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Entry, Exit and Growth of US Commercial Banks

By *John Goddard, Hong Liu and John O.S. Wilson*

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Keywords: Acquisition, Commercial Banks, Community Banks, Entry, Failure, Gibrat's Law, Mergers, Sample selection models

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1. **Introduction**

Deregulation and technological and financial innovation have transformed the banking industry. In the US, the geographic and product market regulations that constrained the scale and scope of commercial banks have been removed and barriers to entry in many markets have been reduced or eliminated. Opportunities for growth have been created for new entrants and established banks, which many have realized via organic diversification or acquisition. Banks that have grown quickly have become less like traditional community banks (which rely on soft information), and use a high output, low cost business models that relies on scale economies, and automated production and distribution processes to deliver standardized products and services (DeYoung, 2014).[1] These changes have impacted profoundly upon the structure of the US banking industry. There has been large scale consolidation through merger and acquisition, and through bank failure. A significant number of new banks have entered the industry, but not on a scale sufficient to offset the decline in bank numbers through consolidation.

An understanding of the underlying mechanisms that determine the structure of the banking industry is relevant for small firm financing and investment, anti-trust policy, financial regulation and supervision, and financial stability (Cettorelli and Gambera, 2001; Gilbert and Zaretsky, 2003; Avery and Samolyk, 2004; Beck, Demirguc-Kunt and Levine, 2006). This paper presents an empirical analysis of the evolution of industry structure for commercial banks in the United States (US) during the period 1984-2012. The investigation follows similar procedures to a study of the corporate demography of the US credit union industry reported by Goddard, McKillop and Wilson (2014). The investigation is focused

[1] Berger, Kashyap and Scalise (1995), Jones and Critchfield (2005), Federal Deposit Insurance Corporation (2012) and DeYoung (2014) describe various aspects of the evolution of the US banking industry.

particularly on the impact of merger and acquisition (M&A), failure, entry, and internally generated growth on industry structure. Specific research questions include the following: What is the relationship between bank size and the propensity of banks to fail, or to be acquired? What is the relationship between bank size and growth? Do small and large banks grow differently?

The data used in the present study are of exceptionally high quality, providing virtually 100% coverage of the US commercial banking industry, over a 29-year period. We are able to track attrition in the population to a very high level of accuracy. The econometric analysis includes an estimation of hazard functions for the determinants of exit through acquisition or failure; and a series of cross-sectional estimations of the relationship between bank size and internally generated growth, which control for survivorship effects.

The main findings are as follows. The hazard of disappearance via acquisition is inversely related to asset size and quality, profitability, managerial efficiency, and positively related to bank capitalisation and liquidity. Small banks, banks with a larger proportion of assets in lending activities, and banks with high credit risk, are more likely to fail. Poorly capitalized banks and banks with high liquidity are at a greater hazard of disappearance via failure. There is evidence of an inverse relationship between bank size and growth, and there is some evidence of persistence in the growth performance of smaller banks over consecutive years.

The rest of the paper is structured as follows. Section 2 provides a brief review of relevant literature. In section 3 we present the data set to be used in the empirical analysis and provide a descriptive analysis of demographic changes in the US banking industry during our sample period. Section 4 provides an analysis of the determinants of exit through M&A and failure, and discusses the impact of this consolidation on industry structure. Section 5

investigates the relationship between bank size and growth using a framework which mitigates against any sample selection bias. Finally, Section 6 concludes.

2. Literature

"*Why are some industries dominated worldwide by a handful of firms? Why is the size distribution of firms within most industries highly skewed? Questions of this kind have attracted continued interest among economists for over half a century. One reason for this continuing interest in 'market structure' is that this is one of the few areas in economics where we encounter strong and sharp empirical regularities arising over a wide cross-section of industries"* (Sutton, 2007, p.1557).

It is well known that empirical firm size distributions in many industries are approximated closely by certain skewed distributions, such as the lognormal. A stochastic model in which the logarithmic size of each firm is subjected to a sequence of purely random shocks over time tends to generate a skewed distribution of this type. The hypothesis that the growth of each firm in each period is random (in other words, independent of observable characteristics of the firm including size or past growth) was first developed by Gibrat (1931). According to Gibrat's law, growth is unrelated to size, and all firms have identical probabilities of achieving any given rate of growth in any period. Over time, however, some firms are 'lucky' and tend to draw an above-average share of high growth, while others are 'unlucky' and tend to grow slowly or decline. If growth is in accordance with Gibrat's law, industry concentration tends to increase naturally over time, and the firm size distribution becomes increasingly skewed. Three testable propositions are derived from Gibrat's law: growth is independent of firm size; the growth of any individual

firm is non-persistent from one period to the next; and the cross-sectional variance of growth is independent of size.

In the empirical banking literature, tests of Gibrat's law have a long tradition. Alhadeff and Alhadeff (1964) report that small US banks grew faster on average than large banks over the period 1930 to 1960. Using 1960s and early-1970s data for the US, Rhoades and Yeats (1974) and Yeats, Irons and Rhoades (1975) also report evidence of an inverse size-growth relationship. European studies by Wilson and Williams (2000) and Hameeteman and Scholtens (2000) based on 1990s data, and an international study by Tschoegl (1983) based on 1970s data, find little or no evidence of any relationship between size and growth. Goddard, Molyneux and Wilson (2004) examine the growth of banks in Denmark, France, Germany, Italy, Spain and the UK for the period 1992-96. Larger commercial banks grew faster on average than smaller banks. High capitalization and x-inefficiency acted as a restraint on growth. Benito (2008) examines the size and growth of Spanish banks during the period 1970-2006. The size-growth relationship varies over time. Small banks grew faster than large banks during periods of tight regulation, and *vice versa* during periods of deregulation. Shehzad, De Haan, and Scholtens (2013) examine cross-country data for the period 1997-2007. Large banks grew more slowly than small banks on average, and there was no persistence of growth.

Much of the previous empirical literature reports a tendency for smaller banks grow faster than their larger counterparts; but it has been suggested that a negative size-growth relationship might, at least in part, be an artifact of the way in which the empirical tests are constructed. Survivorship bias might be responsible for a negative reported size-growth relationship in studies based on data for banks that survived over a given observation period. Several of the earliest US manufacturing studies acknowledged that the validity of

Gibrat's law might be limited to firms operating above a certain size threshold, or minimum efficient scale (e.g. Simon and Bonini, 1958). The survival of small banks may hinge on their ability to achieve at least the MES, so that they can realize the benefits of economies of scale: small banks that grow slowly and fail to achieve the MES are likely to exit. A sample of surviving banks might register relatively high average growth at the lower end of the size distribution, owing to the non-recording of slow-growth non-survivors.

