How Costly were the Banking Panics of the Gilded Age?

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Abstract:

In an era before deposit insurance investors lived in fear of bank runs. How costly were the banking panics of the gilded age? To answer this question I consider hypothetical insurance contracts based on observable New York Clearing House balance sheet statements. The hypothetical contracts I consider would have made it possible for investors to insure against sudden deposit withdraws. I estimate the cost of bank panics by estimating the price of these contracts via no arbitrage restrictions and weak bounds on the volatility of gilded age marginal utility. The estimated price bounds are wide but an investor who bought at the midpoint would be willing to forgo more then 8% per year to insure against banking panics.

Preliminary and Incomplete.

Comments Welcome

How Costly were the banking panics of the gilded age? One way to think about this question is to ask how much a gilded age investor would pay to insure against the consumption loss associated with banking panics. Panic insurance did not exist during the gilded age 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 a series of hypothetical insurance contracts and use observable gilded age asset prices and weak restrictions on investor marginal utility to compute the equilibrium price range had these contracts existed. The results suggest investors would have paid approximately $.78 per year to purchase a contract that paid $100 times unexpected changes in the loan to deposit ratio of NYCH banks. The same investors would have paid approximately $5.43 per year to purchase a contract that paid $100 times the unexpected gross rate of decline in NYCH bank deposits.

The Banking Panics of the Gilded Age

The gilded age was a time of innovation, rapid expansion and panic. 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

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[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.

average weekly and Friday closing values for each bank's loans, deposits, excess reserves, specie, legal tenders, circulation and clearings. These statements were published in the Saturday morning *New York Times, Wall Street Journal and Commercial and Financial Chronicle*. These reports were carefully scrutinized by investors and unexpected changes could set off a stock market rally or sell-off.

My goal is to construct a security that reflects the state of NYCH balance sheets. This security should have different realizations during periods of panic and calm. If such a security had existed, investors would have been able to insure against banking panics by purchasing it.

After examining the balance sheet data two obvious candidate series emerge. First the level of deposits exhibits a strong negative correlation with banking panics. Secondly, the loan to deposit ratio exhibits long secular trends but inevitably spikes during panics and then falls after panics subside. The first result is not surprising. Banking panics are defined by sudden withdraws of demand deposits. The loan to deposit ratio rises because banks are unable to convert loans into reserves at the rate of deposit withdraws. I construct a time series by collecting NYCH deposits and loans every fourth Friday between Jan 1866 and December 1925. The sample dates are selected to correspond with dates for which I have collected the price of virtually every NYSE stock and the minimum call rate of money at the NYSE.

Figure I graphs the Loan/Deposit (L/D) ratio over our sample period. The L/D ratio contains both a predictable seasonal and long run trend. An auto-regression of the L/D ratio on its past 13 observations (1 year) has an adjusted R-squared of 95%. The L/D ratio is stable and predictable, however, during panics the ratio spikes and remains elevated until the panic subsides. This makes the L/D ratio a perfect candidate for a derivative based insurance contract.

Figure I

Loans per $1 Deposit
NY City Banks
1866-1925
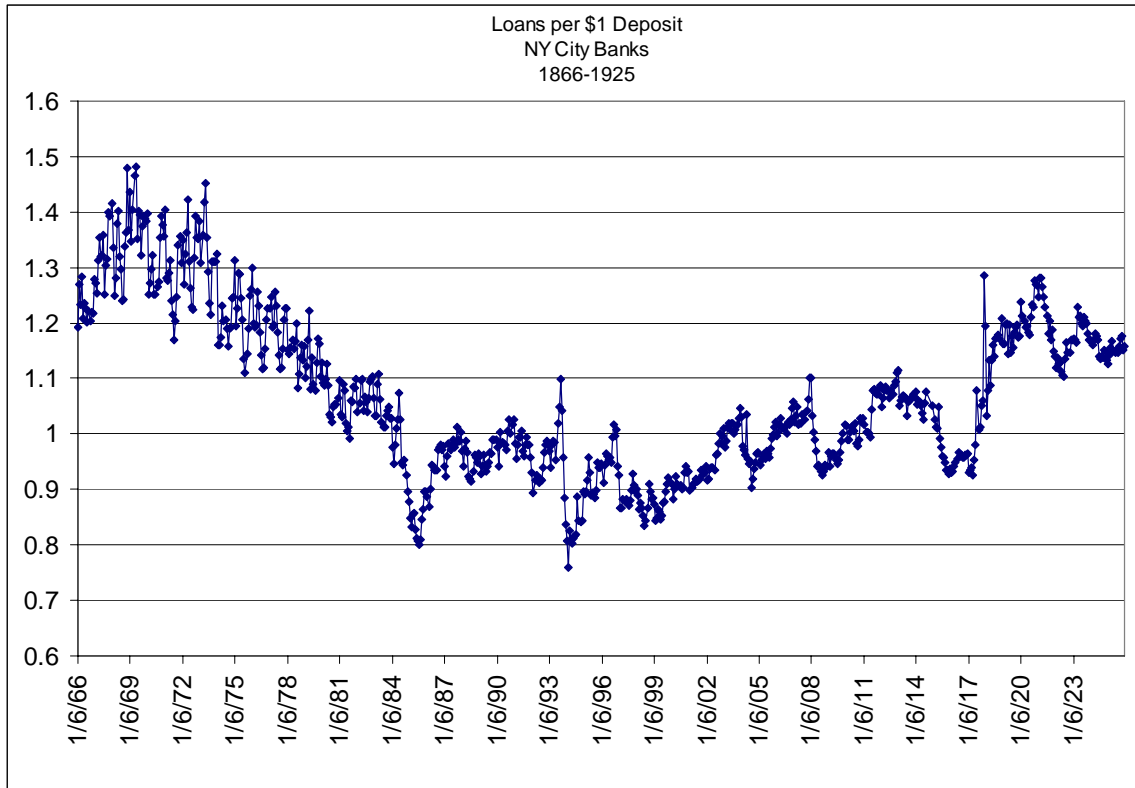
Figures 3-7 graph the NYCH loans, deposits, L/D ratio and NYSE minimum call money rate during the major panics of the gilded age[2]. I include the minimum call rate because it is an excellent proxy for the marginal cost of excess reserves. Brokers and banks could lend or borrow against security collateral at the NYSE call money post. Typically a borrower could borrow up to 80% of the market value of the security pledged for collateral. The rate of interest charged varied with the volatility and liquidity of the collateral. The daily 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

