	14.7	20.5	21.8	17.0	20.2	8.59	11.2	13.0	15.7	20.0
σ_V	3.9	4.40	5.05	5.66	3.70	3.64	1.74	2.79	2.45	2.76	3.92
κ	18.1	30.3	24.3	24.5	20.4	17.5	20.3	24.0	18.3	16.6	19.8
						1928					
N	45	15	17	25	16	26	10	12	44	19	229
D	5.4	0.44	0.94	0.55	1.51	1.58	0.28	0.19	0.95	0.65	12.5
σ_E	33.8	21.1	31.2	17.3	18.3	16.8	13.3	7.03	14.5	22.1	25.4
σ_V	8.1	7.05	10.4	4.91	3.90	3.49	3.62	1.75	2.74	3.96	6.20
κ	24.7	31.5	32.8	29.8	21.6	20.1	27.8	24.4	19.4	17.1	24.1
						1929					
N	34	28	48	45	22	24	18	14	46	24	303
D	6.4	1.16	2.26	1.07	1.84	1.40	0.34	0.20	1.00	1.80	17.5
σ_E	48.6	31.0	31.8	22.4	61.0	61.3	13.5	9.95	39.0	27.4	42.1
σ_V	15.5	8.93	9.77	5.88	13.4	13.2	4.20	2.42	8.66	5.84	11.6
κ	31.4	28.0	30.3	25.3	22.9	24.4	27.6	23.8	18.2	20.0	27.1
						1930					
N	29	32	29	21	17	12	10	11	36	23	220
D	5.6	1.37	2.22	0.69	1.51	0.72	0.33	0.20	0.82	1.89	15.4
σ_E	31.4	20.4	25.2	15.6	29.9	19.6	14.5	21.7	35.0	15.4	25.8
σ_V	10.6	4.20	5.02	3.36	4.90	3.27	3.09	4.55	5.35	2.18	6.43
κ	34.0	20.9	20.3	20.5	16.6	17.2	20.3	20.6	14.2	14.3	23.8
						1931					
N	34	20	20	18	19	14	2	8	21	17	173
D	5.6	1.01	1.56	0.59	1.45	0.48	0.04	0.16	0.61	1.66	13.8
σ_E	35.9	38.7	46.7	33.5	47.5	30.6	23.0	12.2	30.7	24.7	36.1
σ_V	8.0	5.09	4.83	4.10	4.74	1.70	3.08	2.28	3.20	2.82	5.49
κ	22.5	14.1	10.4	12.9	9.95	6.98	12.9	18.6	11.2	11.4	15.6

5.2. *Equity and Asset Volatilities*

One measure of bank risk-taking is given by the estimated equity volatilities and implied asset volatilities derived from the RV equity formula (Appendix A). Deposit-weighted average volatility estimates are shown in Table I by banking region. For 1929, the highest regional weighted-average equity and asset volatilities were found in the industrial midwest banks (IMW) (61.3 and 13.2%), the industrial northeast banks (INE) (61.0 and

TABLE I—*Continued*

	NYC[a]	PHIL	CHI	GNY	INE	IMW	OMW	DC	SE	WC	TOTAL
						1932					
N	19	23	10	15	19	2	2	—	14	18	122
D	4.1	1.06	1.43	0.61	1.40	0.45	0.06	—	0.32	1.61	11.0
σ_E	40.0	62.2	61.7	48.2	64.6	103	11.6	—	53.5	46.0	51.8
σ_V	5.6	8.85	5.33	5.51	4.52	0.99	0.87	—	3.85	4.51	5.37
κ	14.0	15.1	8.63	11.4	8.64	1.27	7.51	—	8.06	9.70	11.2

Note. The data sample includes monthly stock price and annual accounting data on 303 banks (in 1929), covering the period 1927–1939 and aggregated by region. Sample statistics are denoted as follows. N is the sample size and D is total deposits (billions of dollars); σ_E and σ_V are deposit-weighted average estimated equity and (option-implied) asset volatilities (percent); κ is the deposit-weighted average (option-implied) market equity-to-asset ratio (percent).