Over time, a pattern of growth that is independent of firm size generates a positively skewed firm size distribution. If growth rates are normally distributed, a lognormal firm size distribution emerges over the long run. This tendency might be modified, however, by changes to the population of firms resulting from entry, or exit through merger and acquisition (M&A) or failure. The rest of this section reviews the previous banking industry literature on entry and exit.

Empirical evidence on the determinants of entry to the banking industry is limited. Hannan (1983) examines the relationship between market characteristics and entry using bank data for Pennsylvania for 1968-70. Entry is explained by a vector of market structure variables, and in general is deterred in markets when incumbents charge low prices and invest in expanding branch networks. This suggests that limit pricing and increasing capacity are important entry-deterring strategies. Rhoades (1980) reports that net entry (entry *minus* exits) played a limited role in increasing rivalry in local US banking markets during the period 1968-74. More recent research suggests that investment in branch networks, advertising, and consumer switching costs all constitute barriers to effective competition with established counterparts (Dick, 2007; DeYoung and Ors, 2004). For newly chartered US banks during the period 1980-85, Berger and Dick (2007) examine 10,000 cases of entry into local banking markets over the period 1972–2002. Early entry often translated into a

longstanding market share advantage over later entrants, through investment in branch networks. Jeon and Miller (2007) examine the evolution of the population of US banks over the period 1978-2004. Although many small banks entered, only a small minority survived. States with a more permissive regulatory environment experienced higher rates of entry and M&A, but there was no relationship between the regulatory environment and the rate of failure.

Consolidation through M&A has contributed significantly to reductions in the number of banks in the US and elsewhere (Berger, Kashyap and Scalise, 1995; Berger, Demsetz and Strahan, 1999; Amel, Barnes, Panetta and Salleo, 2004). Corporate finance theory identifies the synergy, hubris and agency motives for M&A. Much empirical evidence on the motives for bank merger highlights the importance of the synergy motive (Rhoades, 1998; Wheelock and Wilson, 2000, 2004; Focarelli, Panetta and Salleo, 2002). Banks with low earnings, low capital-to-assets ratios, high local market share, or which operate in urban areas, are more likely to be acquired (Hannan and Rhoades, 1987; Amel and Rhoades, 1989; Hannan and Piloff, 2009; DeYoung, Evanoff and Molyneux, 2009; Adams, 2012).

Bank-specific, regulatory and regional economic conditions are identified as determinants of bank failure (Wheelock and Wilson, 1995, 2000; Kolari, Glennon, Shin and Caputo, 2002; King, Nuxoll and Yeager, 2005; Demyanyk and Hasan, 2010; Cole and White, 2012). Some recent studies suggest that corporate governance and involvement in non-traditional lines of business are also important in explaining bank failure (Berger, Imbievowic and Rauch, 2012; DeYoung and Torna, 2013).

3. Data and descriptive analysis

Data

We obtain fourth-quarter data from 1984 to 2012 on private and public commercial banks in the US from the Reports on Condition and Income ("Call Reports") submitted by insured banks to the Federal Reserve. In 1984 there was a major overhaul of the Call Report format, requiring banks to report more detailed balance sheet data. Pre-1984 data are not considered in this study. Following previous researchers, we study only commercial banks and exclude savings banks, savings and loan associations, credit unions, investment banks, mutual banks, and credit card banks (Berger, Bonime, Goldberg and White, 2004). We use bank-level data and treat each individually chartered bank as a separate entity.

The information on bank failure and M&A is obtained from the inactive bank data provided by FDIC. The FDIC list all banks that closed owing to failure, M&A and change of charter, among other causes of closure, and provide a structural change coding for the reason for closure, the date of closure, and the new FDIC certificate number following acquisition in cases of closure owing to M&A. This source lists 16,736 banks that closed between 1984 and 2012.[2] Of these, the data are incomplete for 268 closures. Prior to the end of 2012, a further 55 banks ceased filing Call Reports for reasons that we are unable to identify after having manually checked the Call Report and FDIC data against data held by the National Information Center. Banks with missing Call Reports are omitted from the analysis. Attrition is tracked, and a cause of disappearance is identified for 98.9% of all exits.

[2] The data provided by FDIC does not include bank acquisitions by holding companies unless the acquired bank is merged with another bank or banks within the holding company.

The acquiring bank is identified for all banks that exited as a result of M&A. M&A accounts for 80.6% of all bank exits.

Demographic change in the US banking industry

Table 1 reports the total number of US commercial banks at the end of December for the period 1984-2012, and an analysis of the evolution of the distribution of the population by asset size. Following the FDIC classification, the population is subdivided into four asset size classes in each year, defined in real terms (2012 prices based on the US GDP deflator) as follows: Band 1, total assets below $100 million; Band 2, total assets between $100 million and $1 billion; Band 3, total assets between $1 billion and $10 billion; and Band 4, total assets above $10billion.

The number of US commercial banks declined from 14,410 in 1984 to 6,082 in 2012. There was a marked shift in the composition of the population by asset size, owing to a combination of consolidation through acquisition and failure, and differences between the average internally-generated growth rates of small and large commercial banks. In 1984, for example, banks with assets below $100 million accounted for 65.2% of the population, while banks with assets between $100 million and $1 billion accounted for 31.6%. For 2012 the corresponding figures are 32.7% and 58.7%, respectively. The proportion of banks with assets above $10 billion increased from 0.4% in 1984 to 1.4% in 2012. The share of industry assets accounted for by banks with assets above $10 billion increased from 44.5% in 1984 to almost 80% in 2012.

Table 2 reports a further analysis of the dynamics of change in the asset size distribution, in the form of a set of empirical yearly rates of transition between each size band and adjacent bands, and the exit rate from each size band. There is a high degree of

stability in the asset size distribution from year to year. The propensity to remain within the same size band is relatively stable across the bands: on average, around 90% of the banks in each band remain in the same band the following year.

