How Costly were the Banking Panics of the Gilded Age?

Benjamin Chabot

Yale University and NBER

benjamin.chabot@yale.edu

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Abstract:

How costly were the panics of the gilded age? I consider hypothetical insurance contracts based on observable New York Clearing House statements. These hypothetical contracts would have allowed investors to insure against sudden deposit withdraws. I estimate the cost of bank panics by estimating the price of insurance implied by historical asset prices. Banking panics were costly. The cross-section of gilded-age stock returns imply investors would have been willing to pay a 4-14% annual premium to insure no more than a 3-7% deposit loss during banking panics.

How costly were banking panics of the late 19th and early 20th centuries? A natural way to think about this question is to ask how much investors would have paid to insure against the consumption loss caused by banking panics. Panic insurance did not exist but it was possible to create a real time insurance contract from the weekly balance sheet statements of New York Clearing House (NYCH) banks. I construct hypothetical insurance contracts and use historical asset prices to draw inferences about investor marginal utility and estimate the equilibrium insurance premium had these contracts existed. The results suggest investors cared a great deal about banking panics and would have paid approximately 4-14% per year to insure against runs on NYCH banks.

The Banking Panics of the Gilded Age

The late 19th and early 20th century business cycle was characterized by booming expansions punctuated by financial panics and depression. In the era before deposit insurance depositors rationally ran on banks whenever they feared a sudden change in actual or perceived solvency. These runs combined with asymmetrical information about the state of individual banks often proved contagious and panic would temporarily rule the day[1].

The NYCH attempted to minimize the information asymmetry by requiring its member banks to publish weekly balance sheet statements. These statements reported the average weekly and Friday closing values for each bank's loans, deposits, excess reserves, specie, legal tenders, circulation and clearings. The statements were published in the Saturday morning *New York Times, Wall Street Journal and Commercial and Financial Chronicle*. Bank statements were carefully scrutinized by investors and

[1]Friedman Schwartz (1963), Calomiris and Gorton (1991) and Wicker (2000) each provide excellent reviews of the facts and theory of late 19th and early 20th century banking panics.

unexpected changes in liquidity could set off a stock market rally or decline.

Figures II-VI graph the NYCH loans, deposits, loan/deposit ratio and NYSE minimum call money rate during the major panics of the gilded age[2]. I include the minimum call rate because it is an excellent proxy for the marginal cost of excess reserves. Brokers and banks could lend or borrow against security collateral at the NYSE call money post. Typically a borrower could borrow up to 80% of the market value of the pledged collateral. The rate of interest charged varied with the volatility and liquidity of the collateral. The minimum call rate was always equal to the rate of interest charged on loans with long-term government bonds as collateral. As the name implies, call loans gave the lender the right to call in the loan at any time. The borrower of a call loan signed the pledged security into the name of the lender. If the lender called the loan and the borrower was not forthright with the money the lender could sell the collateral to satisfy the obligation. If the collateral fell in value the lender could issue a margin call and demand the borrower raise his collateral back to 80%. Thus lenders suffered partial defaults only when the borrower defaulted and the collateral declined by more than 20% in a single day without the lender being able to liquidate. Call loans on government bond collateral were for all practical purposes default-risk free. Despite the right to call at any time a call loan did commit the lender's money for a brief period. Even in the event of a collateral sale the lender would not receive his cash until the sale cleared 3 days after the trade date. The call loan rate therefore reflected the marginal cost of a bank holding excess reserves in their vault as a defense against bank runs rather than loaning it risk-free for a minimum of 3 days.

[2] There is no consensus on exactly what constitutes a gilded age banking panic. However, Sprague (1910), Miron (1986), McDill and Sheehan (2007), Calomiris and Gorton (1991) and Friedman and Schwartz (1963) largely agree that 1873, 1884, 1890, 1893 and 1907 were years of major banking panics in NYC. See Table 3 in McDill and Sheehan (2007) for a summary of the agreements and disagreements on banking panic dates.

