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Explaining Bank Failures in the United States: The Role of Self-Fulfilling Prophecies, Systemic Risk, Banking Regulation, and Contagion

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Explaining Bank Failures in the United States: The Role of Self-Fulfilling Prophecies, Systemic Risk, Banking Regulation, and Contagion*

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Abstract

Using count data on the number of bank failures in US states during the 1960 to 2006 period, this paper endeavors to establish how far sources of economic risk (recessions, high interest rates, inflation) or differences in solvency and branching regulation can explain some of the fragility in banking. Assuming that variables are predetermined, lagged values provide instruments to absorb potential endogeneity between the number of bank failures and economic and regulatory conditions. Results suggest that bank failures are not merely self-fulfilling prophecies but relate systematically to inflation as well as to policy changes in banking regulation. Furthermore, in terms of statistical and economic significance, the distribution and development of bankruptcies across US states depends crucially on past bank failures suggesting that contagion provides an important channel through which banking crises emerge.

JEL classification: G21, G28

Keywords: bank failures, banking crisis, banking regulation, count data

1 Introduction

By accepting deposits that are withdrawable on demand and issuing loans that will mature at a specific future date, banks[1] constitute the predominant financial institution for allocating funds across a broad range of saving and borrowing firms or households. Insofar as frictions such as imperfect information about the creditworthiness of borrowers beset the direct exchange of funds on financial markets (Stiglitz and Weiss, 1981), competitive advantages accrue to specialized intermediaries pooling the short-term liquidity risks of savers (Bryant, 1980; Diamond and Dybvig, 1983) and exploiting scale economies in monitoring investors with long-term profit opportunities (Leland and Pyle, 1977; Diamond, 1984). However, several factors exacerbate the risk of bankruptcies[2] with a banking industry committed to satisfying the disparate financial needs of savers and investors. Firstly, banks engage heavily in intertemporal transactions and are thus particularly exposed to unexpected economic and political events, which render the future payment pattern anything but certain. Secondly, the core business of banking,[3] e.g. the current transformation of highly liquid liabilities into specific assets, rests on the belief that, within a large pool of depositors and borrowers, an

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[1]The term bank is used here in its broader sense to include other financial intermediaries such as mutual funds, savings and loan associations, or credit unions.

[2]The etymology of the term "bankruptcy" goes indeed back to the Old Italian words "banca" (bench ,on which money changers used to exchange currencies) and "rotta" (broken).

[3]Banks provide other services such as the maintenance of the payment system, the monitoring of credit risks, or the provision of various consultancy services.

inferable proportion will be confronted with, respectively, liquidity shortages and default. Therefore, banks retain only a fraction of their liabilities as reserves and reinvest the remaining idle funds in the form of profit-generating loans. However, the coexistence of fractional reserves and liquid liabilities exposes banks to abrupt losses in the public confidence about their ability to honor imminent financial obligations and creates an intrinsic vulnerability to a pattern of withdrawals, which become progressively more correlated. Once trapped in such a vicious cycle, any bank will rapidly run out of liquid assets (Diamond and Dybvig, 1983). Owing to the introduction of deposit insurance, such failures typically manifest today in a reluctance of financiers (financial markets or other intermediaries) to surrender funds to a desperately illiquid bank, rather than a genuine run on its branches (Diamond and Rajan, 2005). Finally, unlike in other industries, depositors simultaneously adopt the role of customer and financier, which tends to weaken the position of specialized and well-informed investors in monitoring a bank's solvency management.

The theoretical literature explaining the fragility in banking can broadly be categorized according to the source of information suddenly inducing depositors to withdraw and investors to withhold liquidity. In the seminal contribution of Diamond and Dybvig (1983), mere self-fulfilling prophecies give rise to the possibility of bank failure. Rational depositors and financiers, who are aware of the implications of fractional reserve banking, will indeed react with panic in the face of fears about their banks' future ability to convert liabilities back into cash. Under this scenario, bank failures may have a purely speculative origin rooted in rumors that initiate mass-withdrawals by nervous depositors. Others have associated sudden losses in confidence that precipitates the financial distress in banking with more fundamental factors. For example in Gorton (1985) and Jacklin and Bhattacharya (1988), banks differ as regards the expected return on outstanding loans and the quality of their assets. Against the corresponding idiosyncratic liquidity and credit risks, concentrated withdrawals may signal emerging information about inadequate management of some banks and competition might eventually eliminate poor performance from the market.[4] Nevertheless, bank failures often arise amid a broader crisis in the financial system or the economy. Systemic risks such as plunging stock markets, a sharp depreciation of the domestic currency, or looming recessions might indeed deplete the entire banking system of liquidity and exacerbate credit risks and, thus, entail a dramatic upsurge in bank failures. In particular, economic downturns reducing income growth induce depositors to reduce savings whilst default rates among borrowers tend to rise, which imperils the asset transformation undertaken by the banking system. Furthermore, Hellwig (1994) argues that fundamental changes in technology and preferences affect average interest rates and pose a non-diversifiable risk that alters the valuation of long-term assets and liabilities. In practice, banks rather than depositors bear the bulk of such interest rate risk. Finally, contagion—the peril that individual failures transmit rapidly to other banks—provides a second channel through which episodes of endemic instability in banking might arise. Owing to incomplete information about a bank's solvency, Chari and Jagannathan (1988) argue that individual bankruptcies may indeed erode the confidence in the banking system as such and thus trigger a cascade of further failures. More recently, Diamond and Rajan (2005) have shown how contagion may likewise arise on the asset side when a reduction in market liquidity, e.g. in the aftermath of the failure of a big financial intermediary, increases interest rates to an extent where the corresponding reduction in real asset value puts otherwise solid banks into financial distress. According to Allen and Gale (2000) as well as Freixas et al. (2000), interbank markets provide the primary vehicle for contagion since they carry an increasing amount of assets and liabilities appearing directly in the books of other banks. To some degree, contagion connects idiosyncratic with systemic risks since individual failures arising e.g. from speculative motives or fundamental factors can rapidly grow into a fully fledged crisis.

[4] Jacklin and Bhattacharya (1988) refer to this scenario as "information-based bank run". However, the transition from dispersed to correlated withdrawals rests inevitably on some information (whether fact or rumor) that dramatically changes depositors' perceptions about their banks' liquidity.

The degree to which adverse information leading to the collapse of a bank is attributable to mere speculation, fundamental factors exacerbating idiosyncratic or systemic risk to asset transformation, or contagion has important economic and regulatory implications. Owing to the liquidation of profitable investment opportunities and the misallocation of funds, purely speculative bank failures inevitably generate losses, which, according to estimates of Caprio and Klingebiel (1997) manifest in forgone economic growth of the order of 10 to 20 percent of GDP for a typical recent banking crisis. However, under scenario that some failures arise from ordinary competition between banks, the elimination of poor performance tends to strengthen the future efficiency and to foster innovation in the banking industry. As regards regulation, relatively crude measures such as the instalment of (explicit or implicit) insurance schemes, which credibly promise to indemnify defaulted deposits (Diamond and Dybvig, 1983), or the announcement that convertibility will be suspended in times of concentrated withdrawals (Chari and Jagannathan, 1988) suffice to interrupt the vicious cycle that drives purely speculative bank failures. Conversely, fundamental events threatening the stability of banks and the banking system pose more subtle regulatory issues. For example, small and largely uninformed depositors may warrant some degree of public supervision and mandatory information disclosure to enable them to identify prudence in liquidity and asset management and, thus, mitigate against contagion between essentially solvent and insolvent banks. Together with systemic risks, contagion directly relates to the peril that failures infringe the proper operation of the banking system and can therefore produce seriously adverse economic effects. It is such fallout that provides not only the rationale for submitting banks to tight public supervision, but also for imposing solvency regulations or granting emergency liquidity assistance that is unprecedented in other industries. However, to the extent that some failures arise from bad banking rather than bad luck (compare Caprio and Klingebiel, 1997), ex-ante solvency regulation and ex-post public rescues to avert follow-up cost deemed excessive gives rise to adverse incentives such as moral hazard. Paradoxically, by insulating banks otherwise unfit for competition from market discipline, excessive regulation may foster, rather than punish, the kind of reckless risk taking leading to self-inflicted bankruptcies. Finally, in contrast to such sector specific intervention, monetary and fiscal policy provides the preferred policy instruments to militate against failures associated with systemic risks such as economic downturns.