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[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.

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 then 20% in a single day without the lender being able to liquidate. Call loans on government bond collateral were for all practical purposes risk-free. Despite the right to call at any time a call loan did commit the lenders money for a brief period. Even in the event of a collateral sale the lender would not receive his cash until 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 then loaning it risk free for a minimum of 3 days.

Figure II

Call Rate on US Gov Collateral
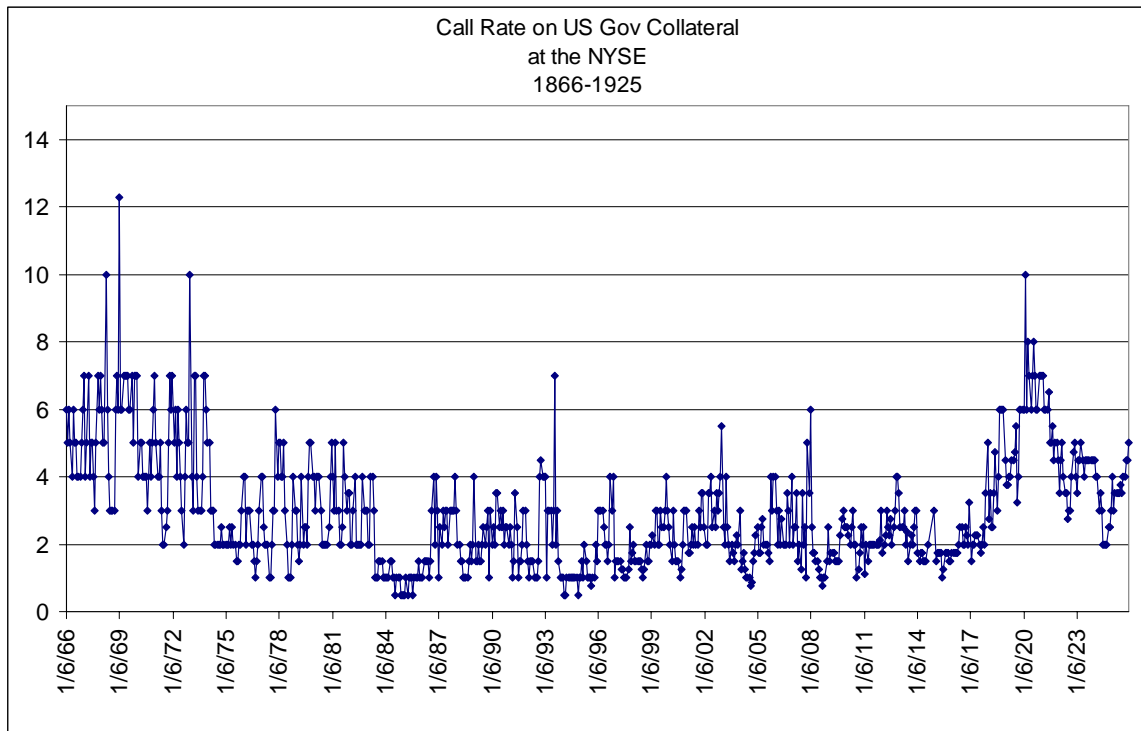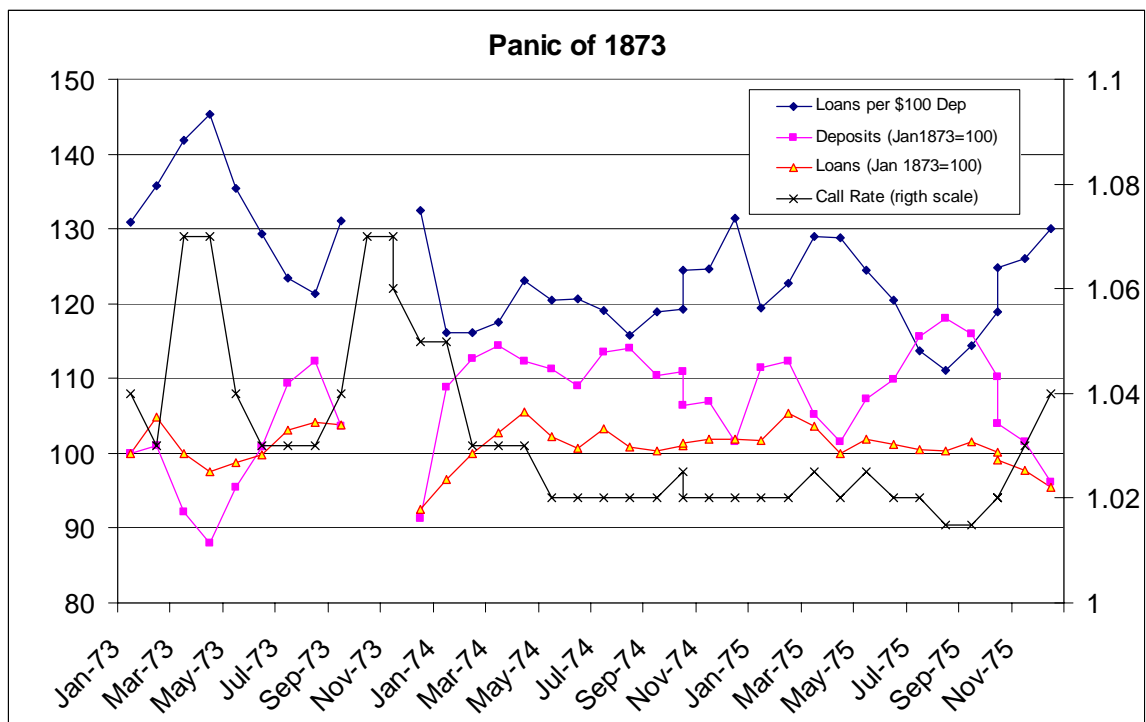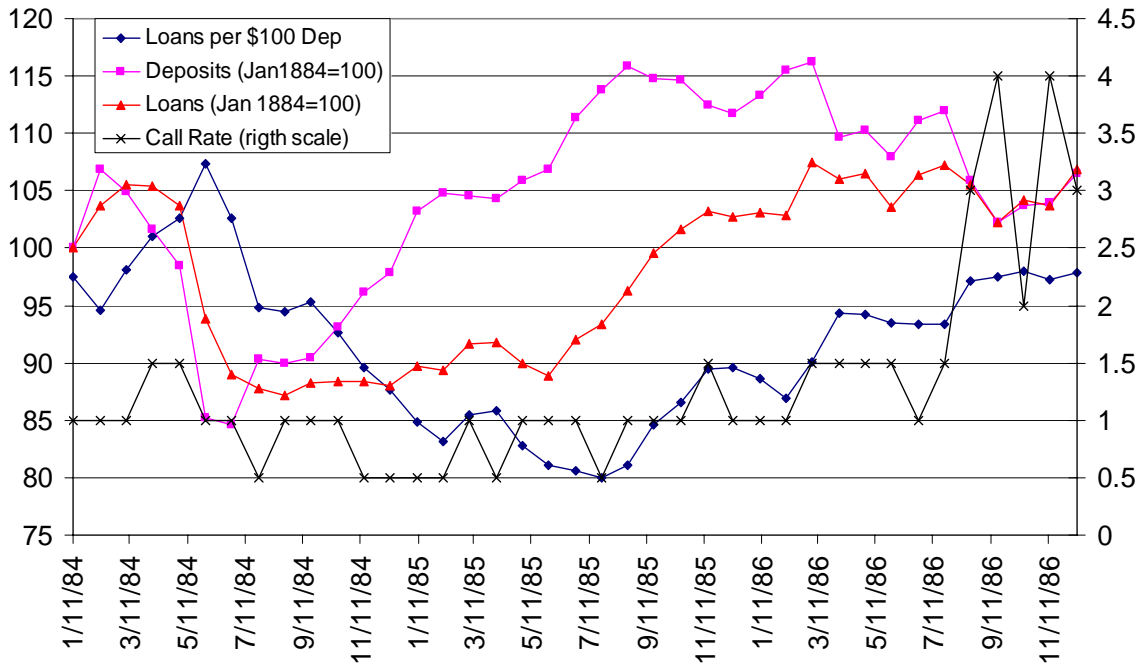at the NYSE
1866-1925