[a] The cities included in each region are as follows: GNY included Bayonne, Brooklyn, Elizabeth, Hartford, Hoboken, Jamestown, Jersey City, Newark, New Brunswick, New Rochelle, Port Chester, Providence, Union City, Wilmington, and Yonkers; INE included banks in Binghamton, Boston, Buffalo, Rochester, and Syracuse; IMW included Cleveland, Detroit, Grand Rapids, Milwaukee, Minneapolis, and Scranton; OMW included Allentown, Columbus, Cincinnati, Erie, Indianapolis, Pittsburgh, Wiles-Barre, and Youngstown; SE included Atlanta, Baltimore, Birmingham, Charleston, Greenville, Knoxville, Louisville, Lynchburg, Memphis, Montgomery, Nashville, New Orleans, Norfolk, Richmond, Shreveport, Spartanburg, Wilmington, and Winston–Salem; WC included Dallas, Houston, Los Angeles, Oakland, Omaha, Portland, Salt Lake City, San Francisco, Seattle, Spokane, and St. Louis.

13.4%), the New York City (NYC) banks (48.6 and 15.5%), and the southeast (SE) region banks (39.0 and 8.66%). Low-volatility regions included west coast (WC) banks (27.4 and 5.84%) District of Columbia banks (DC) (9.95 and 2.42%), and other midwest (OMW) banks (13.5 and 4.20%). Intermediate volatility regions in 1929 included Philadelphia (PHIL) (31.0 and 8.93%), Chicago (CHI) (31.8 and 9.77%), and banks in the greater New York region (GNY, not including New York City banks) (22.4 and 5.88%). The dispersion in regional volatility lends support to a potential cross-subsidy effect among banking regions.

Table I results also indicate that average equity and asset volatilities rose from 1927 to 1929 and then abated until 1932. This pattern is consistent with that found for stocks in general over this period (Wilson *et al.* 1990). Furthermore, our estimates for σ_E in the noncrisis years of 1927 and 1928 are on a similar order of magnitude to those found by RV for 1983. Finally, note that the largest increases in asset volatility from 1927 to 1929 were with the New York City (NYC), industrial northeast (INE), industrial midwest (IMW), and southeast (SE) banks.

5.3. *Bank Capital Ratios*

Table I gives deposit-weighted average market capital-to-asset ratios (κ), derived from observed market equity values and option-implied bank asset values. In 1929, the highest average capital ratios were those of New York City (31.4%), Chicago (30.3%), and Philadelphia (28.0%) banks. The lowest capital-to-asset ratios were among west coast (20.0%) and southeast (18.2%) banks. Not only are these ratios high by current standards, the averages indicate a tendency for banks in higher asset risk regions to hold more capital.

Average capital ratios peaked in 1928 and 1929 and declined sharply thereafter. Cross-regional differences in capital ratios were still apparent in 1932, with average capital ratios for New York City, greater New York City, and Philadelphia banks still in excess of 11%. In contrast, capital ratios of Chicago and industrial midwest banks had declined to 8.6 and 1.3%, respectively. Clearly, the midwest, industrial northeast, and southeast banks were in the weakest capital positions by the end of 1932.

5.4. *Bank Capital Ratio/Asset Volatility Correlations*

Table II shows contemporaneous correlations among individual bank asset volatilities and capital ratios by region. Correlations are positive and significant in most regions and sample years, suggesting that the best capitalized banks were exposed to the most asset risk. This is consistent with the general absence of moral-hazard-type risk-taking by banks. Arguably, excessive risk-taking was discouraged by the double liability rules.

5.5. *Insurance Premium Estimates—Limited Liability*

Table III displays deposit-weighted average insurance premia calculated from the limited-term (RV) model.

Focusing on 1929, the potential cross-subsidy effects between regions become readily apparent. The highest average premia would have been generated by banks in the southeast (SE), industrial midwest (IMW), and industrial northeast (INE), with average premia of 103, 44.5, and 25.9 bp, respectively. In contrast, low average premia were associated with other midwest (OMW) banks, District of Columbia (DC) banks, Greater New York (GNY, outside New York City) banks, and west coast (WC) banks, with premia of 0.0, 0.0, 0.36, and 0.45 bp, respectively. Chicago (CHI) and Philadelphia (Phil) banks were associated with average premia of approximately 1.5 bp. Finally, New York City (NYC) banks would have had an average premium value of 9.96 bp. These results accord with the cross-subsidy concerns of the money-center and large Eastern banks. The cumulative distribution of deposit premia for the sample banks in 1929 are graphed