Hitherto, there has been only scant empirical evidence on the relevance of the competing, but mutually not necessarily exclusive, theories to explain the actual distribution of bank failures. Corresponding research has focussed on the occurrence of banking crises. For the United States (US), Gorton (1988) reports that during the National Banking Era (1865 to 1914) depositors tended to convert their bank savings into cash to avoid anticipated losses due to the crisis that tended to follow virtually every business cycle downturn. This behavior, arguably, lends indirect support to the view that bank failures relate to systemic risk. Another strand of literature investigates the impact of the industry structure and sector specific regulation in banking upon incidents of banking crises, as defined by events where the banking system suffers substantial losses and/or undergoes and extraordinary episode of nationalization. Across countries and during the 1980s and 1990s, Demirgüç-Kunt and Detragiache (2002), Barth et al. (2004), and Beck et al. (2006) find that private monitoring and competition rather than direct regulatory intervention in the form of supervision or deposit insurance schemes tends to avert banking crisis. Arguably, the caveat against these studies lies in the usage of an aggregate measure of the fragility in banking (Beck et. al, 2006, p. 1585; Barth et al, 2004, p. 208). The dating of a crisis rests indeed on subtle classification issues as to when bank failures reflect a normal restructuring of the industry or they mark the occurrence of a more profound instability in financial intermediation. Furthermore, variables designating e.g. the duration of a crisis are uninformative about the degree to which individual banks were affected. Finally, aggregate measures preclude testing theories considering the role of idiosyncratic risks or emphasizing the importance of contagion in the aftermath of individual failures.

To fill this gap, the present study has assembled a new data set containing annual counts of failing banks in US states during the 1960 to 2006 period from the records of the Federal Deposit Insurance Corporation (FDIC). This permits to relate the various sources of risk, the structure of banking regulation in terms of e.g. reserve requirements, and contagion more directly to failures of individual banks and, thus, provides a closer concurrence to theoretical models.

Based on GMM estimates treating potentially endogenous variables as predetermined, results from count regressions suggest that banks are more likely to fail in times of low reserve requirements and after the deregulation of branch restrictions had increased competition across US states. Above all, the number of bank failures during a given year exhibit an economically and statistically highly significant degree of contagion with the number of past bankruptcies. Conversely, there is no evidence that adverse macroeconomic events manifesting in lower, or even negative, income growth or increases in the federal funds rate systematically imperil banks. Inflation merely provides an aggregate source that systematically relates with bank failures. Finally, a considerable number of failures are left unexplained—particularly in times of banking crisis—which, together with the important effect from contagion, lends some support to theories relating failures to self-fulfilling prophecies.

The remaining text is organized as follows. Section 2 presents the data and introduces a set of theoretically underpinned determinants of bank failures in US states. Section 3 addresses econometric issues relating to the potential endogeneity between bank failures, economic conditions, and regulation as well as to the specific nature of count data. Section 4 presents the results. The final section provides some concluding remarks.

2 Data about Bank Failures from US States

Data from US states provide at least two advantages in undertaking research to uncover the role of regulation, sources of systemic risks, and contagion in explaining the distribution and development of bank failures. Firstly, since its establishment in 1934, the FDIC has collected detailed data on the annual number of failing banks in each state.[5] Hitherto, recorded cases have added up to more than 3,500 bankruptcies, which reflects the fragmented structure of the US banking industry encompassing tens of thousands of depository institutions. By way of contrast, the banking industries of e.g. Germany, Switzerland, or the United Kingdom are much more concentrated and have therefore witnessed relatively modest numbers of failures that do not lend themselves to a systematic evaluation.[6] Secondly, many of the complex institutions reflecting substantial differences in the conduct of monetary policy or banking regulation across countries, tend to be much more homogenous across states. Subtle issues in measuring institutional quality can thus be avoided. Still, US states have retained far reaching regulatory competencies in banking—in particular in terms of imposing restrictions on establishing new branches or the chartering of state banks—and exhibit, thus, an ample degree of geographic heterogeneity in regulatory as well as economic conditions.

Reflecting the dual structure of the US banking industry, with overlapping state and federal authority, the failures reported to the FDIC have been classified according to the chartering, supervision, and type of depositary institution (commercial bank or thrift) involved. Categories include (i.) state chartered commercial banks supervised predominantly by the FDIC, but also by the Federal Reserve System,[7] (ii.) state chartered savings banks supervised by the FDIC, (iii.) nationally chartered commercial banks supervised by the Office

[5] Since coverage starts with the establishment of the FDIC, its impact upon banking stability cannot be evaluated with the current data.

[6] See Bank for International Settlements (2004) for an overview of bank failures in mature economies.

[7] Specifically, almost 90 percent of failing state chartered commercial banks fell under the supervision of the FDIC.

of the Comptroller of the Currency (OCC), and (iv.) state or nationally chartered savings association supervised by the Office of Thrift Supervision (OTS).

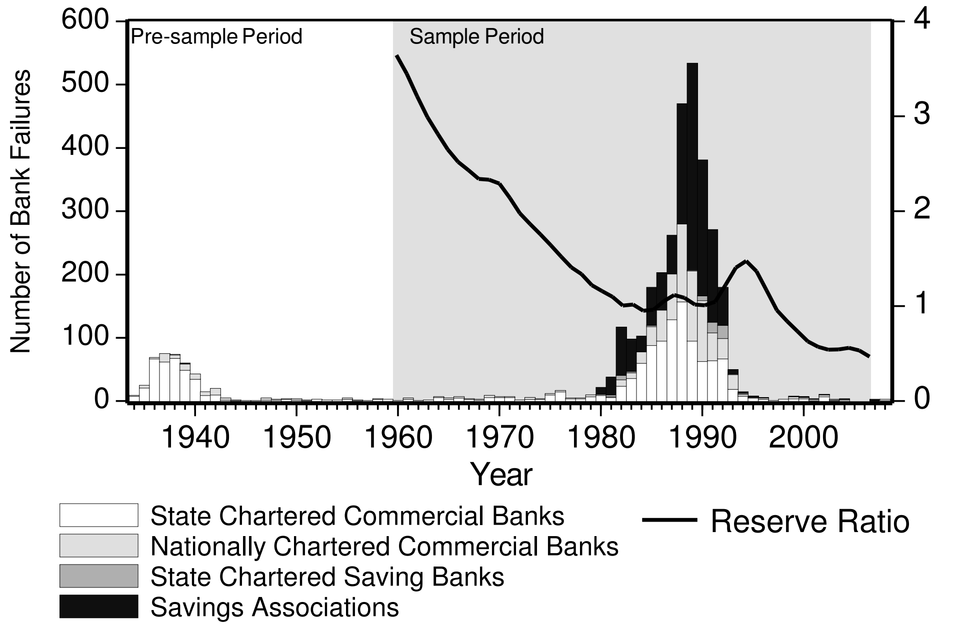
Figure 1 depicts the aggregate number of banks that collapsed in the United States during each year since 1934. The establishment of the FDIC was followed by an upsurge involving dozens of bankruptcies of primarily state chartered banks. However, the endemic instability in the aftermath of the Great Depression was eventually overcome with failures dropping to no more than 10 cases per year during the following decades. This situation of relative stability within the US banking system was dramatically reversed during the 1980s when, amid the outbreak of the Savings and Loan (S&L) crisis, the number of failures climbed to unprecedented levels peaking at over 500 depository institutions filing for bankruptcy during the year 1989.[8] Aside from state chartered banks, this crisis also involved a large part of the thrift industry and nationally chartered commercial banks. Owing to, among other things, the creation of the Resolution Trust Corporation (RTC)—a public scheme to bail out insolvent depository institutions—the sharp increase in bankruptcies of banks at the end of the 1980s was followed by an equally dramatic decrease at the beginning of the 1990s. Table 4 of the appendix provides further details about the distribution of the bankruptcies across US states ranked in the order of the total number of bank failures. This suggest that a disproportionate number of depositary institutions have suspended operations in the state of Texas, which alone accounts for one quarter of all cases, but also in California, Louisiana, and Illinois. Rather than economic size, this ranking appears to be driven by the events of the 1982 to 1992 period during which, as reported in the second column of table 4, almost 80 percent of all 3,543 bankruptcies occurred. The above-mentioned crisis of the 1930s accounts for another 10 percent of recorded cases with a corresponding breakdown across states appearing in the third column of table 4. It is noteworthy that the distribution between the upsurges of bank failures in the 1934 to 1939 and the 1982 to 1992 period exhibits only a modest correlation of 0.17. Ostensibly, different episodes of pervasive banking instability do not necessarily involve the same states.