We also distinguish between exit by M&A and by failure. The rate of exit through M&A is significantly higher than the rate of exit through failure for all size bands. The rate of M&A was particularly high during the period from 1995-2000, owing mainly to unusual patterns of consolidation following the passage of the Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994, which removed the prohibition of inter-state branch banking; and the Gramm-Leach-Bliley Financial Services Modernization Act of 1999, which removed the prohibition of commercial banks from transacting other financial services including investment banking and insurance.

Table 3 reports an analysis of changes in the population of banks through entry and exit. The decline in the number of banks from 1984 to 2010 reflects the net effect on the population size of entry (4,219 banks) and exit (12,597 banks). M&A accounted for 10,308 out of the 12,597 banks that exited (81.8% of the total.)[3] The exit rate was quite stable (between 3% and 5% per year throughout the observation period) and does not appear to be sensitive to the economic cycle.[4]

The FDIC uses three basic resolution methods for bank failures: purchase and assumption (P&A) transactions, deposit payoff, and open bank assistance (OBA) transactions. P&A was the resolution method in almost 70% of the 2,289 bank failures during the observation period, with just over 20% of failures resolved by deposit payoff, and

[3] This figure is consistent with Wheelock and Wilson (2000). Since 1984 the number of acquisitions has exceeded the number of failures roughly four-fold.

[4] The lowest rate of exit is reported for 2012; however, these data may be subject to revision for banks that were in the process of M&A or liquidation, but had still reported data at year-end 2012.

around 10% by OBA.[5] Following restrictions imposed under the Federal Deposit Insurance Corporation Improvement Act (FDICIA) of 1991 and the Resolution Trust Corporation Completion Act of 1993, OBA is no longer a commonly used resolution method.

Figure 1 presents a trend analysis in industry concentration for the period 1984-2012. Panel A plots the 5-, 10-, and 20-bank concentration ratios, and Panel B plots the Herfindahl-Hirshman Index (HHI). Consistent with the patterns reported in Table 1, Panel A indicates a trend toward increased concentration that has been remarkably steady and consistent over time. Panel B provides an indication of the contribution of consolidation through M&A to the trend in concentration, in the form of a "counterfactual" HHI based on hypothetical population data. For the purposes of calculating the counterfactual HHI, each acquired commercial bank is assumed to have continued to operate as a separate entity to the end of 2012. A proportion of the combined assets of the acquirer at each data-point after the merger took place are reallocated to the (counterfactually surviving) acquired bank. The assumed proportion is calculated from the observed asset sizes of the acquirer and the acquired at the data point immediately preceding the merger.

The trend in the actual HHI and counterfactual HHI is similar until 2006. From 2007, the counterfactual HHI decreases, while the actual HHI continues to increase, reaching a peak of 558 in 2010 before declining subsequently. The disparity between the actual and counterfactual HHI in 2012 indicates that M&A accounts for most of the increase in industry concentration since 1984, as measured by the HHI.

[5] The FDIC insurance limit increased deposit insurance coverage from $100,000 to $250,000 following the financial crisis of 2008. This increase was made permanent by the Dodd-Frank Act.

4. Empirical analysis of exit through M&A or failure

This section reports an investigation of the determinants of US commercial bank disappearance through M&A or failure during the period 1984-2012. Following Wheelock and Wilson (2000), we use a competing-risks model to consider explicitly the joint determination of the probability of being acquired and of failing. We use a Cox (1972) proportional-hazard models with time-varying covariates to examine the exit of banks. We estimate separate independent hazards for failure and acquisition. In the failure hazard estimation, the data for acquired banks are treated as right-censored; similarly, in the acquisition hazard estimation, the data for banks that failed are treated as right-censored. Observations on banks that exited for reasons other than acquisition or failure are treated as right-censored in both estimations.

The hazard function expressing the probability that bank i disappears through event k between time t and time t+1, conditional on a vector of covariates specific to bank at time t that influence the probability of event k, denoted $x_{i,k}(t)$, is modelled as follows:

$$\lambda_{k,i}(t \mid x_{k,i}(t), \beta_k) = \bar{\lambda}_k(t)\exp(x_{k,i}(t)'\beta_k) \qquad (1)$$

$\bar{\lambda}_k(t)$ denotes the baseline hazard, and β_k is a vector of coefficients to be estimated. The time-index t is measured in calendar time elapsed since the first observation, for December 1984. The estimation uses data only for those banks that were in existence in December 1984; the data for post-1984 entrants is not considered. Accordingly, calendar time and duration until disappearance are equivalent for all observations used in the estimation. We let R_t denote the set of banks that are in existence at time t and at risk of disappearance between t and t+1, and we let $D_{k,t}$ denote the set of $d_{k,t}$ banks that disappear through event

k between time t and time t+1. The contribution to the partial likelihood function of bank i, which disappears through event k between t and t+1, is:

$$\exp(x_{k,i}(t)'\beta_k) / \sum_{j \in R_t} \exp(x_{k,j}(t)'\beta_k)$$

$\bar{\lambda}_k(t)$ drops out when the partial likelihood function is formed. Therefore $\bar{\lambda}_k(t)$ is not parameterized explicitly, and the proportional hazards model is described as semi-parametric. The log-partial likelihood function is:

$$\ln[L(\beta_k)] = \sum_{t=1}^{T}[\sum_{i \in D_{k,t}} x_{k,i}(t)'\beta_k - d_{k,t} \ln\{\sum_{j \in R_t} \exp(x_{k,j}(t)'\beta_k)\}] \quad (2)$$

The hazard function covariates are: Log total assets (t-1); Growth rate (t-1); Equity/assets (t-1); Liquid assets/assets (t-1); Diversification (t-1); Loans/assets (t-1); Nonperforming loans/assets (t-1); ROA (t-1); and Noninterest expense/assets (t-1).

Table 4 reports summary statistics for the variables used in the hazard function estimations. All variables, except size and age, are winsorized at 1% level to remove the influence of outliers. The average equity-to-assets ratio has increased steadily, from 8.88% in 1984 to 11.09% in 2012. By contrast, the average liquid assets-to-total assets ratio shows no consistent trend, and has fluctuated around an average value of just over 15%. The average proportion of non-interest income to total operating income has increased steadily, from 6.35% in 1984 to 14.03% in 2012. Profitability measured by return on assets (ROA) was depressed during the late-1980s banking crisis, and again during the 2007-2009 financial crisis. In general loans account for around 60% of total assets; recently this ratio has declined as banks have reduced lending following the financial crisis. The ratio of non-performing loans-to-assets has decreased over time, while the ratio of non-interest expenses to total assets shows no consistent trend.