TABLE II

CORRELATIONS BETWEEN RV OPTION-IMPLIED ASSET VOLATILITY AND CAPITAL RATIOS

	1927	1928	1929	1930	1931	1932
NYC	0.46	0.33	0.85**	0.63**	0.33	0.52**
PHIL	0.63	0.68**	0.67**	0.72**	0.91**	0.87**
CHI	0.66**	0.61**	0.68**	0.24	0.64**	0.95**
GNY	0.34	0.56**	0.56**	0.67**	0.38	0.78**
INE	0.98**	0.49	0.83**	0.24	0.63**	0.62**
IMW	0.24	0.70**	0.58**	0.91**	0.87**	—
OMW	0.73*	0.39	0.82**	0.97**	0.88	—
DC	0.74**	0.63*	0.78**	0.24	0.77*	—
SE	0.36*	0.39**	0.56**	0.55**	0.63**	0.77**
WC	0.72**	0.61**	0.85**	0.26	0.79**	0.34
All banks	0.55**	0.52**	0.57**	0.63**	0.53**	0.75**

Note. Bank asset volatilities and (option-implied) market equity-to-asset ratios are derived using the RV limited-term equity model, modified to account for double liability with national banks and those state banks with mandated double liability. Otherwise, limited liability is used. Model formulation is discussed in Appendix A. Results are presented by banking region and for the total sample.

* Significant at the 5% level.

** Significant at the 1% level.

TABLE III

RV FAIR-VALUE DEPOSIT INSURANCE PREMIA UNDER LIMITED LIABILITY OF BANK STOCKHOLDERS

	1927	1928	1929	1930	1931	1932
NYC	0.57	3.48	9.96	0.15	3.84	2.13
PHIL	0.45	0.17	1.85	0.04	1.71	22.6
CHI	0.18	5.80	1.42	0.61	3.77	11.6
GNY	0.94	0.30	0.36	0.00	0.66	7.31
INE	0.00	0.04	25.9	0.07	4.69	11.8
IMW	0.05	0.11	44.5	0.00	0.17	7.41
OMW	0.00	0.00	0.00	0.00	0.05	0.00
DC	0.00	0.00	0.00	4.68	0.00	—
SE	0.15	0.15	103	23.2	1.49	7.69
WC	0.08	1.70	0.45	0.34	0.00	9.70
All banks	0.37	2.06	16.2	1.49	2.71	8.24

Note. DI premia are calculated from the RV limited-term model, assuming limited liability of bank stockholders. Details of the model formulation are discussed in Appendix A. Bank-specific premium values are weighted by each bank's deposit proportion of aggregate sample deposits, and the resulting deposit-weighted average premia are expressed in basis points (bp).

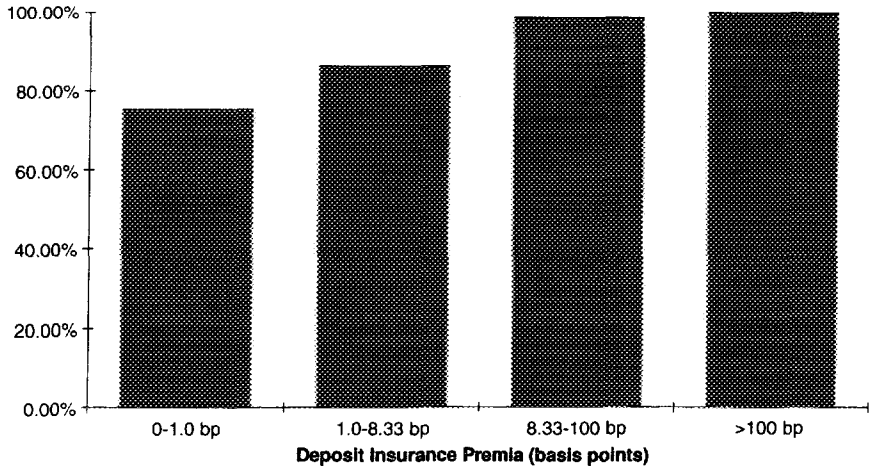

FIG. 1 Cumulative premia, 1929.

in Fig. 1. As can be seen, 13.6% of the sample banks in 1929 had fair premia in excess of the 8.33 bp rate legislated in 1935.