Following the discussion at the outset, several determinants lend themselves to explaining the development and geographic distribution of bank failures across US states. The following paragraphs introduce a set of variables, designated by CAPITAL letters, used for later estimation and covering the years between 1960 and 2006. Table 3 of the appendix provides an overview of the data definitions and sources. For the sample period, column 4 of table 4 of the appendix reports the number of banks that failed to convert deposits into cash, with the remaining columns, 5 to 8, providing a breakdown of the total according to the above mentioned differences in chartering and supervision.

To recapitulate, systemic risks such as adverse economic events imperil the banking system insofar as they result in concentrated withdrawals. In particular, the permanent income hypothesis stipulates a close interrelation between the development of long-term income and current savings. During a recession, households are, thus, expected to convert additional deposits into cash, which exacerbates the risk of financial distress in particular when banks are simultaneously confronted with aggravated levels of default on the asset side due to e.g. increasing bankruptcies in other industries. The degree to which business cycles change liquidity and credit risks is measured by the yearly real INCOME GROWTH per capita in each state, as published by the US Department of Commerce. The expectation is that the development of income exhibits a negative relationship with the pervasiveness of bank failures. However, in times of recession, the sign on INCOME GROWTH reverses, which obscures the interpretation of its impact upon the number of bank failures. Since all states have witnessed periods with negative growth rates, controlling for the impact of sign reversals poses a relevant robustness issue.

[8] However, even higher failure rates occurred during the heyday of the Great Depression. According to Friedman and Schwarz (1993, p. 351) about 9'000 banks suspended operations during the 1930 to 1933 period.

Figure 1: Bank Failures and Reserve Ratio in the US (1934 to 2007)



Interbank markets offer an increasingly more important source to raise short-term liquidity. According to the historical statistics on bank assets and liabilities of the Federal Reserve System, the value of loans to and by US commercial banks has more than tripled in real terms since the 1970s. Therefore, upsurges in bank failures typically coincide with increases in the real[9] FEDERAL FUNDS RATE—the principal interest rate for overnight loans between US depository institutions—reflecting a reluctance to surrender assets in times of imminent liquidity risks. Aside from designating a tendency to store liquidity, Diamond and Rajan (2005) argue that increasing interest rates for interbank loans simultaneously diminish the discounted values of a bank's assets constituting, thus, an additional channel through which the FEDERAL FUNDS RATE exacerbates the risk of banking crisis.[10]

INFLATION likewise signals economic imbalances with the potential to destabilize the banking industry. Since deposits carry virtually no interest rates, aggravated levels of inflation favor early consumption and reduce incentives to save thus affecting withdrawal decisions. Conversely, from the lenders' point of view, increases in average price levels offer the advantage of inflating a part of their debt away. In particular at times when plenty of bad loans come to light, this might contribute to the stabilization of distressed banks. Therefore, the fragility of banks relates ambiguously with INFLATION, as measured by the increase in the average Consumer Price Index across all US cities or, with more disaggregated data that is available from the year 1968 onwards, within US regions.

In the United States, financial deregulation has dramatically changed the structure of the banking industry by lifting restrictions that used to severely curtail the freedom to open new bank branches across, or even within, a state's border. According to Kroszner and Strahan (1999, p.1440) the dismantling of branching regulations occurred in several stages including the permission to (i.) establish multibank holding companies (MBHCs) (ii.)

[9]Nominal interest rates have been converted into real interest rates by subtracting the inflation rate as defined in the next paragraph.

[10]See Hellwig (1990) for a general discussion of aggregate interest risks in banking.

acquire branches via mergers and acquisitions (iii.) open a statewide network of branches, and (iv.) freely operate an interstate branch network. By aggregating nominal variables designating the years during which states abandoned the corresponding restrictions, on a scale from 0 to 4, BRANCHING DEREGULATION measures the ease with which banks can enter other geographic markets by means of establishment or acquisition of additional subsidiaries. Recent steps towards a complete liberalization of branching manifest in an increase in the average index value across states from 1.1 in 1960 to a value of 3.7 in 1999. Note that for states that had not fully liberalized by the end of the 20th century, the data on branching regulation has not been updated for the subsequent years. Arguably, branching by means of mergers and acquisitions constitutes the most important step towards deregulation since this permits the rapid integration within an MBHC of already existing banking networks (Kroszner and Strahan, 1999, p.1440). In the sense of facilitating the contestability of local and statewide banking industries, BRANCHING DEREGULATION provides a proxy for competitive conditions and reflects the threat to under-performing banks to being eliminated by more efficient rivals. The dismantling of branching restrictions fosters, thus, market discipline and thereby provides an impetus to restructure the banking industry, which might initially involve an increase in the number of bank failures. However, at least in the longer term, replacing poorly managed banks tends to strengthen the banking system as such and could thereby enhance stability.

Solvency regulation to mitigate against banking crisis includes minimum reserve requirements stipulating a certain amount of liquid assets banks must surrender to the Federal Reserve System as a security against unexpected withdrawals. Reserves, which pay no interest and hence impose a cost burden on banks, are typically expressed as a fraction of reservable deposits. To construct the RESERVE RATIO,[11] the required reserves reported to the Federal Reserve System have been divided by the deposits in the banking system as obtained from the World Banks's Database on Financial Development. The Federal Reserve System likewise publishes some data on the amount of reservable deposits for the years after 1973 which will be used for robustness checks. Across years, the RESERVE RATIO responds to ongoing changes in solvency regulations, developments in the financial system, or the usage of minimum reserves as a tool for monetary policy. In particular, as depicted by the solid line of figure 1, the RESERVE RATIO has pursued a downward trend during recent decades, which has only been counteracted by transitory upsurges e.g. following the period of financial instability at the end of the 1980s. Finally, aside from the statutory minimum, most banks hold excessive reserves to counter the menace of future illiquidity with the Federal Reserve System collecting corresponding data since 1973.

The peril of contagion across failing banks provides the rationale for stipulating sector specific regulations such as the above-mentioned reserve requirements. The marketed periods with endemic instability in the banking industry depicted in figure 1 are indeed consistent with the view that financial distress affecting individual banks can rapidly spread across the banking system. Under this scenario, the current number of bank failures exhibits some degree of persistency and depends, among other things, on their recent history as embodied e.g. in the number of bankruptcies during the previous year (denoted by $\#\text{FAIL}_{t-1}$).

Finally, the POPULATION of a state controls for differences in size, whereby larger states tend to have larger banking industries and are therefore expected to witness more bank failures during a specific year.[12]

[11] Statutory requirements provide an alternative measure to represent amendments in the reserve policy. However, before 1966 the level of mandatory reserves depended on whether or not a bank was located in a city with a Central Reserve or Reserve Bank. This geographic concept was gradually abandoned in favor of a definition of mandatory reserves according to the level of deposits and, more recently, the type of reservable liability (see Feinman, 1993). Such ongoing changes in the concept of reserve requirements complicate the comparison of statutory reserve requirements across time.

[12] Using total state income provides an alternative variable to control for differences in size. However, in contrast to the POPULATION, total income is likely to be heavily re-affected by a crisis in the banking system. However, replacing POPULATION with total income in the present set of covariates did not change the essence of the results.