Figure II graphs the minimum call rate over our sample period. The call rate is generally quite low. It rises during periods of general 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. In the empirical work to follow I use the minimum call rate as a measure of the risk-free nominal interest rate.
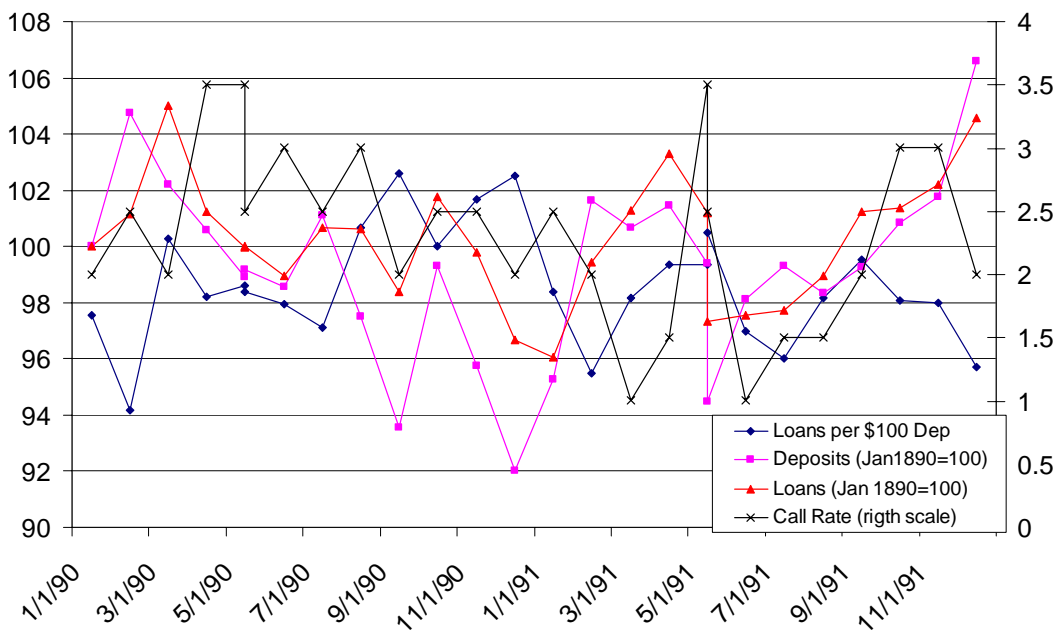