In contrast to 1929, the deposit insurance premia in 1927 and 1928 were mostly small and reveal only small cross-regional differences. By 1929, the increased stock market volatility and the developing economic crisis had the greatest adverse impact on those regions that were the least diversified, i.e., the highly specialized economies of the industrial midwest and northeast, as well as the agricultural southeast. These regions experienced large increases in asset volatility in 1929 without compensating increases in bank capital. Asset volatilities for New York City banks increased in 1929 as well, but were offset to a greater extent by capital increases (see Table I, column 1).

Cross-regional differences in deposit insurance premia appeared to ameliorate post-1929 for three reasons. First, the largest number of bank closures and mergers occurred in 1930 and 1931, removing weaker banks from the sample.[10] In addition, many of the more volatile stocks in 1929 were infrequently traded after the sharp decline in stock prices post-1929.[11] Third, stock market volatility declined after 1929.

[10] For our sample of banks, bank failures numbered 3, 5, 18, and 9 and bank mergers numbered 1, 29, 18, and 5, respectively, in the years 1929 to 1932.

[11] Comparing banks that failed with those that did not fail over the 1929–1931 period, failed banks traded less frequently (with stock price changes in 6.3 versus 7.2 months each year), had lower market capital ratios (13.6 versus 18.0%) and lower asset volatilities (2.9 versus 4.4%) in the year before failure, all significant at the 1% level. Therefore, distressed banks were less likely to be included in the data sample, under the sampling criterion employed. For the baseline years, 1927 and 1928, few banks were closed.

Of additional interest is how national deposit-weighted insurance premia (TOTAL) for these banks compares with the 8.33 bp premium introduced in 1935. Table III shows that except for 1929 and 1932, average deposit insurance premium values were well below the 8.33 bp standard. One reason for these low average premia was the relatively high capital ratios in these years. Specifically, even in 1932 the sample average market capital-to-assets ratio remained above 10.0%.

Whereas the 1932 estimates might be viewed as tainted by survivorship bias, 1927 can be viewed as a baseline in terms of asset and equity volatilities. Moreover, equity volatility in 1927 was on a similar order of magnitude to that found in RV for banks in 1983. The average premium for 1927 was 0.37 bp, with only 7 of the 209 banks displaying premia exceeding 8.33 bp.[12]

5.6. *Insurance Premium Estimates—Double Liability*

The deposit insurance premia reported in the previous section are calculated assuming limited liability. These would be appropriate if the likelihood of collecting assessments against stockholders were essentially zero, or with the anticipation that double liability provisions would be repealed with the advent of deposit insurance.

For completeness, we computed fair-value premiums assuming: (i) double liability with fully-enforced assessments against stockholders, and (ii) double liability with partial (51%) assessments against stockholders in failed banks. The 51% assessment rate represents the historic percentage of assessments actually collected from stockholders during the double liability period (Macey and Miller, 1992). The results under the 100 and 51% assessment rates are shown in Table IV.

Not surprisingly, these premia are well below those obtained under limited liability. Indeed, even in 1929, the year with the highest asset return volatility, the weighted-average premia were 9.84 bp (100% assessment) and 12.4 bp (51% assessment). For 1927, the weighted-average deposit premia were 0.16 and 0.23 bp, respectively.

5.7. *Unlimited-Term Contract Results*

For comparison, fair premia were also calculated under the dividend-extended, Merton–Pennacchi unlimited-term model discussed in Section 3. For brevity, attention is restricted to the sample of New York City banks. The resulting annualized fair-value premiums are shown in Table V.

As expected, the baseline 8.33 bp rate appears underpriced relative to

[12] RV found that 15 of 43 banks had fair premia exceeding 8.33 bp, and Marcus and Shaked (1984) found that 35 and 30% of banks in their sample of 40 bank-holding companies had fair premia exceeding 8.33 bp in 1979 and 1980, respectively.