In contrast to theories associating bank failures with fundamental factors such as systemic risks or the quality of the banking regulation, speculative bankruptcies are by definition related to opaque, but self-fulfilling, rumors about future liquidity risks (compare Gorton, 1988, p.221-222). Nonetheless, the amount of failures left unexplained by the abovementioned determinants provides some indirect information about the relevance of speculation in destabilizing banks. Likewise, the transmission of bankruptcies via contagion inherently exacerbates the nervousness of depositors and investors about future instabilities and supports therefore, at least in part, theories stressing the relevance of self-fulfilling prophecies.

3 Econometric Issues: Count Data and Endogeneity

Principal econometric issues arise from endogeneity and non-linearities when trying to uncover the empirical determinants of bank failures as measured by their annual number across a panel covering US states and the years between 1960 and 2006.

First of all, the number of bank failures, henceforth labelled by #FAIL, exhibit count data[13] characteristics with values that are inevitably non-negative. To account for this, the econometric specification explaining the expected number of bank failures λ across states i and years t conditions on an exponential transformation of explanatory variables, that is

$$E[\#FAIL_{i,t}] = \lambda_{i,t} = \alpha\#FAIL_{i,t-1} + exp(\beta_0 + x_{i,t}^{'}\beta + \delta_i) \tag{1}$$

whereby x collects the dependent variables including POPULATION, INCOME GROWTH, FEDERAL FUNDS, INFLATION, BRANCHING DEREGULATION, as well as the RESERVE RATIO. The parameters β_0, β, and δ_i designate, respectively, a constant, coefficients to be estimated, and unobservable state specific components. By way of contrast, #FAIL$_{i,t-1}$, which captures the propensity of bank failures to exhibit contagion, enters (1) in a linear and additive manner. Together with the condition that $|\alpha| < 1$, this excludes paths with diverging dynamic feedback. Rescaling $\mu_{i,t} = exp(\beta_0 + x_{i,t}^{'}\beta)$ and $\nu_i = exp(\delta_i)$ yields the regression model

$$E[\#FAIL_{i,t}] = \lambda_{i,t} = \alpha\#FAIL_{i,t-1} + \mu_{i,t}\nu_i \tag{2}$$

Across states and years, bank failures are specific but relatively rare events which manifests in integer and, for three quarters of the present data set, zero-valued observations. To account for this, conventional count regressions assume that λ follows a distribution of the Poisson family.[14] However, for the following reasons, the estimation of (2) warrants a different approach. Firstly, to the degree that states differ systematically e.g. in terms of public policies towards banking or an inherited banking structure that is more or less prone to failures, ν_i represents an idiosyncratic component. Rather than exploiting within state heterogeneity, non-linear models such as (2) eliminate a fixed effect such as ν_i by means of quasi-differencing. However, this precludes, in turn, the inclusion of lagged dependent variables such as # FAIL$_{i,t-1}$ to measure e.g. the impact of contagion (Cameron and Trivedi, 1998, 295ff.). Then again, treating state-specific components as random effects instead would only lead to consistent results when (2) includes all relevant determinants in x and ν_i therefore merely adds additional randomness that is uncorrelated with any of the explanatory variables, that is $E[x_{i,t}\nu_{i,t}] = 0$. Yet, endemic instability in the banking sector is likely to result in contemporaneous feedback with economic and regulatory conditions introducing correlation between $\nu_{i,t}$ and $x_{i,t}$. In particular, in states with important financial industries, incomes are directly re-affected when bank failures become endemic. Furthermore, much of

[13] For an excellent analysis of count regressions with panel data see Chapter 9 of Cameron and Trivedi (1998).

[14] In an early empirical study on the time series behaviour of the aggregate number of US bank failures between 1947 and 1986, Davutyan (1989) employs a Poisson regression.

the banking regulation is at least in part a response to historical crises. The establishment of a federal deposit insurance scheme in the aftermath of the Great Depression or the creation of the Resolution Trust Corporation to resolve the Savings and Loan crisis provide prominent examples for this.

To relax the assumption about the strict exogeneity of the determinants of bank failures, Blundell et al. (2002) exploit the dynamic features of panel count data. In particular, they present estimation techniques with predetermined regressors which remain uncorrelated with past events, that is $E[x_{i,t}\nu_{i,t-p}] = 0$ with $p \geq 1$, but may correlate with current or future events, that is $E[x_{i,t}\nu_{i,t+f}] \neq 0$ with $f \geq 0$. This assumption may be reasonable when current political or economic development shape the future of the banking sector whereas they do not affect historical events. Under this assumption, lagged independent variables provide instruments $z_{i,t} = x_{i,t-p}$, where p typically includes up to two years, that are uncorrelated with stochastic components $\mu_{i,t}$ and enable to establish the causal impact of $x_{i,t}$ upon # $\mathrm{FAIL}_{i,t}$. To eliminate the fixed effects δ_i with weakly exogenous regressors, Chamberlain (1992) proposes the use of quasi-differences and thereby obtaining a residual that re-scales the lagged dependent variable on the same mean as the actual values,[15] that is

$$s_{i,t} = \#FAIL_{i,t-1} - \#FAIL_{i,t}\frac{\mu_{i,t-1}}{\mu_{i,t}}. \tag{3}$$

Then, $s_{i,t}$ generates orthogonality conditions with respect to instrumental variables and, for the present case, the sample moment conditions

$$\sum_{i=1}^{51}\sum_{t=1960}^{2006} z_{i,t}s_{i,t} = 0 \tag{4}$$

permit to estimate the causal impact of determinants $x_{i,t}$ upon the number of bank failures $\#\mathrm{FAIL}_{i,t}$ by the Generalized Method of Moments (GMM). Aside from the specification of (2), Blundell et al. (2002) consider a case without dynamic feedback, that is $\alpha = 0$ and a case where pre-sample means of the dependent variable capture the persistency in e.g. instability in the banking industry. The latter arguably enhances the efficiency of the estimation to the extent that averages $\overline{\#\mathrm{FAIL}}_{i,p}$ across the 1934 to 1959 period, during which some of our causal variables are unavailable, embody latent information about the future propensity to bank failures in state i.

In the case that the number of variables in $z_{i,t}$ exceeds the number of coefficients to be estimated, (4) is over-identified and testing whether the corresponding empirical restrictions hold, ascertains the exogeneity of the chosen set of instruments. Furthermore, the Hausman test provides statistical evidence as to whether state-specific components δ_i merely introduce additional randomness or represent systematic unobserved differences across states, and are thus potentially correlated with the determinants of bank failures $x_{i,t}$.

Finally, alternative transformations to (3) have been proposed. For example, Wooldridge (1997) suggests using

$$s_{i,t} = \frac{\#FAIL_{i,t}}{\mu_{i,t}} + \frac{\#FAIL_{i,t+1}}{\mu_{i,t+1}} \tag{5}$$

to eliminate fixed effects from an equation such as (2) without applying the strict exogeneity assumption. Applying this transformation is left as a robustness check in section 4.2.

[15] The first order condition determining the maximum likelihood function of a Poisson count regression with fixed effects generates a similar expression.

4 Results

4.1 Baseline Results

Table 1 reports the baseline results. Columns 1 and 2 relate the number of bank failures to the covariates introduced in section 2 by means of, respectively, a random and fixed effects Poisson regression. Estimated coefficients are statistically significant and most of them shape up to economic priors. Specifically, with both random and fixed effects the likelihood of bank failures increases with lower income growth, modest mandatory reserves, higher interest rates for interbank loans, a larger number of past failures, and with steps to lift regulatory restrictions on branching. Conversely, states with a larger population do not tend to witness more bank failures. This finding is broadly consistent with the ranking of table 4 which does not exhibit an apparent relationship with state size. In spite of the similarities between the results with random and fixed effects, the Hausman test statistic (χ^2) of 48.44 in column 1 provides statistical evidence that the random effects count model omits relevant sources of unobserved, state-specific heterogeneity thus underscoring the importance of introducing fixed effects into the present count regressions. Then again, in the case that determinants interrelate with the number of bank failures—meaning that the strict exogeneity assumption does not hold—even introducing fixed effects does not rule out spurious results due to reverse causality. Indeed, instead of representing a causal effect, the coefficients of column 2 could also be interpreted as banking crises reversely reducing income growth, creating uncertainty induced increases in the federal funds rate, fostering inflation, or wiping out reserves.