Figure I

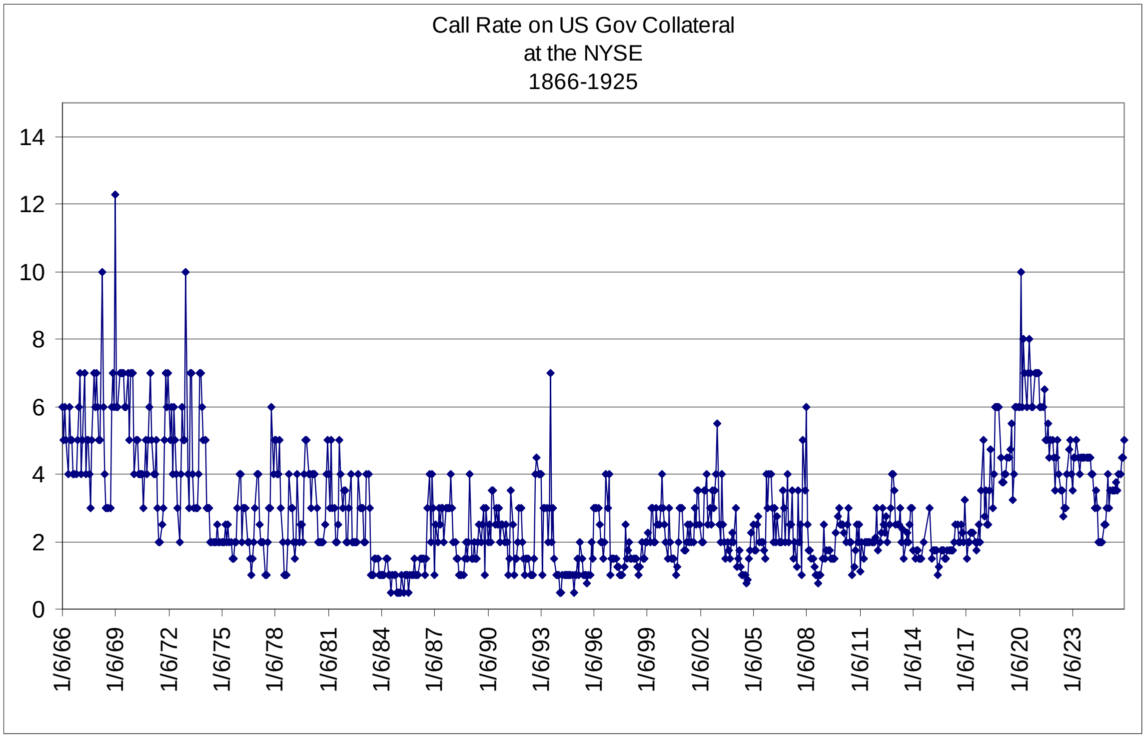
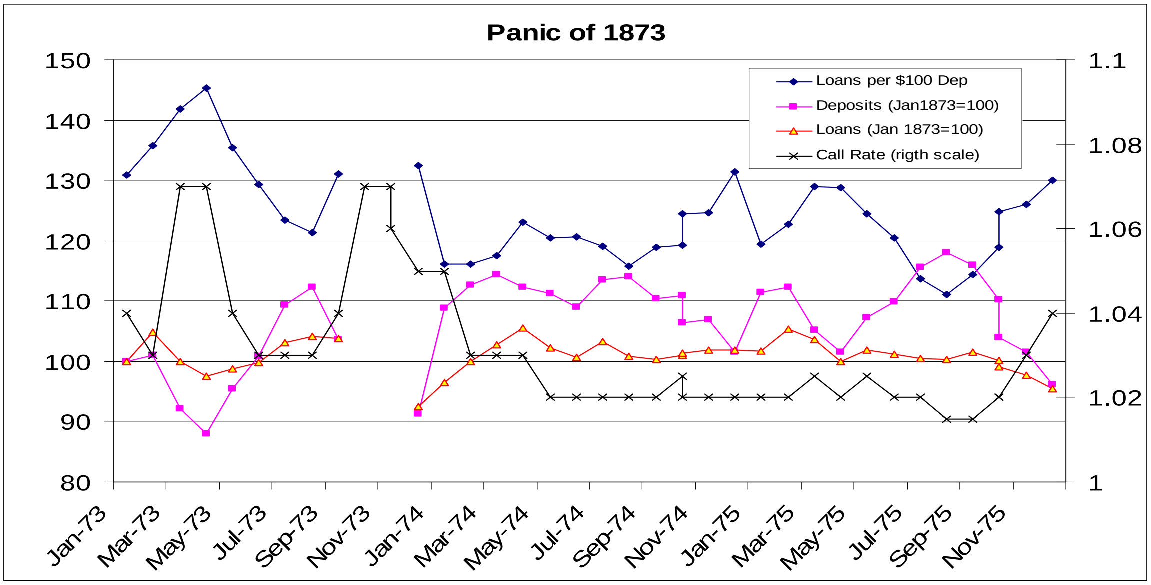
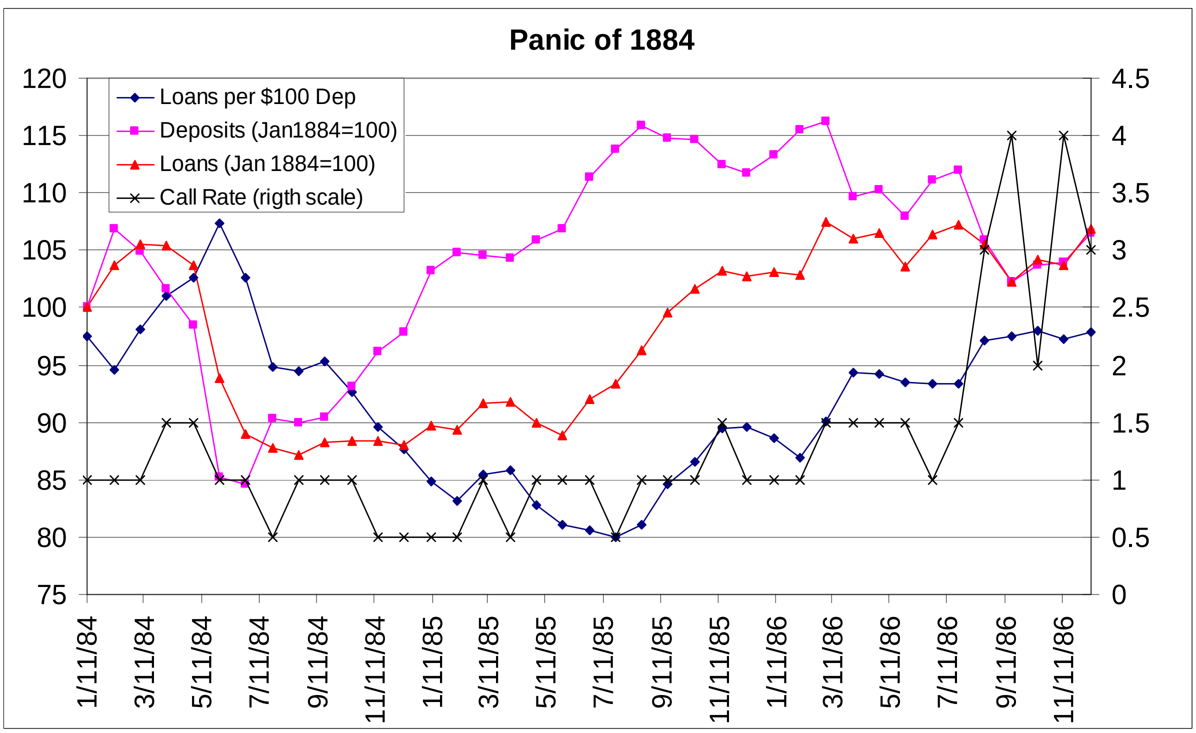