TABLE IV
RV Fair-Value Deposit Insurance Premium under 100 and 51% Double Liability Assessments of Bank Stockholders

	1927	1928	1929	1930	1931	1932
NYC	0.30/0.40	1.74/2.42	5.73/7.51	0.01/0.04	0.05/0.21	0.04/0.25
PHIL	0.00/0.02	0.00/0.04	0.83/1.21	1.74/0.21	0.04/0.07	0.86/0.9
CHI	0.03/0.08	3.45/4.46	0.56/0.88	1.74/0.21	0.04/0.07	0.86/0.9
GNY	0.29/0.52	0.03/0.10	0.06/0.14	0.00/0.00	0.00/0.00	0.36/0.58
INE	0.00/00.0	0.00/0.01	10.4/15.3	0.00/0.00	0.03/0.14	1.80/0.58
IMW	0.00/0.01	0.02/0.05	25.8/34.0	0.00/0.00	0.00/0.00	0.00/0.00
OMW	0.00/0.00	0.00/0.00	0.00/0.00	0.00/0.00	0.00/0.00	0.00/0.00
DC	0.00/0.00	0.00/0.00	0.00/0.00	3.05/1.11	0.00/0.00	—/—
SE	0.01/0.04	0.03/0.07	77.7/88.6	9.53/10.1	0.19/0.09	0.06/0.13
WC	0.00/0.01	0.64/1.05	0.03/0.12	0.88/14.3	0.00/0.00	1.38/1.00
All banks	0.16/0.23	1.04/1.44	9.84/12.4	0.60/0.91	0.05/0.28	1.04/2.40

Note. DI premia are calculated using the RV limited-term model, under alternative assumptions of (i) 100% double liability, and (ii) 51% double liability. The latter (51%) assumption is the average percent of assessments collected historically from bank owners. The resulting deposit-weighted average premium results are expressed in basis points (bp).

the limited-term contract results in Table V. The resulting deposit-weighted average fair premia range from 11.41 bp in 1927 to 37.12 bp in 1929 and 14.50 bp in 1932. Also listed in Table V, for comparison, are the deposit-weighted average deposit insurance premia from Table III adjusted for auditing costs.

TABLE V
Unlimited-Term Fair-Value Deposit Insurance Premium

1927	1928	1929	1930	1931	1932
Average (deposit-weighted) unlimited-term premia					
11.41	21.85	37.12	26.68	25.80	14.50
Average (deposit-weighted) limited-term premia plus auditing costs					
1.91	4.82	11.30	1.49	5.18	3.47

Note. Deposit-weighted average premia are calculated using a dividend-extended, Merton–Pennacchi unlimited-term model, as formulated in Appendix B. The resulting premia are then taken as lump-sum perpetuities and multiplied by the Treasury bond yield to derive equivalent annual premia. For comparison, the deposit-weighted average premia in Table III are restated with 1.34 bp in auditing costs, calculated as the ratio of 1935 FDIC administrative expenses ($2.7 million) to 1935 FDIC-insured deposits ($20,158 million). All results are expressed in basis points (bp).

6. SUMMARY AND CONCLUSIONS

During the early 1930s, large Eastern and money-center banks lobbied strongly against federal deposit insurance legislation on the grounds that better-capitalized banks would be forced to subsidize the poorly managed and weaker ones. Cross-subsidy and related moral hazard issues also attracted considerable interest as a result of the deposit insurance crises of the 1980s. These renewed concerns were addressed, in part, by the FDICIA of 1991, which led to the introduction of risk-based deposit insurance premiums and implementation of the PCA program. The initiatives taken under FDICIA were the first significant departures from the original flat-rate premium and limited liability rules legislated in the Banking Acts of 1933 and 1935.

This paper examined these cross-subsidy, fair pricing, and bank liability issues through an analysis of fair-value deposit insurance premia during 1927–1932 period, just prior to the introduction of federal deposit insurance. This period is of particular interest since the confounding effects of mispriced federal deposit insurance system were absent.

Our results indicate large cross-subsidies in the period just prior to the inception of deposit insurance. Sharp regional differences in asset volatilities were found over this period, particularly in 1929. In addition, capital ratios declined to historically low levels, particularly at banks outside of the large Eastern and money-center bank regions. These results are especially striking given that our sample consisted primarily of large banks with actively traded stocks. Even greater cross-subsidies might be expected among smaller local banks, since these failed in greater numbers in the 1930–1932 period.

Specifically, using the limited-term European put–option valuation model, our results show that the initial 8.33 bp rate for federal deposit insurance was overpriced on average, relative to fair-value premia estimated over the pre-FDIC period 1927–1932, with the possible exception of 1929 and 1932. Using 1927 as a benchmark, the weighted-average, fair-value premium for that year was 0.37 bp. These findings of over-pricing parallel those of MS (1984) and RV (1986), in their estimation of fair deposit insurance premium values during the late 1970s and early 1980s.