The series breaks during and 15 weeks after the panic of 1873. This panic resulted in the closing of the NYSE and the suspension of reporting requirements by the NYCH.
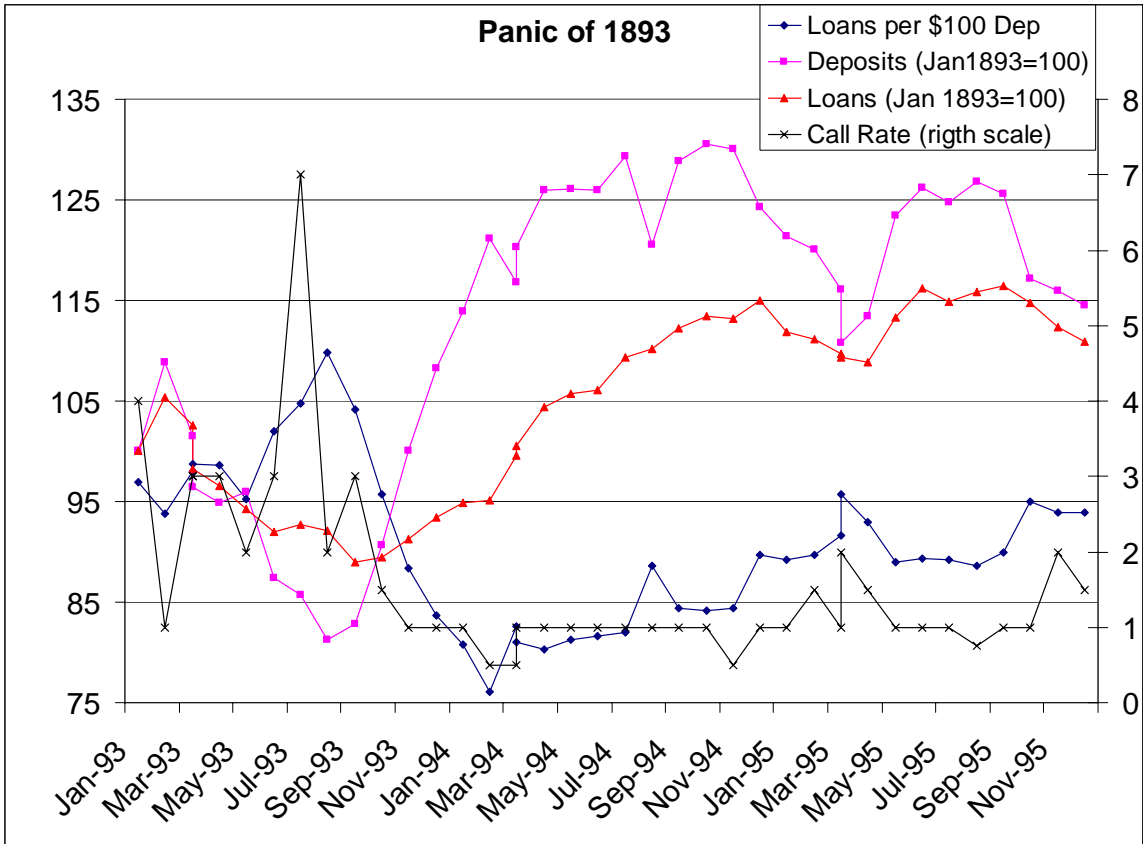
Panic of 1884

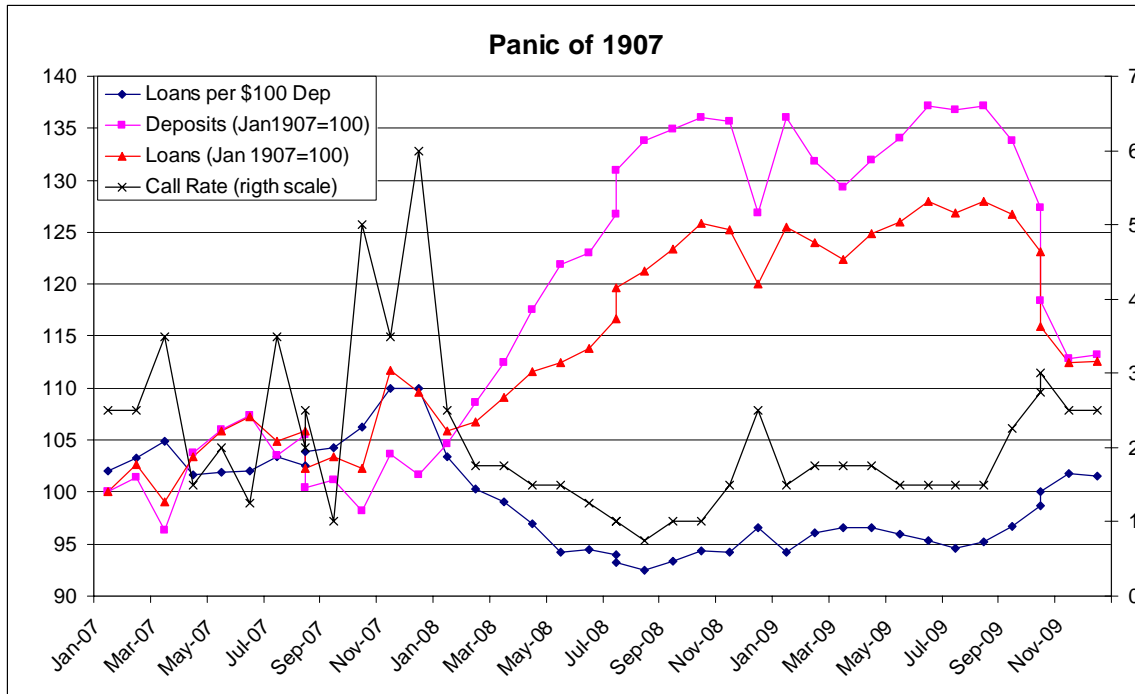- Loans per $100 Dep
- Deposits (Jan1884=100)
- Loans (Jan 1884=100)
- Call Rate (rigth scale)