Table 5 reports the empirical hazard function estimation results. The M&A hazard function is based on 9,472 cases of acquisition, and the failure hazard function is based on 1,858 failures. Estimated hazard function coefficients, rather than hazard ratios, are reported.

Hazard of disappearance via M&A

Within each asset size band, larger banks are less likely to be acquired than their smaller counterparts. This finding is consistent with the received wisdom that smaller banks are more suitable takeover targets because they are more easily integrated into an acquirer's operations. Furthermore, small bank acquisitions are less likely to attract the attention of the anti-trust authorities.

The impact of recent growth on the hazard of acquisition varies across the size bands. For banks in Band 1, rapid recent growth reduces the likelihood of being acquired; while for banks in Band 3, rapid recent growth increases the likelihood of being acquired. The results suggest that the criteria for the selection of targets may vary with the size of the acquisition. If the target is a small bank slow growth may be attractive, if the acquirer is able to envisage opportunities for increasing the target's growth by absorbing the target into its own corporate identity and organizational culture (Moore, 1996; Pasiouras, Tanna, Gaganis, 2007). By contrast, if the target is relatively large and the acquirer plans for the target to retain its own corporate identity and organizational culture, a past record of rapid growth may be an attractive criterion for selection, since the acquirer may prefer a target that can demonstrate an independent capability for sustaining growth (Hannan and Rhoades ,1987).

We find that age is associated negatively with the likelihood of being acquired for banks in Band 1 and Band 2. However, age is associated positively with the hazard of acquisition for banks in Band 3.

Highly capitalized banks are less likely to be acquired. This result is consistent with Hannan and Piloff (2009) who contend that high capitalization indicates limited scope for post-merger efficiency gains. Wheelock and Wilson (2000) suggest that skilful managers might be able to operate banks safely with little capital, and such banks might be highly profitable or desirable takeover candidates.

Diversified banks are less attractive acquisition targets than their more focused counterparts. Small banks with low loans-to-assets ratios are more likely to be acquired, perhaps because acquirers envisage that there is potential to improve returns by increasing the proportion of loans within a larger and therefore more highly diversified merged assets portfolio. Banks with a higher non-performing loans ratio are more likely to be acquired in all asset size bands except Band 4. These results are consistent with previous evidence suggesting that a high-risk assets portfolio increases the probability of a bank being acquired (Wheelock and Wilson, 2000).

Profitability (ROA) is associated positively with the hazard of acquisition for banks in Bands 1 and 2, but not for banks in the larger size bands. This result is inconsistent with previous studies (Wheelock and Wilson, 2000; Hannan and Piloff, 2009) that suggest a negative relationship between profitability and the likelihood of acquisition, usually justified by the hypothesis that poorly managed banks are likely targets for acquirers who believe they can increase the efficiency of the target, and consequently profit and shareholder value. However, if profitability primarily reflects local market trading conditions, rather than

managerial performance, then acquirers may be more likely to seek targets in markets with profitable trading opportunities (Hannan and Rhoades, 1987; Focarelli and Pozzolo, 2005).

The ratio of non-interest expenses to total assets, interpreted as a managerial inefficiency measure, is positively and significantly associated with the hazard of acquisition for all four asset size bands, suggesting that inefficiently managed banks are more vulnerable to acquisition. This finding is consistent with results reported by Hannan and Pilloff (2009), but contrary to those of Wheelock and Wilson (2000). There is an inverse relationship between liquidity and the hazard of acquisition for the smallest banks (Band 1); but the direction of association is reversed for larger banks (Bands 2 to 4). GDP growth and inflation are positively and significantly associated with the hazard of acquisition for banks in all size bands, reflecting a tendency for the rate of M&A to increase when economic conditions are buoyant.

Overall, the results indicate that smaller banks, poorly capitalized banks, highly specialized banks, and banks with higher credit risk, are more likely to be acquired. Several other factors impact on the hazard of acquisition in a manner that varies with bank size.

Hazard of Disappearance via Failure

The impact of bank size within each asset size band on the likelihood of failure varies across the size bands. Among the smallest banks in Band 1, the larger banks are more likely to fail, while the smaller banks within Band 2 are more likely to fail. Bank size is not a significant determinant of the hazard of failure for banks within Bands 3 and 4. Overall it appears that banks which are located towards the upper end of asset size Band 1 or the lower end of Band 2 have the highest likelihood of failure. Recent growth of assets is negatively and significantly associated with the hazard of failure for banks in Band 1, but not

for banks in the other asset size bands. For relatively small banks (Bands 1 and 2), younger banks are more likely to fail than their older counterparts. No relationship is evident between age and the hazard of failure for large banks in Bands 3 and 4. Poorly capitalized banks are found to be more likely to fail, consistent with previous research (Berger, Herring and Szego, 1995; Kim and Kross, 1998, Beltratti and Stulz, 2012).

The extent of diversification is positively and significantly associated with the likelihood of failure for the smallest banks (Band 1), but not for banks in the other size bands. This suggests that for the smallest banks the safest strategy is to focus on traditional intermediation (deposit-taking and lending) business, rather than diversify into non-interest income lines of business.[6]

With the exception of banks in the largest size band, banks with larger loans-to-asset ratios are more likely to fail. This finding is consistent with previous research reporting that a higher concentration of bank assets in loans implies a higher likelihood of failure (Wheelock and Wilson, 2000). A high non-performing loans ratio is positively and significantly associated with the hazard of failure for all but the largest banks in Band 4. Unsurprisingly, the hazard of failure is negatively related to ROA for banks in all size bands. There is no association between the ratio of non-interest expenses to assets, again interpreted as a measure of managerial inefficiency, and the hazard of failure. Banks in Bands 2 and 3 with a higher proportion of liquid assets face a higher hazard of failure hazard, but the same does not apply to banks in Bands 1 and 4. Although a bank with a high

[6] DeYoung and Torna (2013) analyse data on US banks during the period 2008-2010. Banks that diversified into pure fees-based non-traditional lines of business, such as securities brokerage and insurance sales, generated stable revenue and experienced a lower likelihood of failure. However, large banks may also engage with asset-based non-traditional lines of business such as venture capital, investment banking and asset securitization, which may increase the probability of failure. Overall, the impact of diversification on the hazard of failure is approximately neutral.

proportion of liquid assets may be better able to survive a liquidity shock, maintaining excessive liquidity could indicate mismanagement of the assets portfolio and a failure to pursue profitable investment opportunities.