Column 3 of table 1 accounts for the potential interrelationships between banking instability, economic conditions, and regulation by means of employing the GMM estimator presented in section 3. To recapitulate, quasi-differences eliminate state-specific effects in a similar manner to that in a fixed effects Poisson count model, but lagged variables from the previous two years provide instruments generating orthogonality conditions to unfold causal relationships. Owing to the usage of lagged variables as instruments, the years 1960 to 1962 drop out of the sample and the number N of observed state - year pairs declines from 2,307 to 2,154. The GMM estimator suggests that banking regulation in terms of reduced mandatory reserves requirements or branching deregulation constitutes a statistically significant cause for instability. Ostensibly, the continuing reduction of the RESERVE RATIO depicted in figure 1 can partly explain the distribution and development of bank failures. In a similar vein, granting more economic freedom to structure branch networks facilitates the entry into new regions and states and appears to compete a significant number of banks out of business. Furthermore, the recurrent positive and highly significant entry of past failures lends compelling support to the view that the fragility in banking is subject to contagion. This concurs with the visual evidence of figure 1 showing that years during which bank failures are endemic or virtually absent tend to follow each other. Finally, inflation appears to reduce the number of bank failures. This is perhaps not surprising since increases in the average price level enable banks in financial distress to inflate a part of their bad debt away. It is noteworthy that the entry of inflation is only significant at the 10 percent level and might be due to the special conditions of the 1970s, when the first and second oil price shock pushed inflation rates into double digits whilst the number of bank failures remained at historically low levels. Conversely, the statistical significance of coefficients pertaining to changes in the INCOME GROWTH per capita, the real FEDERAL FUNDS rate, and the POPULATION of a state vanish once their potential endogeneity has been accounted for. Apparently, geographic and temporal differences in the fragility of the banking industry are neither strongly related with such sources of systemic risk nor do they reflect mere differences in state size.

With a J-statistic of 7.619, the set of instruments underlying the estimation of column 4 of table 1 is sufficiently exogenous to provide orthogonality conditions. Furthermore, with a

Table 1: Baseline Results

Method:	Panel Count Model		Generalized Method of Moments				
	Random E.	Fixed E.					
Sample	All Commercial Banks and Thrifts				State Chartered Commercial Bank. Supervision FDIC or Fed.	National Chartered Commercial Bank. Supervision OCC	Savings Associations. Supervision OTS
	(1)	(2)	(3)	(4)	(6)	(7)	(8)
Population	-0.268***	-1.923***	-1.561	-0.408	2.313	19.36	2.886
	(0.099)	(0.237)	(8.283)	(7.068)	(9.492)	(19.53)	(10.19)
Income Growth	-0.172***	-0.172***	0.007	0.015	0.073**	0.159**	-0.053
	(0.005)	(0.008)	(0.030)	(0.033)	(0.032)	(0.074)	(0.039)
Federal Funds Rate	0.356***	0.344***	-0.057	-0.050	-0.243**	-0.204	0.037
	(0.011)	(0.012)	(0.078)	(0.079)	(0.104)	(0.178)	(0.102)
Inflation	-0.030***	0.044***	-0.114*	-0.106*	-0.265***	-0.281*	-0.067
	(0.007)	(0.010)	(0.065)	(0.061)	(0.082)	(0.160)	(0.071)
Reserve Ratio	-0.374***	-0.670***	-3.501***	-3.566***	-2.446	-3.140	-5.588***
	(0.046)	(0.070)	(1.098)	(0.987)	(1.500)	(2.322)	(1.452)
Branch Deregulation	0.316***	0.355***	0.510**	0.533**	0.415	1.312	
	(0.011)	(0.024)	(0.217)	(0.226)	(0.208)	(1.487)	
$\#\text{Fail}_{t-1}$	0.010***	0.010***	0.013***	0.013***	0.013***	0.020***	0.025***
	(0.003)	(0.0004)	(0.004)	(0.005)	(0.004)	(0.008)	(0.006)
$\overline{\#\text{FAIL}}_{i,p}$				0.040			
(average 1934-1959)				(342189000)			
N	2,307	2,307	2,154	2,154	2,154	2,154	1,338
Log Likelihood	-3,787	-3,498					
J-statistic			7.968	8.140	9.135	3.634	8.904
χ^2	48.44	—	48,831	24,748	1,534	2,023	8,663

Notes: The dependent variable is $\#\text{Fail}_{i,t}$ e.g. the number of bank failures in US state i for each year t between 1960 and 2006. Each regression includes a constant. Estimation of columns 1 and 2 is by maximum likelihood based on a Poisson distribution with group effects. Columns 3 and 8 are panel count estimates based on the GMM method of Blundell et al. (2002). Gauss-Marquard was used as the optimization method and standard errors have been calculated by using the optimal weighting matrix from the inverse of the covariance during a first round of GMM estimation. The list of instruments includes the first and second lag of the reported variables. Starting values are taken from a Poisson count regression. J-statistic reports the estimated value of the test for overidentifying restrictions and χ^2 is the Hausman test for endogeneity in random effects and GMM estimates as compared with the fixed effects panel count model of column 2. Significance at the 10% level is denoted by *, at the 5% level by **, and at the 1% level by ***.

value of 25.62, the Hausman test statistic (χ^2) rejects the hypothesis of equality between the coefficients reported in columns 2 and 3 meaning that endogeneity warrants the usage of instrumental variables.

Adding pre-sample averages of bank failures across the 1934 to 1959 period ($\overline{\#\text{FAIL}}_{i,p}$) in column 4 of table 1 does not affect the significance of coefficient estimates and, possibly due to the time invariant nature of this variable, corresponding standard errors are particularly large.[16] The extent to which episodes of banking fragility affected states before 1960 seems to be by and large irrelevant to explaining the subsequent geographic distribution of bank failures. Therefore, at least in the long term, states affected by fragile banking industries appear not to be doomed to suffer from ongoing instability.

The remaining columns of table 1 report separate baseline estimates according to the chartering and type of financial intermediary. Across these estimates, J-statistics cannot reject the hypothesis of sufficiently exogenous instruments whilst the Hausman test always rejects the hypothesis of exogenous coefficients.[17] Recall from figure 1 that state chartered commercial banks and savings associations account for a large fraction of failures. Aside from the impact of contagion,[18] which is always highly significant, remarkable differences arise as regards the impact of adverse economic effects and regulation across different types of banks and thrifts.

Though mandatory reserves affect the stability of financial intermediation in general, no significant effect arises with commercial banks in columns 6 and 7 of table 1. Possibly, a larger balance sheet and branching network enables nationally chartered banks to diversify liquidity risks in a much broader manner. The fact that almost 90 percent of failing state chartered banks were not members of the Federal Reserve System, provides an explanation as to why the RESERVE RATIO fails to produce an effect in column 7, though its significance just misses the 10 percent level. In contrast to the full sample, changes in INCOME GROWTH affect the stability of commercial banks. It should be noted that the corresponding positive entry designates that more dramatic contractions in income, whose sign is negative, endanger the banking system whilst corresponding positive income changes cannot be interpreted in a meaningful way. Robustness checks controlling for such ambiguities from variables with reversing signs are relegated to section 4.2. As reported in column 6, increasing interest rates tend to imperil state-chartered commercial banks which apparently have scant alternative sources to obtain liquidity when the federal funds market runs dry.