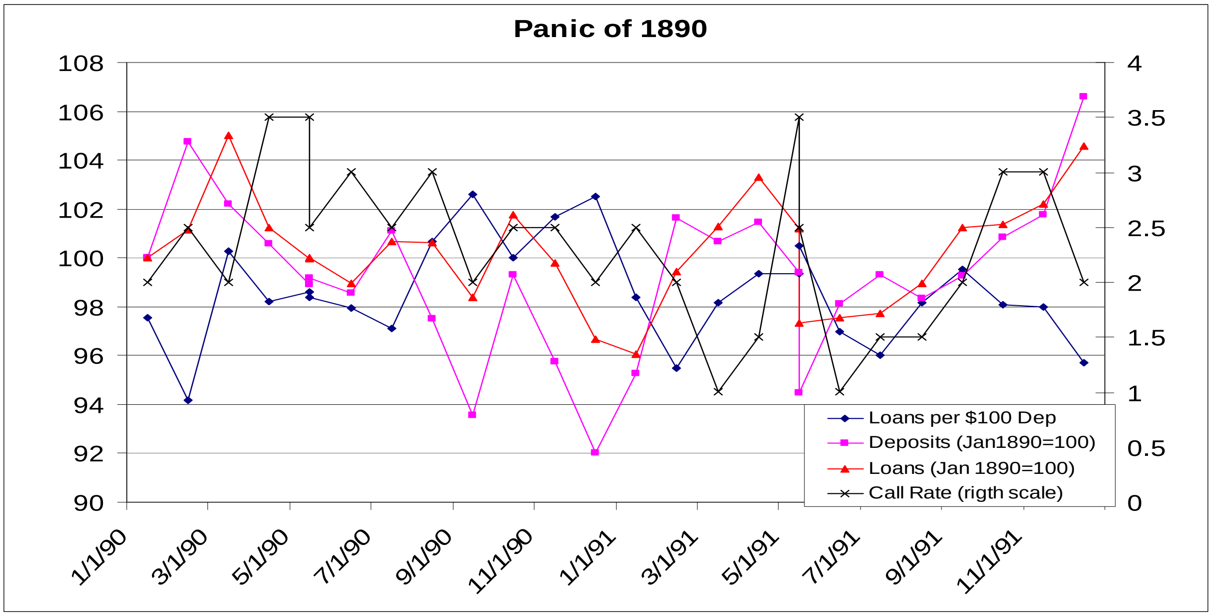
Figure I graphs the minimum call rate over our sample period. The call rate is generally quite low. It rises during periods of business expansion when banks wish to leverage their balance sheets and the marginal benefit of excess reserves is high. The call rate also spikes during panics when banks are desperate for reserves.