The double liability of bank stockholders in this period also allows an assessment of the effects of relaxing limited liability rules, both in terms of stockholder discipline and regulator (FDIC) exposure. Double liability in conjunction with deposit insurance is shown to significantly reduce resulting fair value deposit insurance premia.

Finally, relaxing the limited-term assumption for the deposit insurance contract reverses the findings of overpricing, despite the high capital ratios and double liability of the period. Thus, whether the contact was overpriced

or underpriced at its inception depends crucially on whether regulators, depositors, and stockholders rationally expected at the time of the contract's introduction (i) a limited-term contract with frequent premium adjustments or (ii) an unlimited contract with fixed premia.

APPENDIX A: LIMITED-TERM DEPOSIT INSURANCE PRICING

Following Merton (1977), MS and RV, deposit insurance is assumed to be isomorphic to a one-period European put option.[13] Let

V = the unobserved value of bank assets,

B_1 = the face value of insured bank deposits,

B_2 = the face value of other bank liabilities,

$B = B_1 + B_2$ = the face value of total debt liabilities,

E = bank equity value,

σ_E = the instantaneous standard deviation of the return on bank equity,

σ_V = the instantaneous standard deviation of the return on bank assets,

δ = dividends per dollar of bank assets, paid n times per year,

T = time until the next bank audit,

$N(\cdot)$ = the standard normal distribution, and

d = the insurance premium per dollar of insured deposits.

The fair-value premium, d, under limited liability is then given as

$$d = N(y + \sigma_V\sqrt{T}) - (1 - \delta)^n(V/B)N(y) \tag{A1}$$

and

$$y = \{\ln[B/V(1 - \delta)^n] - \sigma_V^2 T/2\}/\sigma_V\sqrt{T}. \tag{A2}$$

The bank's equity value, E, is modeled as a European call option, which must satisfy the "put–call parity" condition, $E = V - B + dB_1$. Substituting from (A1) yields

[13] As in RV, bank audits are assumed to be annual. Klebaner (1990) indicates that national, and most state, bank examinations were annual until the Federal Reserve Act of 1913, when biennial examinations were instituted for national banks.

$$
\begin{aligned}
E &= V - B + B_1 N(y + \sigma_V\sqrt{T}) - (1-\delta)^n V(B_1/B)N(y) \\
&= V[1 - (1-\delta)^n(B_1/B)N(y)] - B_2 N(y + \sigma_V\sqrt{T}) \\
&\quad - B[1 - N(y + \sigma_V\sqrt{T})] \qquad \text{(A3)} \\
&= [1 - (1-\delta)^n(B_1/B)]VN(y) - B_2 N(y + \sigma_V\sqrt{T}) + VN(-y) \\
&\quad - BN(-y - \sigma_V\sqrt{T})
\end{aligned}
$$

and

$$\sigma_V = \sigma_E E/V(\partial E/\partial V). \qquad \text{(A4)}$$

(A4) differs from RV, which does not satisfy the put–call parity condition, by the first two terms given in (A4).[14]

Deposit Insurance and Equity Value under Double Liability

Under double liability, bank owners bear a residual (postbank closure) liability, equal to the total par value (Par) of equity outstanding. The deposit insurance liability is then defined as

$$\max\{0, \text{FV}(B_1) - (V_T + \text{Par})B_1/(B_1 + B_2)\}. \qquad \text{(A5)}$$

Let $f^*B_1 = [1 - \text{PV(Par)}/B]B_1$, where PV (FV) denotes present (future) value. Then

$$d = N(y + \sigma_V\sqrt{T})f^* - (1-\delta)^n(V/B)N(y) \qquad \text{(A6)}$$

and

$$y = \{\ln[f^*B/V(1-\delta)^n] - \sigma_V^2 T/2\}/\sigma_V\sqrt{T}. \qquad \text{(A7)}$$

As expected, double liability reduces the cost of deposit insurance provision. Derivation of E follows from the put–call parity condition, $E = V - B + dB_1$:

$$
\begin{aligned}
E &= V - B + B_1 f^* N(y + \sigma_V\sqrt{T}) - (1-\delta)^n V(B_1/B)N(y) \\
&= [1 - (1-\delta)^n(B_1/B)]VN(y) - B_2 f^* N(y + \sigma_V\sqrt{T}) \qquad \text{(A8)} \\
&\quad + \text{VN}(-y) - \text{B}f^* N(-y - \sigma_V\sqrt{T}) - B(1 - f^*)
\end{aligned}
$$