The adoption of the Depository Institutions Deregulation and Monetary Control Act in 1980 permitted the thrift industry to accept deposits withdrawable on demand and issue consumer and commercial loans, thus engaging in the type of asset transformation that introduces much of the fragility in bank business. In order to reflect former regulatory constraints and the fact that hardly any failure of a Savings Association has been recorded prior to 1980, the corresponding years have been dropped from column 8 of table 1. By way of contrast, the 1980s witnessed an upsurge in collapsing savings associations and banks until the bankrupt Federal Savings and Loan Insurance Corporation—the former public insurance

[16] Conversely, Blundell et al. (2002) find that introducing pre-sample means enhances the efficiency of estimates explaining the relationship between expenditures for research and development by US firms and patent applications. Furthermore, introducing pre-sample average of bank failures in the random effects panel count model of column 1 of table 4 results in a positive coefficient that is significant at the 10 per cent level. The time-invariance rules out a corresponding estimation within a fixed effects panel count model.

[17] The Hausman test continues to compare the results of columns 6 to 8 with the fixed effects panel regression on all bank failures as reported in column 2. However, calculating the Hausman test statistic on the basis of a fixed effects panel model with the specific bank type as dependent variable likewise results in the rejection of the hypothesis of exogenous variables.

[18] Contagion refers here to the reaction of bankruptcies across different types of banks and thrifts to the history of recent failures across the entire industry. Looking at the effect of contagion within each type of bank (say the effect of collapsing nationally chartered banks on the propensity of future failures in this group) yields likewise a significant and positive entry.

for the thrift industry—had to be replaced by the Resolution Trust Corporation (RTC) to dispose of much of the accumulated bad debt. Compared with commercial banking, the nationally chartered thrift industry has enjoyed much greater freedom to engage in nationwide branching. In particular, many restrictions prohibiting branching within states or mergers across states' boundaries had already been lifted at the beginning of the 1980s. Since branching deregulation concerned primarily commercial banks, the corresponding variable has been dropped from column 8.[19] Then, significant determinants explaining the collapse of nationally chartered savings associations merely encompass modest reserve requirements and contagion. Whilst commercial banks were affected by adverse macroeconomic effects, the narrow business model of the thrift industry of accepting savings and issue mortgage loans has proven to be more resilient by adverse developments in per capita income, average prices, or on the interbank market. Finally, for numerical reasons, estimation to explaining the determinants of failing state chartered savings banks broke down. Recall from table 4 that they only account for a modest number of failures and apparently do not exhibit sufficient heterogeneity to uncover systematic relationships by means of the present estimation technique.

4.2 Robustness Checks

In spite of finding that changes in banking regulation and contagion recursively constitute a significant determinant for the distribution and development of bank failures, several robustness issues arise as regards the sample, specific variables, and the estimation technique employed in section 4.1. In particular, the negative entry of inflation might be attributable to the aggravated degree of price increases during the first and second oil price shocks—a period during which bank failures remained at historically low levels. However, excluding the years between 1973 and 1982, during which annual inflation rates exceeded 5 percent, in column 1 of table 2 rather enhances the significance of INFLATION. Conversely, though the magnitude of coefficients remains by and large unaffected, dropping years with relatively high inflation removes the significance of the impact of banking deregulation and contagion, possibly because taking out a period of relative stability in banking reduces the precision of coefficient estimates. The decade following 1982 was marked by a dramatically aggravating degree of fragility in the banking industry culminating in the savings and loans (S&L) crisis. After dropping the 1982 to 1992 period, with in excess of 100 bankruptcies per year, contagion alone produces a significant effect. This is perhaps not surprising since disregarding this period not only ignores about 80 percent of bank failures within the total sample, but also leaves profound developments in financial services liberalization, which included in particular the deregulation of branching restrictions, unaccounted for. Finally, a disproportionate number of banks have suspended operations in the state of Texas (see table 4). Though the reason for this remains somewhat obscure, dropping the corresponding observations did not affect the essence of the results.

Columns 4 to 8 of table 2 consider an array of alternative variables to estimate the coefficients of the baseline specification. During the 1960 to 2006 period, all states have witnessed years with negative growth rates of average real income per capita. Therefore, sign reversals between positive and negative values render the interpretation of the corresponding coefficient somewhat hazardous. To more consistently assess the impact of recessions upon the stability in the banking sector, column 4 assigns a value of zero to years with positive income growth and leaves the 499 observations with negative values unchanged. The expectation would be that this variable produces a negative entry since more dramatic reductions in income expose the banking system to more withdrawals. However, the corresponding coefficient estimate of column 4 is insignificant and considering only negative values of INCOME GROWTH does not overturn the essence of the previous results. It is noteworthy that applying this

[19] Including the effect of more leniency in branching restrictions nevertheless results in a positive and significant coefficient that is similar to the baseline specification of column 3.

Table 2: Robustness Checks

Robustness Check:	Smaller Sample Without:			Alternative Covariates:					Alternative Estimation
	1973 to 1982	S&L (1982-1992)	Texas	Negative Inc. Growth	Deposits from Fed.	Total Reserves	Branch M&A	Regional Inflation	Wooldridge Transformation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Population	-6.313	-15.40	-2.991	2.952	-4.933	-2.282	-9.916	-3.253	1.871**
	(7.821)	(17.02)	(7.008)	(8.049)	(8.675)	(7.507)	(14.26)	(8.790)	(0.835)
Income Growth	0.047	-0.059	-0.038	-0.123	-0.021	-0.001	-0.015	-0.008	-0.035
	(0.031)	(0.062)	(0.026)	(0.076)	(0.031)	(0.029)	(0.033)	(0.032)	(0.082)
Federal Funds Rate	-0.204*	0.051	-0.033	-0.033	-0.139*	-0.056	-0.092	-0.120	0.409
	(0.112)	(0.127)	(0.090)	(0.090)	(0.072)	(0.077)	(0.086)	(0.089)	(0.432)
Inflation	-0.276***	-0.129	-0.136**	-0.115*	-0.169**	-0.121*	-0.142**	-0.157**	0.223
	(0.096)	(0.194)	(0.067)	(0.060)	(0.078)	(0.066)	(0.068)	(0.075)	(0.376)
Reserve Ratio	-3.985***	-4.114	-3.065***	-3.305***	-1.886**	-3.265***	-2.878**	-3.311***	-0.348
	(1.313)	(2.852)	(1.062)	(0.102)	(0.879)	(0.979)	(1.201)	(1.121)	(2.053)
Branch Deregulation	0.684	6.627	0.228	0.549**	0.458**	0.524**	-0.074	0.440**	0.187
	(0.434)	(5,813)	(0.282)	(0.270)	(0.193)	(0.204)	(0.093)	(0.192)	(0.468)
#Fail$_{t-1}$	0.019	0.157***	0.042***	0.011***	0.015***	0.013***	0.017***	0.014***	0.250
	(0.016)	(0.038)	(0.013)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.249)
N	1,644	1,593	2,110	2,154	1,491	2,154	2,154	1,797	2,154
J-statistic	9,278	6.444	8.659	8.791	9.342	8.380	8.569	7.534	0.001

Notes: The dependent variable is the number of failures of different financial intermediaries in US states between 1962 and 2006. Each regression includes a constant. Estimation is by the GMM panel count method of Blundell et al. (2002). Gauss-Marquard was used as the optimization method and standard errors have been calculated by using the optimal weighting matrix from the inverse of the covariance during a first round of GMM estimation. The list of instruments includes the first and second lag of the reported variables. J-statistic reports the estimated value of the test for overidentifying restrictions. Significance at the 10% level is denoted by *, at the 5% level by **, and at the 1% level by ***.

robustness check to the subgroup of state and nationally chartered commercial banks as reported in columns 6 and 7 of table 1, removes the significance of INCOME GROWTH.

In section 2, mandatory reserves held within the Federal Reserve System have been calculated with deposits reported to the World Bank's Database on Financial Development which offers the advantage of a comprehensive time coverage. However, since 1973 the Federal Reserve has been recording the amount of reservable deposits, which encompass only three quarters of the amount published by the World Bank. Aside from reducing the sample size, using this data in column 5 to calculate mandatory reserves naturally increases the average value of the RESERVE RATIO. Then again, high levels of inflation, branching deregulation, contagion, and above all the endorsement of a modest level of reserves continue to be the statistically significant determinants of bank failures. Likewise, the direction and significance of coefficients remain by and large unaffected when using total, e.g. mandatory and excessive, liquid assets held within the banking system to calculate the RESERVE RATIO in column 6.