Overall, the results indicate that poorly capitalized banks, banks with high loans-to-asset ratios, banks with high credit risk, and banks with low profitability, are more likely to fail. The impact of the other factors on the hazard of failure varies across the assets size bands.[7]

5. Heckman sample selection modified test of Gibrat's law

In this section, we report tests for the validity of Gibrat's law, based on cross-sectional regressions using the following general model specification:

$$(S_{i,t} - S_{i,t-1}) = \emptyset_{0,i,t} + \emptyset_{1,i,t} S_{i,t-1} + \emptyset_{2,i,t}(S_{i,t-1} - S_{i,t-2}) + \emptyset_{3,i,t} t + u_{i,t} \quad (3)$$

In Equation (3), logarithmic growth over a one-year period is the dependent variable, where $S_{i,t}$ is the logarithm of total assets of bank *i* at time t, and log size at the start of the period and growth over previous one-year period are the explanatory variables. Following Goddard, McKillop and Wilson (2014) we assume that the coefficients are the same for all bank *i* but variable over time, so that $\emptyset_{1,i,t} = \beta_{1,t}$ for all *i*. A series of cross-sectional regressions (for each t=1,….T) is defined as follows:

$$(S_{i,t} - S_{i,t-1}) = \beta_{0,t} + \beta_{1,t} S_{i,t-1} + \beta_{2,t}(S_{i,t-1} - S_{i,t-2}) + u_{i,t} \quad (4)$$

Each regression in Equation (4) has $i = 1,\ldots..N_t$ observations (where N_t is the number of banks live in year t). The focus is on the cross-sectional size-growth relationship, which might be

[7] For example, smaller and younger banks that transact excessively in non-interest income lines of business are more likely to fail. However, the same does not apply to the failure hazard of large banks.

either positive ($\beta_{1,t}$> 0), neutral ($\beta_{1,t}$= 0), or negative ($\beta_{1,t}$< 0). The case $\beta_{1,t}$= 0 represents Gibrat's law.

The cross-sectional size-growth regressions are modified using the Heckman (1979) sample-selection correction, to mitigate possible survivorship bias. As argued above, an inverse empirical size-growth relationship may be a manifestation of survivorship bias. Small banks are less likely to survive than large banks, but fast-growing small banks are likelier to survive than slow-growing ones. As a consequence, estimations based on data on banks that survived over a given period are subject to a form of survivorship bias, because banks that failed to achieve rapid growth and exited were not recorded. The sample-selection model comprises Equation (4) and the following survivorship regression observed for all banks live at t–1:

$$z_{i,t}^{*} = \gamma_{0,t} + \gamma_{1,t} s_{i,t-1} + \gamma_{2,t}\left(s_{i,t-1} - s_{i,t-2}\right) + \gamma_{3,t} x_{i,t-1} + \varepsilon_{i,t} \qquad (5)$$

We let the binary variable $z_{i,t}$=1 denote survival between t–1 and t, and $z_{i,t}$=0 denote non-survival. Then $z_{i,t} = 1$ if $z_{i,t}^{*} + \varepsilon_{i,t} > 0$; and $z_{i,t} = 0$ if $z_{i,t}^{*} + \varepsilon_{i,t} < 0$, where $\gamma_{3,t}$ is a vector of coefficients and $x_{i,t-1}$ is a vector of covariates defined as follows: Log total assets; Growth rate; Equity/assets; Liquid assets/assets; Diversification; Loans/assets; Nonperforming loans/assets; ROA; and Noninterest expense/assets. Equation (4) is observed only for which $z_{i,t} = 1$ in Equation (5). The disturbances $u_{i,t}$ in Equation (4) and $\varepsilon_{i,t}$ in Equation (5) are assumed to be bivariate normal, with var($\varepsilon_{i,t}$) = 1, var($u_{i,t}$) = $\sigma_{u,t}^{2}$, corr($\varepsilon_{i,t}$, $u_{i,t}$) = $\rho_{\varepsilon u,t}$.

Table 6 reports the estimation results for the cross-sectional sample-selection growth model (Equation 4). A separate set of estimations is reported for growth rates defined over each yearly interval for the period 1984 to 2012 inclusive, for banks within each of the four size bands. The estimated β_1 (coefficients on initial bank size) are negative

in every case, and predominantly significant, indicating that small banks within each size band tended to grow faster than their larger counterparts. The estimated β_1 vary quite widely in magnitude across the size bands. The estimated β_1 for Band 1 are mostly below 0.05 in absolute magnitude. Most of the estimated β_1 for Band 2 fall between 0.05 and 0.10 in absolute magnitude, except towards the end of the observation period when these values drop below 0.05. Overall, the deviation from Gibrat's law for small banks (smaller than $1 billion) is rather trivial. For Bands 3 and 4 the estimated values of β_1 are much larger in absolute value, and the departure from Gibrat's law is more pronounced. For all of the size bands, there is a tendency for β_1 to decline in absolute magnitude over the observation period.

The estimated β_2 (coefficients on lagged growth) are positive in most cases, and predominantly significant for Bands 1 and 2. For Bands 3 and 4 there is a mix of significant and non-significant estimated coefficients. A significant estimated β_2 implies that strong growth performance in one period carries over into the following period (Tschoegl, 1983).

The estimates of the correlation coefficient (λ) between the stochastic components of the survivorship and growth regressions are varied in sign. A positive λ indicates a positive correlation between the non-systematic components of the equations for growth and the probability of survival; while a negative λ indicates a negative correlation. There is a preponderance of negative estimated lambda during the late 1980s and early 1990s, and again following the financial crisis of the late 2000s.

6. Final Thoughts

An understanding of the mechanisms that determine the structure of the banking industry is of crucial importance for small firm financing and investment, anti-trust policy, financial regulation and supervision, and financial stability. This paper attempts to shed light on these issues, by means of an exploration of the entry, exit and growth of commercial banks in the United States during the period 1984-2012.