Because it increases during both panics and booms the call rate by itself is a poor candidate for an insurance contract. However, knowledge about the call rate and bank balance sheets can be combined to construct a real time derivative that reflects banking panics.



The series breaks during and 15 weeks after the panic of 1873. This panic resulted in the closing of the NYSE and the suspension of reporting requirements by the NYCH.




Panic of 1890
108
106
104
102
100
98
96
94
92
90
4
3.5
3
2.5
2
1.5
1
0.5
0
Loans per $100 Dep
Deposits (Jan1890=100)
Loans (Jan 1890=100)
Call Rate (rigth scale)
1/1/90
3/1/90
5/1/90
7/1/90
9/1/90
11/1/90
1/1/91
3/1/91
5/1/91
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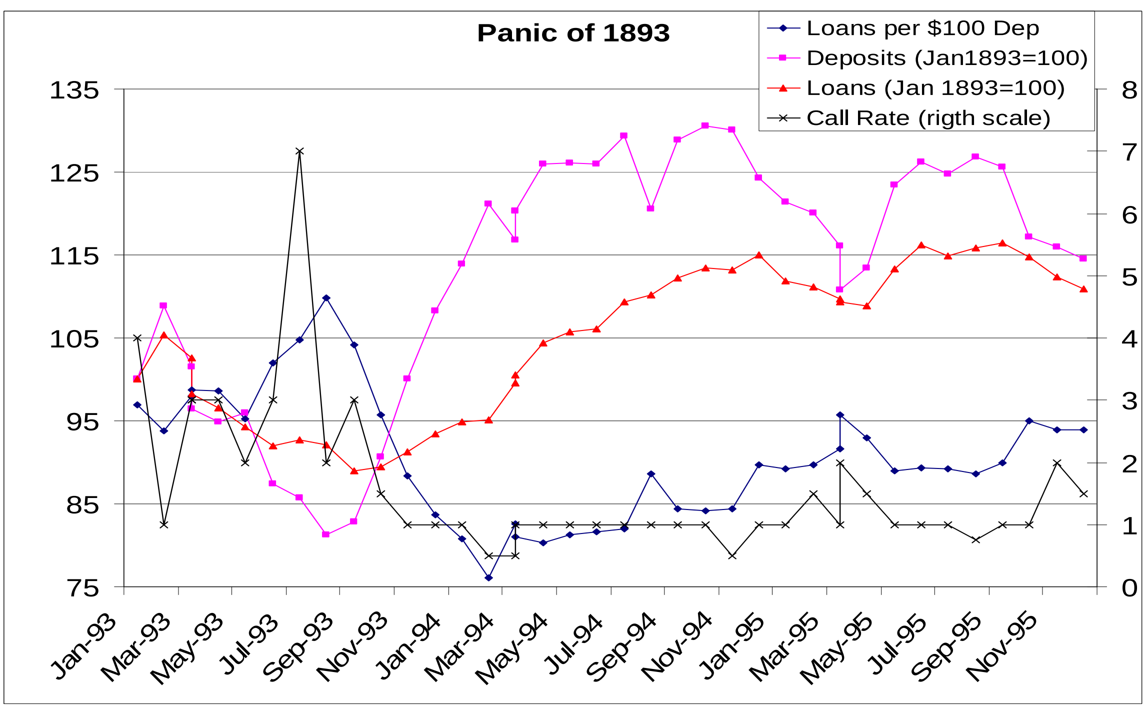
9/1/91
11/1/91