Kroszner and Strahan (1999, p.1440) argue that the integration of existing banks by means of mergers and acquisitions constitutes the vital step towards removing the impediments from branching restrictions as it permits MBHC to rapidly expand and restructure their retail network. Column 7 employs therefore a nominal variable designating years during which states permit banks to incorporate branch networks via mergers and acquisitions. This one-dimensional concept apparently neglects important aspects since BRANCHING DEREGULATION now relates neither positively nor significantly to banking failures.

Column 8 takes into account that average increases in consumer prices might differ across regions. Accounting for the specific price conditions in the West, Midwest, Northeast, and South of the USA, which have been recorded since 1968, reduces the sample to 1,797 observations. Nevertheless, even after allowing for such geographic heterogeneity, INFLATION retains its significantly negative coefficient.

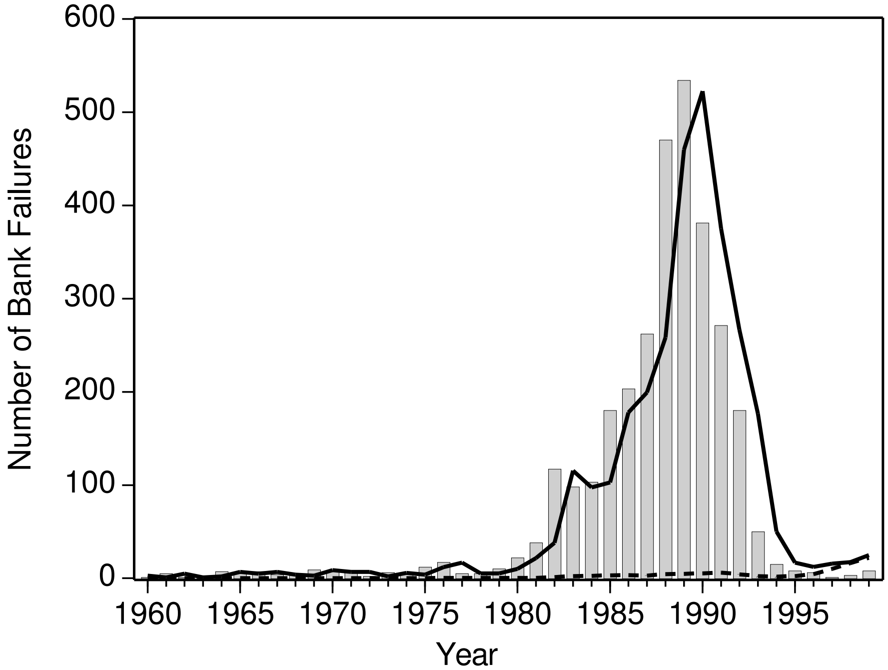
Finally, to establish the determinants of bank failures without the strict exogeneity assumption, column 9 of table 2 employs the transformation proposed by Wooldridge (1997) as discussed at the end of section 3. However, compared with Blundell et al. (2002), this alternative transformation appears to be less efficient in uncovering systematic relationships between the number of bank failures and the present set of possible determinants. Indeed, only the control variable of the state size as measured by its POPULATION is significant in column 9.

4.3 Within Sample Predictions

The previous sections have established a causal link between inflation as well as changes in solvency and branching regulation with the economic condition of the banking industry in US states. Though self-fulfilling prophecies provide the traditional argument to explain the fragility of financial intermediaries operating with fractional reserves, this result suggests that fundamental factors determine, at least in part, the probability of bankruptcies. Nevertheless, in particular in times of low confidence in the financial system, a self-reinforcing interrelationship between anxieties about imminent insolvency and exceptionally high withdrawals by nervous depositors or investors might exacerbate liquidity risks. The resulting inertia, where periods of relative stability and fragility in the banking system tend to follow each other, provides a possible interpretation for the recursively significant effect of contagion. Following Gorton (1988), the fraction of bank failures left unexplained by the econometric results reported in table 1 offers another of indication that speculation and self-fulfilling prophecies trigger actual bank failures.

Based on the coefficients of the baseline model of column 3 of table 1, the solid line of figure 2 represents the predicted number of bank failures whilst the bars show the corresponding actual development. To enable a comparison between the actual and fitted values, the sample has been restricted to the 1960 to 1999 period where available data cover all states.

Figure 2: Actual and Predicted Bank Failures in the US (1960 to 1999)



Furthermore, to control for unobserved heterogeneity across states calls for the estimation of fixed effects by solving (1) for δ_i and taking averages across states, that is

$$\widehat{\delta_i} = \ln(\overline{\#FAIL_i} - \alpha\overline{\#FAIL_{i,t-1}}) - \beta_0 - \overline{x_i'}\beta \tag{6}$$

By and large, predictions correctly replicate the relatively modest number of bank failures that occurred up to the year 1980. Conversely, with the outbreak of the Savings and Loan crisis, the predictive ability of the baseline model deteriorates. Possible explanations for this include not only the aggravated level of uncertainty about the future development of the banking industry in times of crisis, which inevitably reduces the explanatory power of the current set of determinants, but also the creation of the RTC in 1989, which might have helped to short-circuit the vicious cycles underlying this crisis. Yet, with a correlation coefficient of 0.79, the predicted and actual numbers of banks suspending operations exhibit a remarkably close relationship. Furthermore, for 1,338 observations, which represent about 66 percent of the sample, the correct number of failures has been predicted whereby the preponderance of zero-valued observations commonly found in count data account for a large proportion of this. When it comes to errors, the remaining 34 percent of observations encompass a total of about 2,000 wrongly predicted cases. The inclusion of a constant and state-specific fixed effects ascertains the unbiasedness of such prediction errors with almost equally distributed under- and overestimates. Nevertheless, against the actual number of 3,063 bank failures during the 1962 to 1999 period, the magnitude of this error appears to be considerable.

The dotted line at the bottom of figure 2 represents corresponding predictions when disregarding the impact of contagion, that is setting $\alpha = 0$ in (1). Adopting this scenario results in a dramatic loss in fit. In particular, when disregarding the effect of #FAIL$_{i,t-1}$, the baseline specification of column 3 of table 1 generates a modest and virtually constant number of failures, which even a the height of the Savings and Loan crisis do not exceed 10 cases per year. This manifests in a substantially lower correlation coefficient of 0.17 between the actual and predicted course of banks filing for bankruptcies. Still, for 1,251 observations, or about 61 percent of cases, the baseline model predicts the correct number of failures. By way of contrast, omitting the effect of contagion introduces a bias. In particular, for 556 observations, the predicted values underestimate the true extent of bank failures leaving in excess of 3,000 cases unexplained, whereas overestimation occurs for only 25 observations with the prediction error encompassing 46 failures. In sum, when it comes to economic significance, the clustered occurrence of bank failures in times of crisis appears to be primarily attributable to the effect of contagion. This is perhaps not surprising when the collapse of individual, and in particular large, banks wipes out liquidity and ignites an uncertainty-induced hysteria undermining the confidence in the proper working of the banking industry as such.

5 Conclusions

In a banking system with fractional reserves, abrupt withdrawals or withholdings of liquidity imperil the solvency of every bank. To confront the theories relating the fragility of banking with the emergence of adverse information about underlying changes in systemic risks, the quality of banking regulation, or merely in response to self-fulfilling prophecies and contagion, this paper has tried to establish inasmuch bank failures occurring in US states during the 1960 to 2006 period can be related with fundamental factors. Accounting for the potential endogeneity between determinants and the nonlinearities inherent in panel count data by the empirical approach of Blundell et al. (2002), results give rise to the following conclusions:

- Some fundamental factors systematically affect the distribution and development of bank failures in US states. Most of all, solvency regulation stipulating relatively low reserves and branching deregulation designed to lift the restrictions to establish, or invest, in new subsidiaries tend to undermine the stability of some banks in a statistically significant manner. Rather than being a pure self-fulfilling and speculative event, the probability of bank failures appears to increase with inadequate regulation.