Panic of 1890

Panic of 1893

Legend:
- Loans per $100 Dep
- Deposits (Jan1893=100)
- Loans (Jan 1893=100)
- Call Rate (rigth scale)

Panic of 1907

In each panic deposits fall and the loan to deposit ratio increases. Both the fall in deposits and the increase in L/D are smaller during the panics of 1890 and 1884. Part of this is due to the 28-day sampling. If a panic occurs after our sample date and is largely contained before our next observation 28-days later we will not measure the peak decline in deposits or increase in L/D and call money. However, if panics leave no noticeable effects on bank balance sheets and interest rates it is unlikely that the panic will have an effect on consumption as well.

In general the L/D ratio and change in deposits 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. I consider the following two hypothetical securities.

1. A series of 28-day cash settled futures contracts that trade each observation date and pays $1 times the L/D ratio 28-days latter.

2. A series of 28-day cash settled futures contracts that trade each observation date. The

contract that trades at date t pays \$1 times the $\frac{Deposit_{t+1}}{Deposit_t}$ ratio.

An investor could insure against banking panics by buying the L/D contract or selling the Deposit contract.

Pricing an Insurance Contract

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 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 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.

$$1 = E[mR] = E[m]E[R] + cov(m, R)$$

$$E[R] - R_f = -\frac{cov(m, R)}{R_f}$$

$$(2)$$

Insurance contracts pay high X when times are bad and marginal utility of money is high. $cov(m, R)$ 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 the expected excess return of R should be negative.

Figures 1-7 suggest our hypothetical future contracts are correlated with banking panics. Were banking panics correlated with gilded age marginal utilities? In other words, were banking panics costly in a utility sense $cov(m, R) > 0$, beneficial $cov(m, R) < 0$ or neither $cov(m, R) = 0$? To answer this question we need a test of the null hypothesis that $cov(m, R) = 0$. 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

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

m_t is unobservable, however. In most cases an unobservable LHS variable is an insurmountable burden to estimating a regression. In this case, we can estimate $\hat{\alpha}$ and $\hat{\beta}$ from (3) and the moment restrictions $P = E[mX]$.

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 stocks and the call rate. I estimate the regression of marginal utility on our hypothetical future contracts $\hat{m}_t = \hat{\alpha} + \hat{\beta} X_t^{fut}$ via GMM by choosing $\hat{\alpha}$, $\hat{\beta}$ to best satisfy $P = E[(\hat{\alpha} + \hat{\beta} R_t) X^{stock}]$ for 5 NYSE CAPM beta and 5 size sorted stock

portfolios. The beta t-stats are -3.16 and 2.71 for the L/D and $\frac{Deposit_{t+1}}{Deposit_t}$ securities respectively. Thus we are confident that the L/D ratio was negatively correlated with gilded age marginal utility and the $\frac{Deposit_{t+1}}{Deposit_t}$ was positively correlated with marginal utility.

Robustness Check: Are we Merely Measuring Stock Market Risk?

We've established that L/D 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 is negatively correlated with banking panics and the fact that the observable stock market excess return $E[R^{sm}] - R_f$ is greater then zero suggests the stock market is negatively correlated with marginal utility. When we estimate (3) and find significant betas we should worry that we may be suffering from an omitted variable bias by excluding the stock market from our regression. To test if banking panics effect marginal utility holding the stock market fixed we require a multiple regression of marginal utility on our hypothetical futures contract and the return on the stock market

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

Again I estimate (4) via GMM by choosing the regression coefficients to best price 5 NYSE CAPM beta and 5 size sorted stock portfolios. The beta t-stats remain significant but decrease in magnitude to -2.01 and 2.71 respectively. Thus we are confident that our banking panic variables contain information about marginal utility even after controlling for the stock market declines that so often coincided with banking panics.

Pricing the Futures Contracts

We have constructed two contracts that gilded age investors could use to insure against the utility loss of banking panics. The question remains just how costly were these risks? A natural way to think about the cost of bad outcomes is to ask what would one pay to avoid them? The L/D ratio rises during panics. If an investor expected his consumption to change by $-\delta(L/D)$ due to a panic, he could insure against this risk by purchasing δ 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 $cov(m, X) > 0.$

Our GMM regressions of m on our hypothetical assets suggest it is costly to insure by buying the L/D contract or shorting the deposit growth contract. 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?