Panic of 1893
Loans per $100 Dep
Deposits (Jan1893=100)
Loans (Jan 1893=100)
Call Rate (rigth scale)
135
125
115
105
95
85
75
8
7
6
5
4
3
2
1
0
Jan-93
Mar-93
May-93
Jul-93
Sep-93
Nov-93
Jan-94
Mar-94
May-94
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Jan-95
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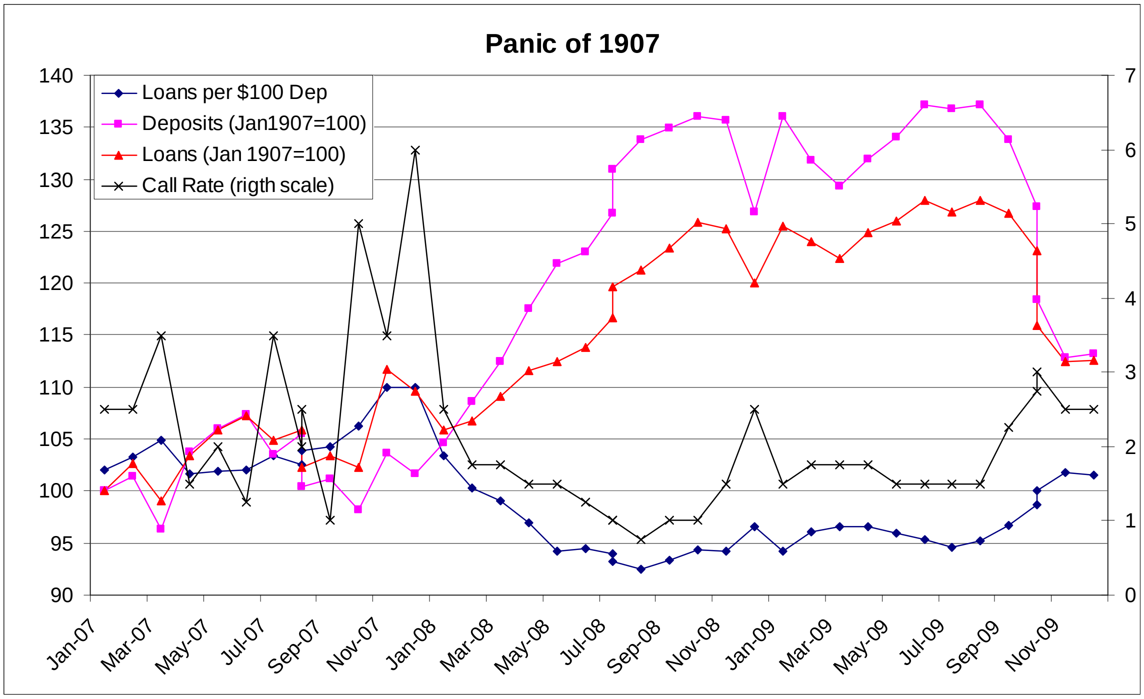
Nov-95



After a carefully examination of the balance sheet series some common patterns emerge. The call rate increases and the level of loans and deposits decline sharply during panics. The loan to deposit ratio inevitably spikes during panics and then falls after panics subside. These traits are not surprising. Banking panics are defined by sudden withdraws of demand deposits. The loan to deposit ratio initially rises because banks are unable to convert illiquid loans into reserves at the rate of deposit withdraws. The ratio then falls as banks curtail lending and build excess reserves until fear subsides.

Data

The figures suggest that derivatives based on the change in deposits, loans or call rates may have allowed investors to insure against banking panics. To test this conjecture I construct time series of NYCH deposits and loans sampled every fourth Friday between Jan 1866 and December 1925. The 28-day sampling frequency was selected to correspond with dates for which I have previously collected the call rate of money and price, shares outstanding and dividends of every NYSE stock. The stock data allow me to compute the market value and 28-day holding period return for each stock on the NYSE.

Using Stock Returns to Draw Inferences about Marginal Utility and Banking Panics

Stock returns contain a great deal of information about investor's consumption. When production (wealth) unexpectedly falls, risk-averse investors wish to smooth consumption by selling assets. If the production (wealth) decline is idiosyncratic, some other investors with unexpectedly high wealth will buy assets. Thus idiosyncratic risks can be shared without altering prices.

If aggregate production unexpectedly declines risk-averse investors will try to borrow and smooth consumption by selling assets, but in the aggregate we cannot all borrow! If aggregate production declines someone must consume less. Stock prices must therefore fall (and expected returns rise) until investors are willing to consume less. Stock returns therefore reflect changes in aggregate consumption. We can use this insight to draw inference about aggregate consumption from stock returns.

Before we price the hypothetical gilded-age securities it is useful to consider a simply discrete asset that pays $\$X_p$ if a banking panic occurs next period and $\$X_{np}$ otherwise. The asset is an insurance contract so $\$X_p > \$X_{np}$. If this security trades in a market where investors face the same price to buy or sell the price of the security must satisfy $P = E[mX]$ or

$$P = \pi_p m_p X_p + (1-\pi_p) m_{np} X_{np} \qquad (1)$$

Where π_p is the expected probability of a banking panic and m is the marginal utility of money in each state. (1) is derived from the first order condition of investors who purchase or sell the security until the expected marginal gain from buying $E[mX]$ equals the marginal cost P.