The number of commercial banks has fallen steadily throughout this period, and there has been a marked shift in the composition of the population of banks by asset size, brought about by a combination of consolidation via acquisition and failure, and differences between the average internally-generated growth of small and large banks. Merger and acquisition accounts for most of the increase in industry concentration since 1984, as measured by the HHI.

Bank exit via acquisition is inversely related to asset size and quality, profitability, efficiency, capitalization and liquidity. Small banks with a higher proportion of assets committed to lending, and small banks with high credit risk, are more likely to fail. Poorly capitalized and highly liquid banks are at a greater hazard of disappearance via failure. We report evidence of an inverse relationship between bank size and growth, and persistence in growth performance from one year to the next among smaller banks.

The evolution of industry structure for commercial banking in the United States is undoubtedly a complex phenomenon. Forces that are currently generating further change in industry structure include technological progress, and re-regulation following the financial crisis. Further research aimed at examining the effects of such forces on the firm-size distribution will provide useful insights into the future evolution of industry structure.

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Table 1 Trends in the size distribution and market share of the population of US commercial banks, 1984-2012

Year	Number of banks					Total assets				Market share by assets			
	Total Number of banks	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	1	2	3	4
1984	14410	9,388	4,549	413	60	23.5	122.7	1460.2	18468.3	8.88	22.41	24.22	44.50
1985	14326	9,212	4,615	430	69	24.4	128.3	1522.2	17952.5	8.31	21.84	24.15	45.70
1986	14127	8,894	4,719	438	76	25.4	133.7	1609.8	17840.5	7.75	21.62	24.16	46.46
1987	13634	8,570	4,542	445	77	26.1	136.2	1678.8	18030.1	7.51	20.78	25.09	46.62
1988	13067	8,146	4,401	437	83	27.1	143.3	1798.3	17757.2	7.10	20.27	25.26	47.37
1989	12655	7,770	4,359	437	89	28.2	150.5	1840.0	17683.4	6.74	20.17	24.72	48.38
1990	12290	7,458	4,315	429	88	29.8	157.3	1945.7	18301.9	6.64	20.28	24.95	48.13
1991	11868	7,094	4,254	434	86	31.1	161.1	1999.3	18876.5	6.49	20.18	25.54	47.79
1992	11418	6,665	4,229	442	82	32.5	163.9	1992.3	20359.1	6.26	20.03	25.45	48.25
1993	10934	6,252	4,170	422	90	33.6	166.5	2061.3	21003.6	5.74	18.95	23.73	51.58
1994	10432	5,870	4,033	434	95	34.4	170.0	2123.3	22874.0	5.08	17.22	23.14	54.56
1995	9918	5,379	3,997	438	104	35.6	176.2	2096.7	23709.9	4.47	16.45	21.46	57.62
1996	9515	5,049	3,952	414	100	36.3	181.4	2094.4	27725.5	4.04	15.79	19.10	61.07
1997	9128	4,804	3,837	401	86	37.2	186.3	2087.3	37681.6	3.60	14.38	16.84	65.19
1998	8764	4,421	3,859	395	89	38.1	190.7	2140.1	41016.5	3.12	13.63	15.65	67.60
1999	8571	4,260	3,817	407	87	38.8	196.2	2218.1	44375.4	2.91	13.19	15.90	68.00
2000	8301	4,040	3,779	387	95	40.1	203.6	2187.5	46299.4	2.62	12.46	13.71	71.21
2001	8068	3,730	3,859	384	95	41.7	211.4	2199.6	49114.1	2.40	12.59	13.03	71.98
2002	7874	3,466	3,914	397	97	43.0	217.7	2167.6	53082.8	2.13	12.15	12.27	73.45
2003	7753	3,282	3,957	418	96	44.0	223.6	2175.4	58153.8	1.92	11.76	12.09	74.23
2004	7613	3,145	3,947	423	98	45.4	234.9	2169.8	64539.0	1.72	11.15	11.04	76.09
2005	7506	3,044	3,934	432	96	46.6	250.2	2321.1	70932.7	1.59	11.01	11.22	76.19
2006	7458	2,986	3,925	454	93	47.1	259.4	2354.7	83522.8	1.41	10.19	10.70	77.71
2007	7336	2,877	3,908	464	87	48.6	267.5	2436.8	100384.0	1.27	9.46	10.23	79.04
2008	7130	2,658	3,917	466	89	51.1	274.4	2442.7	109504.2	1.12	8.89	9.41	80.58
2009	6884	2,444	3,895	456	89	52.8	280.0	2428.9	104862.4	1.11	9.35	9.50	80.04
2010	6572	2,272	3,771	443	86	53.8	277.2	2480.6	111640.7	1.03	8.81	9.26	80.90
2011	6330	2,148	3,661	435	86	55.6	286.1	2502.5	100643.0	1.09	9.60	9.98	79.33
2012	6119	2,001	3,591	441	86	57.2	294.8	2636.5	107432.9	0.99	9.14	10.05	79.82
Average		4911	3924	414	85	37.7	194.9	2039.1	48125.7	3.97	14.96	17.30	63.77

Notes:
Asset size bands s are defined in real terms, measured in 2012 prices, as follows:
Band 1, assets below $100 million;
Band 2, assets between $100m and $1bn;
Band 3, assets between $1bn and $10bn;
Band 4, assets above $10bn. All price conversions are based on the US GDP deflator.