A "Good-Deal" Range for the Futures Contracts

How can we determine the historical price of an asset that didn't exist? This problem is not as daunting as it seems. We can observe the prices of many financial assets that did exist. Financial markets and financial journals are full of examples of relative pricing models that precisely price a non-traded asset with information about

traded asset prices. The Black-Scholes model, Put-Call parity, the CAPM and APT are all prominent examples of relative pricing models. Relative pricing is very appealing to historical research where many state variables are unobserved. I take no stand on the underlying preferences and general equilibrium conditions that generate asset prices. Instead, I take the observable call rate and NYSE stock prices as given and ask what constraints these observable prices place on the prices of our hypothetical futures contracts.

Recall that the price of any asset satisfies $P = E[mX]$. We can observe the X sequence of payouts for both of our hypothetical contracts. Placing restrictions on P amounts to placing restrictions on m. Cochrane and Saa-Requejo (2001) show how to bound P by restricting m to rule out arbitrage and high sharp-ratio portfolios. They call these "good-deal" bounds because they are derived by assuming no investor will pass up a sufficiently good deal.

What restrictions can we place on the marginal utility of gilded age investors? For starters we can rule out arbitrage. The arbitrage bounds are computed by solving

$$P_{low} = \min_m E[mX^f]$$
$$s.t. \ \mathbf{P}^s = [m\mathbf{X}^s]$$
$$s.t \ \frac{1}{E[m]} = callrate$$
$$s.t. \ m > 0 \tag{5}$$

Where $\mathbf{P}^s$ and $\mathbf{X}^s$ are the price and payout of the NYSE stock portfolios. The solution to (5) is lowest price assigned by all discount factors that correctly price the NYSE stock portfolios, the minimum call rate and satisfy the no arbitrage condition that marginal utility is positive in every state of the nature. The upper bound is computed by replacing min with max and resolving.

What other constraints can we place on m? Cochrane and Saa-Requejo suggest we impose a variance bound on m. Hansen and Jagannathan (1991) have shown this is equivalent to limiting the sharp ratios of permissible portfolios. Consider two assets. A

valid m must price both assets so $1 = E[mR]$ for both R. Form an excess return by buying one asset and shorting the other. This excess return is also priced $0 = E[mR^e]$.

If we expand the expectation we get the Hansen-Jagannathan bound $\frac{\sigma(m)}{E[m]} \geq \frac{R^e}{\sigma(R^e)}$.

Cochrane and Saa-Requejo assume that investors will purchase portfolios with sharp ratios above a certain threshold. This assumption bounds the variance of m.

Cochrane and Saa-Requejo show how to compute good-deal bounds by solving

$$P_{low} = \min_m E[mX^f]$$
$$s.t. \; \mathbf{P}^s = [m\mathbf{X}^s]$$
$$s.t \; \frac{1}{E[m]} = callrate$$
$$s.t. \; m > 0$$
$$s.t. \; \sigma(m) < h \qquad (6)$$

I solve (6) with observable NYSE portfolios, call rate and Sharp ratio bound of 1.25 times the SR on the NYSE market portfolio. When computing bounds I assume the covariance between asset returns is always equal to the unconditional covariance. All time series variation in estimated price is therefore due to the change in the call rate and conditional expected futures payout $E[X]$.
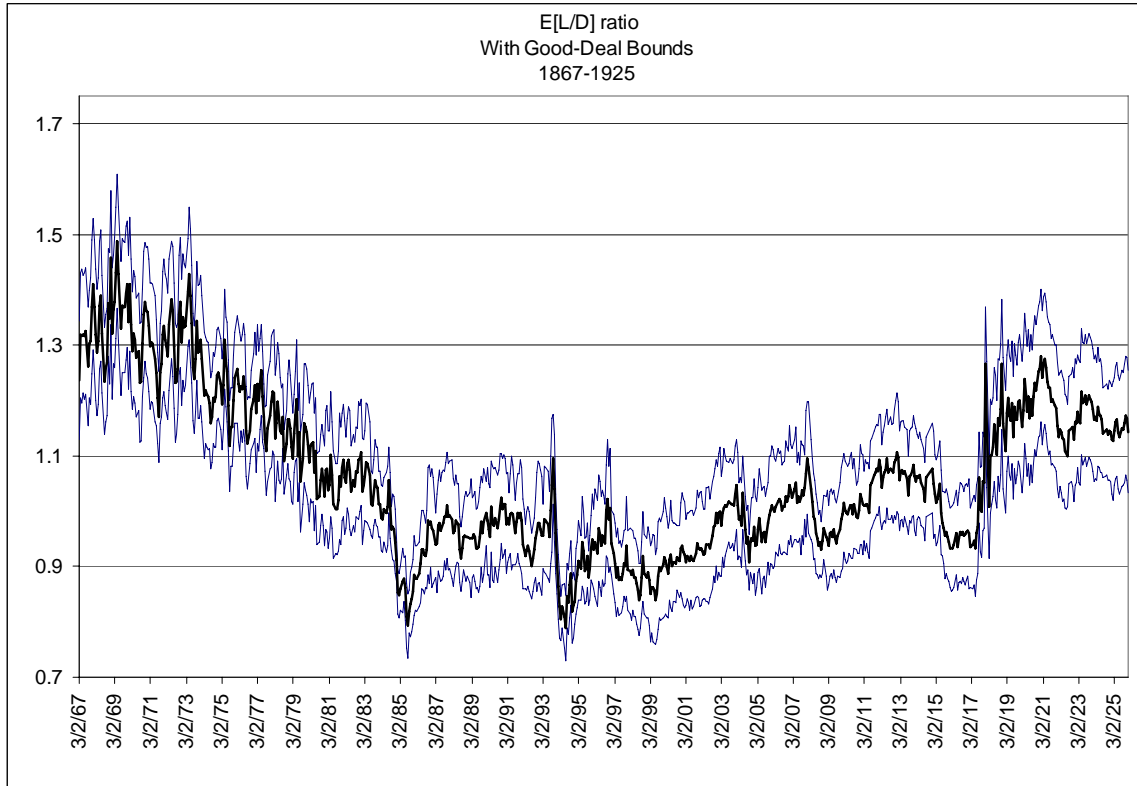
Results:

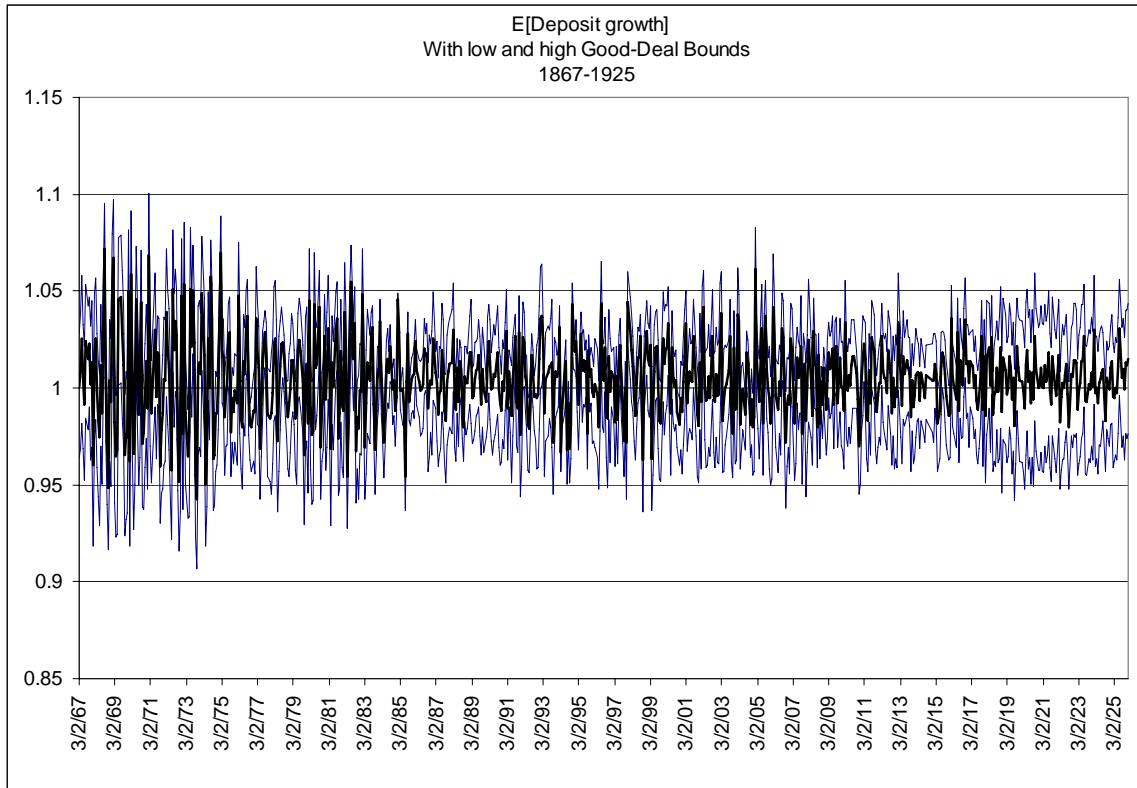Figures VIII and IX graph the times series values for $E_t[L_{t+1}/D_{t+1}]$, $E_t[Deposit_{t+1}/Deposit_t]$ and their "good-deal" price bounds implied by NYSE portfolios

and the risk-free call rate.

Figures VIII-IX

E[L/D] ratio
With Good-Deal Bounds
1867-1925

E[Deposit growth]
With low and high Good-Deal Bounds
1867-1925

The good-deal bounds are wide. They vary by up to $.07 in the case of the
L/D contract and $.035 in the case of the deposit growth contract. Figures X-XI
graph the midpoints of the price bounds and expresses this midpoint price as a
percentage of the expected payout.