Next consider a nominally risk free asset that pays $1 in both the panic and no panic states. This asset will trade at $P = E[m]$. The gross risk-free rate is therefore equal to $R_f = \frac{1}{E[m]}$. If we divide both sides of (1) by P we can express the expected excess return of the insurance contract as a function of the covariance between the insurance return and marginal utility.

$$\begin{aligned} 1 &= E[mR] = E[m]E[R] + \mathrm{cov}(m,R) \\ E[R] - R_f &= -R_f \, \mathrm{cov}(m,R) \end{aligned} \qquad (2)$$

Insurance contracts pay high returns when times are bad and the marginal utility of money is high. $\mathrm{cov}(m,R)$ is therefore positive and the expected excess return of an insurance contract is negative. Equation (2) provides a testable prediction about the cost of banking panics. If R is the return of any variable positively correlated with banking panics and banking panics were costly in terms of utility, the expected excess return of R should be negative.

Securities based on changes in deposits, loans or call rates appear to be excellent candidates for insurance contracts. An insurance contract should pay a high rate of return in the states of nature we wish to insure against and a low return otherwise. Consider the following hypothetical securities.

1. A series of 28-day cash-settled future contracts that trade each observation date and pay $1*(change in NYCH aggregate deposits).

2. A series of 28-day cash-settled future contracts that trade each observation date and pay $1*(change in NYCH aggregate loans).

3. A series of 28-day cash-settled future contracts that trade each observation date and pay $1*(change in NYSE call rate on government collateral).

An investor would be able to insure against changes in balance sheets or call rates by buying or shorting these contracts.

Figures II-VI suggest our hypothetical future contracts are correlated with banking panics. Were banking panics correlated with the marginal utility of gilded-age investors? In other words, were banking panics costly in a utility sense $\operatorname{cov}(m,R) > 0$, beneficial $\operatorname{cov}(m,R) < 0$ or neither $\operatorname{cov}(m,R) = 0$? To answer this question we need a test of the null hypothesis that $\operatorname{cov}(m,R) = 0$. Where R is the return on one of our insurance contracts.

If we could observe a time series of m and R a natural test would be to estimate a regression of m on R

$$m_t = \alpha + \beta R_t + \varepsilon_t \qquad (3)$$

The marginal utility of gilded-age investors, m_t, is unobservable, however. In most cases an unobservable LHS variable is a considerable burden when estimating a regression! In the case of many asset returns, however, we can estimate α and β from (3) and the moment restrictions $P = E[mX]$ and the law of one price.

The law of one price requires the same m price all assets. Therefore the unobservable m that prices our hypothetical insurance contract must also price observable gilded age NYSE stock returns. We can therefore estimate the regression of unobservable marginal utility on our hypothetical future contracts via GMM by choosing α and β to best satisfy $P = E[mX]$ for observable asset returns.

I estimate (3) via GMM by choosing the regression coefficients to best price 5 NYSE call-rate beta and 5 size-sorted stock portfolios. The size-sorted portfolios were formed by assigning stocks to quintiles based on market value at the beginning of each 28-day period. Value-weighted returns are computed and stocks are reassigned each period based on updated market values. The call-rate beta portfolios were computed via the following two step procedure.

1. For each time period estimate the following regression from the trailing 3 years of 28-day data:

$$R_{it} = \alpha_i + \beta_{i1} R_t^{callrate} + \beta_{i2} R_t^{market} + \varepsilon_{it}$$

2. With beta estimates in hand, assign stocks to quintile value-weighted portfolios based on their trailing call-rate beta

The resulting 10 size and call-rate sorted portfolios should exhibit cross-sectional differences in returns and sensitivities to banking panics and business cycles.

Table I reports the regression coefficients and t-stats from GMM regressions of gilded-age marginal utility on the deposit, loan and call-rate future contracts.

Table I

GMM regression: $m_t = \alpha + \beta_1 R_t^{fut} + \varepsilon_t$

Estimated with 5 size and 5 call-rate beta sorted NYSE portfolios

1869-1925

regression	(1)	(2)	(3)
Future Contract:	$1*deposit growth	$1*Loan growth	$1*change in call rate
beta	-4.6482	-9.6636	53.15
t-stat	-1.251	-1.4408	0.3952

Changes in deposit growth, loan growth and the call rate were not significantly correlated with the marginal utility implied by asset returns. The regression coefficients on loan and deposit growth have the expected sign but the effects are statistically indistinguishable from zero.

Were bank balance sheet variables and consumption uncorrelated? Before we jump to that conclusion a word of caution is in order. Changes in marginal utility reflect *unexpected* changes in consumption. If changes in deposits or loan were predictable these changes would already be reflected in investor's consumption decisions and asset prices. In fact, deposit and loan growth were predictably seasonal during the gilded-age [3].