[14] The Solver Routine of Microsoft Excel was used to solve for implied asset value, V, and asset volatility, σ_V. The Solver routine uses standard Gauss–Newton procedures. No convergence problems were encountered with the routine.

and

$$\sigma_V = \sigma_E E/V(\partial E/\partial V). \tag{A9}$$

APPENDIX B: THE MERTON/PENNACCHI UNLIMITED-TERM MODEL

Merton's (1978) unlimited-term model, extended by Pennacchi (1987) to endogenize mispriced deposit insurance, is extended to include dividend payments, since these are included in RV. Let the premium value, p, satisfy the following set of differential equations:

$$\begin{aligned} &\tfrac{1}{2}\sigma_V^2 x^2 p_1'' + (r - g - \theta)xp_1' - (r - g)p_1 + \lambda c = 0, \qquad x \geq 1 \\ &\tfrac{1}{2}\sigma_V^2 x^2 p_2'' + (r - g - \theta)xp_2' - (r - g + \lambda)p_2 + \lambda[c + 1 - x] = 0, \qquad x \leq 1. \end{aligned} \tag{B1}$$

The following boundary conditions must be satisfied:

$$p_1(1) = p_2(1), p_1'(1) = p_2'(1), p_2(0) = \lambda[1 + c]/(r + \lambda - g)$$

and

$$p_1(x) \text{ is bounded as } x \to \infty.$$

The resulting solutions are given as

$$\begin{aligned} p_1(x) &= \lambda c/\mu + a_2 x^{r12}, && x \geq 1 \\ p_2(x) &= \lambda(c + 1)/(\mu + \lambda) - (\lambda/(\theta + \lambda))x + b_1 x^{r21}, && x \leq 1, \end{aligned} \tag{B2}$$

where

$$\begin{aligned} a_2 &= [\lambda/(r_{21} - r_{12})][(1 - r_{21})/(\lambda + \theta) + r_{21}[(1 + c)/(\mu + \lambda) - c/\mu]] \\ b_1 &= [\lambda/(r_{21} - r_{12})][(1 - r_{12})/(\lambda + \theta) + r_{12}[(1 + c)/(\mu + \lambda) - c/\mu]] \\ r_{21} &= [-\Phi + (\Phi^2 + 2(\mu + \lambda)\sigma_V^2)^{1/2}]/\sigma_V^2, \\ r_{12} &= -[\Phi + (\Phi^2 + 2\mu\sigma_V^2)^{1/2}]/\sigma_V^2, \\ \mu &= r - g, \end{aligned}$$

and

$$\Phi = r - \theta - g - \tfrac{1}{2}\sigma_V^2,$$

With free entry into banking, $\mu = \lambda c$, it then follows that

$$p_1^*(x) = 1 + \lambda(1 - r_{21})x^{r_{12}}/(\theta + \lambda)(r_{21} - r_{12}), \tag{B3}$$

where

$$x = V/D,$$
$$r_{21} = [-\Phi + (\Phi^2 + 2(\mu + \lambda)\sigma_V^2)^{1/2}]/\sigma_V^2,$$
$$r_{12} = -[\Phi + (\Phi^2 + 2\mu\sigma_V^2)^{1/2}]/\sigma_V^2,$$

and

$$\Phi = r - \theta - g - \tfrac{1}{2}\sigma_V^2.$$

In addition, c are audit costs, λdt is the probability of an audit over the next instant, θ is the dividend payout rate, and $\mu = r - g$ is the interest rate minus the deposit growth rate.

Merton (1978) results if θ equals zero. Audit costs, c, are set to 0.000134, which is the 1935 FDIC administrative expenses ($2.7 million) divided by 1935 total insured deposits ($20,158 million). Auditing frequency, λ, is set equal to 1.0. The resulting premium values are treated as lump-sum perpetuities and multiplied by the Treasury bond yield[15] of the period to derive an equivalent annual payment amount.

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[15] Long-term government bond yields were taken from Ibbotson Associates (1991), Exhibit A-9, p. 154. Corresponding yields for corporate bonds are not available for comparison.

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