Mid-point of Good-Deal Price Bounds
per $1 expected L/D payout
1866-1925

Mid-point of Good-Deal Price Bounds
per $1 expected Deposit Growth payout
1866-1925
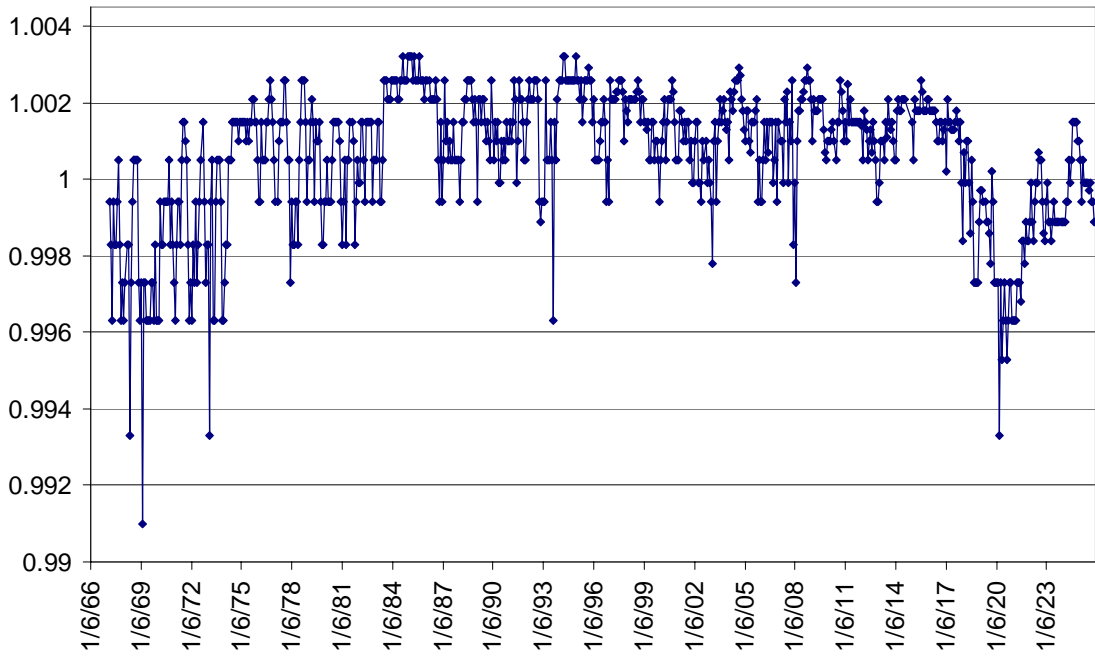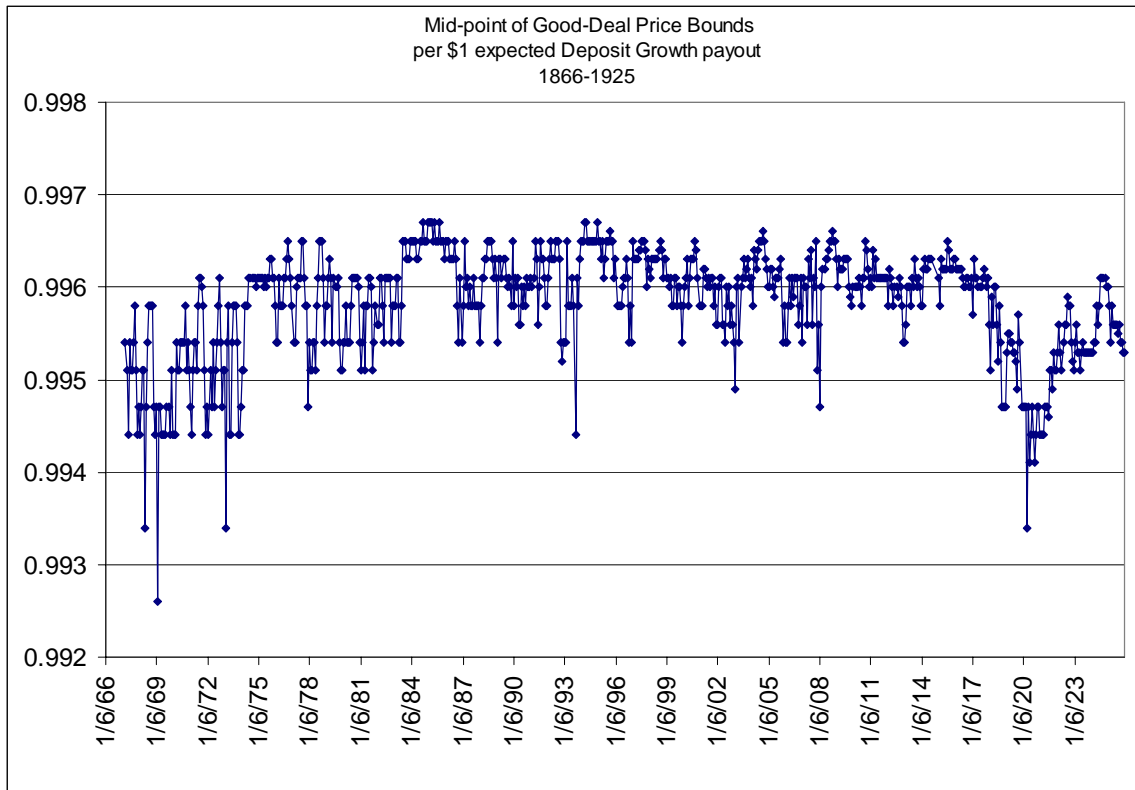
The midpoint of the L/D price range is often above $1 per $1 of expected return. For much of our sample investors where willing to purchase a security with negative expected return in order to insure against banking panics. Like other assets, the price of the L/D future did fall during panics. Although investors still valued insurance the marginal utility of money was so high during panics that anyone attempting to get money by selling a promise of money in the future received a low price (high return).

The midpoint of the insurance contract price range was almost always above the risk free asset and generally above the actuarially fair price. Had an investor purchased at the midpoint of our price range over the entire sample he would have lost .78% per year. The risk-free asset returned 2.86% per annum so the investor who purchased at the midpoint willingly gave up $3.64 for each $100 insured via the L/D contract.

Deposit growth was negatively correlated with banking panics. To insure via the deposit growth contract an investor would therefore have to sell short. As our GMM regressions predict the good-deal price range for the deposit insurance contract imply high returns for investors willing to buy and negative returns for investors looking to insure by selling short. Had an investor sold the deposit contract short at the midpoint of our price range over the entire sample he would have lost 5.43% per year. After accounting for the opportunity cost of foregoing investments in the risk-free asset the gilded age investor would have paid $8.29 per $100 insured against deposit declines.

These returns reflect the risk of banking panics. To put this cost in perspective, our best estimate of the stock market risk premium is roughly 6% per annum. Gilded age investors feared sudden bank withdraws slightly more then modern investors fear stock market crashes.

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