[3] Miron (1986)

Roughly 30% of the time series variation in loan and deposit growth can be explained by a simple autoregression. This predictability introduces measurement error in our independent variable. Table II reports regression coefficients and t-stats from GMM regressions of gilded-age marginal utility on the unexpected change in NYCH deposit and loans.

Table II

GMM regression: $m_t = \alpha + \beta_1 R_t^{fut} + \varepsilon_t$

Estimated with 5 size and 5 call-rate beta sorted NYSE portfolios

1869-1925

regression	(1)	(2)
Future Contract:	\$1*(Unexpected[1] deposit growth)	\$1*(Unexpected[1] loan growth)
beta	-8.8363	-11.0775
t-stat	-1.8986	-1.4382

1) unexpected growth is the residual from an OLS autoregression with 39 lags

The unpredictable movements in balance sheets are more correlated with implied marginal utility but the result remains insignificant. In the case of loans this is not so surprising. Banks suffer panics because their loan portfolios cannot be quickly converted into specie. Therefore loan growth and panic states may be weakly correlated. Furthermore, contracts based on unexpected changes require knowledge about investor's expectations.

Options

Future contracts based on changes in bank balance sheets and call rates are poor predictors of changes in implied marginal utility. Either, banking panics were relatively costless in terms of utility or our hypothetical insurance contracts do a poor job of paying high returns during panics and low returns otherwise. Too many false positives (high returns in non-panic states) can weaken the relationship between our future contracts and marginal utility.

An examination of the balance sheet data suggests a solution. Panics are characterized by *severe* declines in deposits and a spike in the call rate. Table III reports GMM regression coefficients from a regression of investor marginal utility on dummy variables for different magnitudes of deposit declines. If changes in deposits are correlated with marginal utility we would expect the marginal utility to increase with the severity of the deposit withdraw.

Table III

GMM regression: $m_t = \alpha + \beta_1 Dum + \varepsilon_t$

Estimated with 5 size and 5 call-rate beta sorted NYSE portfolios

1869-1925

regression	(1)	(2)	(3)
Dum Var = 1 if:	Dep growth < -3%	Dep growth < -5%	Dep growth < -7%
beta	0.8968	2.4006	5.6501
t-stat	0.752	2.1394	1.6509
% of obs with dum =1	0.185	0.07	0.027

Implied marginal utility increases with the severity of deposit withdraw. This is consistent with costly banking panics. The dummy variables used to estimate the results in Table III have an insurance contract interpretation. Each dummy is equivalent to a binary put option that pays $1 if deposit growth falls below a threshold and $0 otherwise. We could price this option and draw inference about the utility cost of large declines in deposits. A binary option does not include all available information, however. We know banking panics are characterized by sharp declines in deposits *and* increases in the marginal value of excess reserves. Table IV reports GMM regression coefficients from a regression of investor marginal utility on dummy variables for different magnitudes of deposit declines interacted with a dummy for increases in the call rate of money.

Table IV

GMM regression: $m_t = \alpha + \beta_1 Dum + \varepsilon_t$

Estimated with 5 size and 5 call-rate beta sorted NYSE portfolios

1869-1925

regression	(1)	(2)	(3)
Dum Var = 1 if:			
change in call rate > 0 and	Dep growth < 3%	Dep growth < 5%	Dep growth < 7%
beta	1.6293	3.3582	8.0185
t-stat	1.6669	2.2489	2.3712
% of obs with dum =1	0.108	0.046	0.023

The difference between the coefficients in Table III and IV reflect the change in estimated marginal utility between panic and non-panic states when we re-code panic states to include *both* a large decline in deposits and an increase in the call rate. The coefficients increase dramatically. Large declines in deposits corresponded with high marginal utility if the marginal cost of liquidity also increased. In the rare cases where deposits declined sharply but the cost of excess reserves did not increase the marginal utility implied by asset prices remained low.

The results in Table IV suggest an insurance contract that satisfies our conditions of correlated with banking panics and observable to the econometrician. Consider a put option on deposit growth with a knock-out provision if the call rate does not increase. The knock-out put option would have the following payouts

1. If call rate increases: $1*max{(strike - % decline in deposits),0}
2. If call rate does not increase: $0

Table V reports GMM regression coefficients from a regression of investor marginal utility on the payout from our knock-out put option.