- Bank failures tend to occur in clusters. The present empirical results indeed provide compelling evidence for the relevance of contagion—e.g. the failure of in particular big banks can undermines the confidence in the banking system and put previously solvent banks into a situation of sudden financial distress. The self-reinforcing effect of contagion introduces a non-linear relationship between fundamental forces and bank failures that ostensibly sustains persistent periods of crisis and relative stability in the banking system. Yet, this persistency appears to cover years rather than decades as past crises such as the Great Depression or the Savings and Loan crisis have affected vastly different states and the average number of bank failures between 1934 and 1959 explains little about the subsequent distribution of bankruptcies.

- There is no systematic empirical evidence that sources of systemic risk from adverse macroeconomic shocks in income and interest rates provide an explanation for the occurrence of banking crises (let alone individual bank failures). In particular, events on the interbank market appear not to be causally related to instability in the banking sector. However, modest increases in average prices appear to imperil banks to some degree, possibly by foreclosing the path to avert bankruptcy by inflating bad debt away.

- In spite of the empirical relevance of some of the fundamental factors, self-fulfilling prophecies, or speculation, continue to provide a valid explanation for many bank failures. Firstly, the effect of contagion might, at least in part, be attributable to vicious cycles involving nervous depositors and investors and banks exposed to financial distress when confronted with resulting decreases in liquidity. Secondly, self-fulfilling prophecies, which are inevitably unmeasurable, provide an obvious explanation as to why fundamental factors fail to explain a substantial proportion of actual bankruptcies.

- Fundamental factors affect commercial banks and the thrift industry in a different manner. In particular, mandatory reserves matter for the stability of savings associations but are not significantly related to failures of commercial banks. Furthermore, income growth and inflation matter for the solvency of commercial banks but less so for the thrift industry. Then again, for all types of financial intermediaries, the statistically and economically most important effects occur though contagion.

- As regards policy conclusions, present results suggest that tightening minimum reserve requirements provides the primary instrument to reduce the probability of bank failures. Furthermore, it appears to be vital to try to interrupt emerging effects of contagion as quickly and as early as possible to prevent that self-reinforcing feedbacks trigger a fully developed crisis with a pervasive number of bank failures.

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A Data Appendix

Table 3: Data definitions
This table summarizes the data set collected across US states and, unless otherwise stated, covers the years 1960 - 2006.

Variable	***Description***	***Source***
#FAIL	Number of bank failures per state and year with data covering the 1934 to 2006 period. Aggregate counts are further broken down according to (i.) state chartered commercial banks supervised by the Federal Reserve System or the Federal Deposit Insurance Corporation (FDIC), (ii.) state chartered saving banks supervised by the FDIC, (iii.) nationally chartered commercial banks supervised by the Office of the Comptroller of the Currency (OCC), and (iv.) state or nationally chartered savings associations supervised by the Office of Thrift Supervision (OTS). The lagged number of bank failures is referred to by $\#\text{FAIL}_{t-1}$ and $\overline{\#\text{FAIL}}_p$ designates the state average of bank failures during the 1934 to 1959 period.	Federal Deposit Insurance Corporation (FDIC).
BRANCHING DEREGULATION	Aggregate index designating states and years in which (i.) the establishment of multibank holding companies (MBHCs) (ii.) the acquisition of branches via mergers and acquisitions (iii.) the operation of a statewide network of branches, and (iv.) free interstate branching was permitted. Index scores are assigned values between 0 and 4 with higher values representing more deregulation. For some states, this data is not available after 1999.	Compiled and updated from Kroszner and Strahan (1999).
FEDERAL FUNDS	Effective federal funds rate which has been annualized using a 360-day year (or bank interest) and converted into real terms by subtracting the rate of inflation (see INFLATION).	Compiled from the Statistical Releases and Historical Data of the Federal Reserve System and US Bureau of Labor Statistics.
INCOME GRWOTH	Annual growth of per capita income per state deflated by the consumer price index of US cities (see INFLATION).	Compiled from US Department of Commerce and US Bureau of Labour Statistics.
INFLATION	Price increases as measured by the consumer price index in US cities with base year 1982 to 1984. Data on the national average of inflation cover the entire sample period whilst data on inflation rates across the US regions West, Midwest, South, and Northeast cover only the years after 1968.	US Bureau of Labor Statistics.
RESERVE RATIO	Fraction between required reserves in the Federal Reserve System and the amount of deposits in banks. The baseline data is constructed with the amount of deposits reported to the World Bank. Since 1973, the Federal Reserve System has reported the amount of reservable deposits and the total amount of (mandatory and excessive) reserves in the banking system providing alternatives to calculating the reserve ratio.	Compiled from the Statistical Releases and Historical Data of the Federal Reserve System and the World Bank's Database on Financial Development and Structure (Beck et al., 2000).

Table 4: Overview of Bank Failures

Period:	1934 to 2008	1934 to 1939	1982 to 1992	Sample Period 1960 to 2006				
	All Commercial Banks and Thrifts				Commercial Banks		Thrift Industry	
					State Charter	National Chart.	State Charter	National Charter
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Texas	898	16	836	875	257	371	0	247
California	221	0	171	219	69	31	0	119
Oklahoma	175	5	162	167	75	52	0	40
Louisiana	164	3	154	161	62	13	0	86
Illinois	161	12	120	143	28	15	0	100
Florida	126	1	109	124	30	17	0	77
Missouri	122	41	64	73	42	4	0	27
Kansas	111	7	93	102	63	9	0	30
New Jersey	105	31	59	66	8	7	3	48
New York	98	6	57	72	6	11	18	37
Colorado	93	1	81	92	38	30	0	24
Iowa	80	5	65	74	34	12	0	28
Tennessee	74	12	58	62	37	2	0	23
Pennsylvania	64	7	28	34	3	4	3	24
Massachusetts	58	2	49	56	18	5	24	9
Minnesota	58	4	51	53	31	7	1	14
Ohio	55	2	46	50	5	3	0	42
Nebraska	50	4	42	45	34	2	0	9
Indiana	48	15	28	28	6	4	0	18
Virginia	48	6	38	40	5	3	0	32
Connecticut	47	2	38	45	19	6	10	10
Kentucky	44	19	18	21	7	3	0	11
North Dakota	44	26	13	15	7	2	0	6
Arkansas	43	5	33	36	9	5	0	22
Georgia	43	6	26	33	8	0	0	25
Wisconsin	41	24	7	10	3	2	0	5
South Dakota	40	22	17	17	6	2	0	9
Mississippi	36	2	30	33	6	0	0	27
Michigan	33	6	15	25	11	1	0	13
Alabama	32	2	23	29	12	2	0	15
Oregon	31	0	27	29	17	0	0	12
Arizona	29	0	26	29	14	5	0	10
New Mexico	29	0	27	29	4	8	0	17
Wyoming	28	0	27	27	11	9	0	7
Maryland	26	4	20	21	2	0	0	19
North Carolina	22	4	12	15	1	1	0	13
Utah	22	0	20	22	12	1	0	9
New Hampshire	20	1	18	19	9	1	6	3
Montana	19	4	13	14	9	2	0	3
Washington	19	0	17	18	4	0	0	14
West Virginia	17	3	12	14	4	2	0	8
Alaska	13	0	12	13	6	2	0	5
South Carolina	13	1	9	11	2	1	0	8
Distr. of Columbia	8	0	6	8	0	5	0	3
Hawaii	6	0	3	6	2	2	0	2
Idaho	6	0	4	4	1	0	0	3
Maine	6	0	5	5	0	1	1	3
Rhode Island	6	0	4	6	1	0	1	4
Vermont	5	1	1	2	1	1	0	0
Nevada	4	0	4	4	1	0	0	3
Delaware	2	0	1	2	2	0	0	0
Total	3543	312	2799	3028	157	862	68	647