TABLE 2 Yearly rates of transition between asset size classes, 1984-2011

Year	1			2				3				4		
	2	M&A	Failure	1	3	M&A	Failure	2	4	M&A	Failure	3	M&A	Failure
1984	0.035	0.018	0.013	0.024	0.009	0.029	0.004	0.031	0.022	0.024	0.002	0.000	0.000	0.000
1985	0.041	0.019	0.014	0.025	0.009	0.026	0.007	0.023	0.019	0.035	0.007	0.000	0.014	0.000
1986	0.030	0.029	0.020	0.033	0.006	0.053	0.007	0.020	0.007	0.041	0.000	0.013	0.039	0.000
1987	0.033	0.032	0.021	0.023	0.007	0.058	0.011	0.013	0.018	0.047	0.025	0.026	0.013	0.013
1988	0.032	0.032	0.018	0.024	0.007	0.027	0.014	0.016	0.016	0.027	0.016	0.000	0.012	0.012
1989	0.033	0.024	0.016	0.022	0.007	0.037	0.010	0.029	0.011	0.066	0.007	0.044	0.022	0.000
1990	0.034	0.033	0.010	0.026	0.009	0.038	0.009	0.019	0.016	0.051	0.009	0.056	0.023	0.034
1991	0.035	0.033	0.010	0.019	0.009	0.035	0.011	0.018	0.014	0.048	0.009	0.034	0.081	0.000
1992	0.035	0.039	0.006	0.018	0.009	0.043	0.008	0.027	0.022	0.081	0.011	0.012	0.012	0.000
1993	0.036	0.043	0.003	0.022	0.010	0.056	0.003	0.009	0.021	0.071	0.002	0.033	0.033	0.000
1994	0.053	0.050	0.002	0.010	0.013	0.068	0.001	0.027	0.032	0.067	0.005	0.000	0.063	0.000
1995	0.053	0.039	0.001	0.010	0.011	0.066	0.001	0.020	0.020	0.128	0.000	0.038	0.115	0.010
1996	0.057	0.034	0.002	0.012	0.016	0.080	0.001	0.005	0.014	0.191	0.000	0.020	0.210	0.000
1997	0.078	0.042	0.001	0.007	0.013	0.077	0.001	0.005	0.025	0.132	0.002	0.023	0.070	0.000
1998	0.055	0.038	0.002	0.012	0.013	0.054	0.002	0.020	0.018	0.068	0.008	0.022	0.101	0.000
1999	0.065	0.034	0.003	0.010	0.014	0.063	0.001	0.017	0.039	0.140	0.000	0.023	0.080	0.000
2000	0.080	0.030	0.003	0.007	0.011	0.050	0.002	0.013	0.026	0.085	0.005	0.021	0.095	0.000
2001	0.076	0.025	0.003	0.010	0.013	0.036	0.003	0.010	0.018	0.070	0.003	0.000	0.063	0.000
2002	0.069	0.025	0.003	0.012	0.013	0.028	0.000	0.013	0.013	0.048	0.010	0.010	0.062	0.000
2003	0.065	0.026	0.004	0.016	0.012	0.033	0.001	0.012	0.024	0.079	0.000	0.000	0.094	0.000
2004	0.066	0.026	0.001	0.013	0.009	0.040	0.001	0.012	0.012	0.047	0.007	0.020	0.082	0.000
2005	0.071	0.036	0.001	0.011	0.014	0.040	0.001	0.014	0.018	0.060	0.000	0.020	0.104	0.000
2006	0.073	0.029	0.003	0.013	0.011	0.037	0.004	0.018	0.013	0.053	0.004	0.031	0.097	0.000
2007	0.088	0.031	0.005	0.016	0.014	0.034	0.006	0.026	0.017	0.054	0.024	0.011	0.069	0.000
2008	0.075	0.023	0.012	0.014	0.010	0.017	0.022	0.036	0.015	0.015	0.052	0.033	0.034	0.022
2009	0.060	0.022	0.016	0.016	0.007	0.025	0.025	0.035	0.013	0.031	0.048	0.078	0.022	0.011
2010	0.048	0.030	0.007	0.018	0.007	0.020	0.019	0.029	0.011	0.027	0.018	0.023	0.047	0.000
2011	0.048	0.029	0.013	0.011	0.007	0.023	0.011	0.018	0.007	0.028	0.005	0.045	0.012	0.000
Average	0.054	0.031	0.008	0.016	0.010	0.043	0.007	0.019	0.018	0.065	0.010	0.023	0.060	0.004

Notes:
Asset size bands s are defined in real terms, measured in 2012 prices, as follows: Band 1, assets below $100 million; Band 2, assets between $100m and $1bn; Band 3, assets between $1bn and $10bn; and Band 4, assets above $10bn. All price conversions are based on the US GDP deflator.

TABLE 3 Entrants and exits, 1984-2012

Year	Entrants	Partial Purchase & Assumptions	Deposit Payoffs	Open Bank Assistance	Unclassified liquidation and payoff	Change in insurance status or conversion to non-commercial bank	M&A	Total exit	Exit rate	Number of live at end of year
1984	376	95	40		1	1	307	444	3.08	13,966
1985	307	113	43	2	4	1	315	478	3.34	13,848
1986	236	182	22	3	7	2	526	742	5.25	13,385
1987	201	190	43	6	4	2	555	800	5.87	12,834
1988	224	189	21		3		398	611	4.68	12,456
1989	187	146	18		2	4	380	550	4.35	12,105
1990	164	103	13		6		429	551	4.48	11,739
1991	100	71	40		10	5	410	536	4.52	11,332
1992	65	56	15		9	6	474	560	4.90	10,858
1993	55	11	18		2	1	533	565	5.17	10,369
1994	39	6	10		3	3	603	625	5.99	9,807
1995	99	5	5		2	3	544	559	5.64	9,359
1996	144	2	9		2	2	588	603	6.34	8,912
1997	181	3	6		1	1	554	565	6.19	8,563
1998	186	8	8		3	2	416	437	4.99	8,327
1999	229	5	4		4		452	465	5.43	8,106
2000	188	7	6		8	1	351	373	4.49	7,928
2001	124	4	16		5		267	292	3.62	7,776
2002	87	2	4		9	1	221	237	3.01	7,637
2003	109	3	7		8		257	275	3.55	7,478
2004	121	1	2		6		269	278	3.65	7,335
2005	164		2		3		304	309	4.12	7,197
2006	177	1	24		3		266	294	3.94	7,164
2007	164	19	24		6		252	301	4.10	7,035
2008	89	114	25		5		135	279	3.91	6,851
2009	29	130	24		7	2	167	330	4.79	6,554
2010	12	83	9		4	6	158	260	3.96	6,312
2011	0	39	17		12	2	159	229	3.62	6,101
2012	0	3	6		2		24	35	0.57	6,084
Mean	140	57	17	4	5	3	356	434	4.40	9221

Notes:
A partial P&A is a resolution transaction in which a healthy institution purchases some of the assets of a failed bank and assumes some of the liabilities, including all insured deposits, while the FDIC acts as a receiver to complete the rest of the transactions. In a deposit payoff, the FDIC is appointed receiver to collect the failed bank's assets, and pays all of the failed bank's depositors with insured funds the full amount of their insured deposits. In an open bank assistance transaction, the FDIC provides financial assistance to an operating insured bank deemed to be at risk of failure. Forms of assistance include lending, purchasing assets, or placing deposits.