Table V

GMM regression: $m_t = \alpha + \beta_1 Put_t + \varepsilon_t$

Estimated with 5 size and 5 call-rate beta sorted NYSE portfolios

1869-1925

regression	(1)	(2)	(3)
Strike:	Dep Growth< -3%	Dep growth < -5%	Dep growth < -7%
beta	91.804	192.5111	439.5856
t-stat	2.4322	2.5591	2.0563

The put options pay high returns in states where implied marginal utility is high. The coefficients increase as the strike price becomes further out-of-the-money. This is exactly what we would expect if banking panics were costly utility terms. The options pay $.01 for each 1% decline in deposits below the strike price. The larger the decline in deposits the more investors valued a marginal penny of wealth.

Robustness Check: Are Really Measuring Stock Market Risk?

We've established that call rates and deposit growth are correlated with banking panics and marginal utility. Before we place a price on this risk we need to be certain that we aren't simply measuring stock market risk. The stock market declines during banking panics and the fact that the observable stock market excess return $E[R^{sm}] - R_f$ is positive suggests the stock market is negatively correlated with marginal utility. When we exclude the stock market from our estimation of (3) we should worry that our estimated betas may be biased from an omitted variable. To test if banking panics effect marginal utility holding the stock market fixed we require a multiple regression of marginal utility on our hypothetical put option and the return on the stock market

$$m_t = \alpha + \beta_1 R_t^{put} + \beta_2 R_t^{sm} + \varepsilon_t \qquad (4)$$

Again we estimate (4) via GMM by choosing the regression coefficients to best price 5 NYSE call-rate beta and 5 size-sorted stock portfolios.

Table VI

GMM regression: $m_t = \alpha + \beta_1 R_t^{put} + \beta_2 R_t^{sm} + \varepsilon_t$

Estimated with 5 size and 5 call-rate beta sorted NYSE portfolios
1869-1925

regression	(1)	(2)	(3)
Strike:	Dep Growth< -3%	Dep growth < -5%	Dep growth < -7%
Beta Put	77.2673	163.8054	318.7019
t-stat	2.2801	2.2889	1.7184
Beta Stock Market	-2.4964	-1.9231	-2.5621
t-stat	-1.6685	-1.2465	-1.77

The betas decrease slightly in magnitude but remain significant. Thus we are confident that our hypothetical put options contain information about marginal utility even after controlling for the stock market declines that so often coincided with banking panics.

Pricing the Put Options

We have constructed option contracts that gilded age investors could use to insure against the utility loss of banking panics. The question remains, just how costly were these panics? The regressions in Tables IV-VI provide strong evidence that marginal utility was higher during times when our options expired in-the-money. With over 700 time series observations and portfolios comprised of more than 200,000 individual stock returns even economically insignificant utility differences will be statistically significant. Before we draw conclusions about the economic cost of banking panics we require a price of panics in terms of forgone consumption.

A natural way to think about the cost of bad outcomes is to ask, what would one pay to avoid them? The put option payouts increase during panics. If an investor expected his consumption to fall due to a banking panic, he could insure against this risk by purchasing option contracts. This would eliminate the risk but it would come at a cost if $P = E[mX] > \frac{E[X]}{R_f}$. That is, it would be costly to insure if the expected return to buying the contract is lower then the return of the risk-free asset. From (2) we know that this is equivalent to saying it is costly to insure if $\operatorname{cov}(m, X) > 0$.

Our GMM regressions of m on our hypothetical options tell us it is costly to insure by buying put options. How costly amounts to an empirical question of what price would our hypothetical contracts trade for if they were offered for sale during the gilded age?

We can price the put options from the time series of option payouts and the moment condition price $P = E[mX]$. The price will obviously depend upon the marginal utility m. What m should we use? An obvious choice is the marginal utility implied by our regression $m_t = \alpha + \beta_1 R_t^{put} + \beta_2 R_t^{sm} + \varepsilon_t$.

With the realizations of option payouts and estimates of $P = E[mX]$ we can compute the option risk premium $E[R^{put}] - R_f$. Table VII reports the annual cost of insuring $1 of bank deposits against declines below the strike price during months that the call rate increases (the expected "cost" of buying a $1 knock-out put option).

Table VII

Annual cost of insuring $1 by purchasing the knock-out put option

Strike Price	3% O.T.M.	5% O.T.M.	7% O.T.M.
Annual Cost of Insuring $1	0.1451	0.1053	0.0442

It would have cost between 4.4-14.5% to insure bank deposits against simultaneous increases in the call rate and deposit declines of 3-7% respectively. For comparison it would cost 2.6%, 5.64% and 11.16% to insure each month against 3%,5% and 7% declines in the stock market using plain vanilla puts priced via Black-Scholes at 20% implied volatility. As 20% is approximately the average implied volatility on the S&P 500 over the past 20 years we can conclude that gilded age investors feared bank panics at least as much as modern investors fear stock market declines.

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