TABLE 4 Descriptive statistics: Mean values of key variables, by year

Year	Total assets	Converted total assets	Age	Equi-ty/Assets	Liquid as-sets/Assets	Diversification	ROA	Total loans/Assets	Non-performing loans/Assets	Non-interest ex-pense/Assets
1984	172836	335578	55.0	8.88	15.30	6.35	0.68	53.10	0.59	3.27
1985	189220	356531	54.8	8.81	16.22	6.83	0.60	52.82	0.56	3.36
1986	206572	380695	55.1	8.58	18.19	7.55	0.44	51.37	0.50	3.35
1987	218393	391052	56.1	8.74	15.77	8.00	0.48	52.45	0.41	3.38
1988	238107	411982	56.9	8.82	14.81	7.87	0.61	53.09	0.36	3.34
1989	257074	428691	57.6	8.94	15.39	7.60	0.70	53.50	0.34	3.34
1990	272261	437420	58.2	8.90	14.05	7.75	0.64	53.58	0.32	3.34
1991	286219	444697	59.3	8.96	12.73	8.55	0.70	52.82	0.29	3.41
1992	303007	461087	60.4	9.21	12.33	9.85	0.96	52.29	0.21	3.42
1993	335193	499132	61.7	9.60	10.99	10.94	1.07	53.46	0.18	3.41
1994	381759	557106	62.7	9.62	26.08	10.52	1.05	56.04	0.17	3.39
1995	431514	615395	63.6	10.20	20.55	9.61	1.07	56.39	0.19	3.22
1996	477105	668581	64.0	10.28	19.42	9.72	1.07	57.82	0.21	3.15
1997	544625	748819	63.9	10.56	18.45	9.49	1.06	59.03	0.20	3.13
1998	616143	835372	63.9	10.55	18.73	9.65	0.98	57.97	0.21	3.12
1999	662429	885096	63.5	10.32	15.69	9.77	0.94	60.42	0.18	3.17
2000	744050	973195	63.1	10.64	14.93	9.21	0.94	61.91	0.18	3.15
2001	803395	1027421	63.5	10.51	15.13	10.13	0.87	61.66	0.20	3.11
2002	890348	1120468	64.2	10.69	14.66	11.83	0.97	61.74	0.19	3.09
2003	970077	1195646	64.7	10.69	13.63	13.40	0.96	61.63	0.17	3.09
2004	1091864	1308905	65.0	10.82	12.52	12.98	0.97	63.38	0.14	3.05
2005	1190791	1381674	64.6	10.89	12.65	11.76	0.99	64.17	0.14	3.05
2006	1340225	1506406	64.0	11.39	12.84	10.66	0.95	64.43	0.14	3.11
2007	1506204	1645310	63.8	11.62	12.14	10.13	0.79	65.29	0.17	3.14
2008	1696346	1812904	64.3	11.10	11.49	10.69	0.36	66.14	0.19	3.15
2009	1693792	1794473	65.7	10.71	13.16	11.64	0.11	64.07	0.19	3.22
2010	1805787	1887787	67.7	10.74	13.86	12.28	0.40	62.07	0.15	3.19
2011	1723618	1764371	69.5	11.05	14.64	12.63	0.58	59.67	0.13	3.14
2012	1891622	1891622	71.6	11.09	15.73	14.03	0.77	58.53	0.12	3.07
Mean	791054	957497	62.4	10.10	15.24	10.05	0.78	58.30	0.24	3.22

Note:
All mean values are calculated using nominal values except "Converted total assets", which are in 2012 prices with conversions using the US GDP deflator.

TABLE 5 Estimation results: M&A and failure hazard functions

	M&A				Failure			
	1	2	3	4	1	2	3	4
ln(total assets)	-0.525***	-0.114***	-0.116**	-0.239***	-0.499***	0.243***	-0.066	-0.197
	(-19.333)	(-4.351)	(-2.137)	(-3.234)	(-9.701)	(3.836)	(-0.473)	(-0.483)
Growth rate	-0.522***	-0.097	0.336***	0.053	-0.574***	-0.088	-0.453	-3.390
	(-8.439)	(-1.061)	(3.996)	(0.412)	(-5.984)	(-0.521)	(-0.999)	(-1.298)
ln(age)	-0.399***	-0.080***	0.215***	0.140	-0.304***	-0.255***	-0.110	0.083
	(-29.307)	(-5.518)	(5.002)	(1.516)	(-11.526)	(-7.203)	(-1.130)	(0.176)
Equity/assets	-14.961***	-23.036***	-15.674***	-10.351***	-12.295***	-24.245***	-16.266***	-47.325*
	(-29.021)	(-30.749)	(-8.990)	(-3.554)	(-12.224)	(-12.020)	(-3.710)	(-1.677)
Diversification	-2.688***	-5.616***	-4.799***	-1.813	1.667***	0.530	-1.960	-4.713
	(-7.671)	(-17.275)	(-7.832)	(-1.402)	(3.069)	(0.786)	(-1.292)	(-0.643)
Loans/assets	-1.942***	-1.888***	0.172	1.358*	1.686***	1.837***	3.753***	4.770
	(-16.718)	(-15.958)	(0.507)	(1.917)	(6.017)	(4.715)	(3.605)	(1.287)
Nonperforming loans/assets	8.631**	20.779***	35.238***	3.041	79.066***	91.871***	88.855***	-32.565
	(2.406)	(4.604)	(3.030)	(0.146)	(18.738)	(15.050)	(4.877)	(-0.307)
ROA	5.675***	15.947***	0.605	-15.317	-62.936***	-61.395***	-55.987***	-61.944**
	(2.920)	(7.666)	(0.132)	(-1.420)	(-23.788)	(-18.205)	(-6.721)	(-2.336)
Noninterest expense/assets	13.616***	37.592***	34.486***	18.819**	-4.347	-5.178	-20.273*	-54.772
	(6.769)	(19.820)	(9.164)	(2.344)	(-1.386)	(-1.225)	(-1.949)	(-0.947)
Liquid assets/assets	-0.890***	0.945***	1.892***	2.612***	-0.021	2.792***	4.515***	2.428
	(-6.613)	(6.444)	(4.545)	(2.976)	(-0.062)	(5.945)	(3.586)	(0.572)
GDP growth	24.549***	35.731***	36.521***	36.591***	36.037***	6.530**	13.546*	64.840
	(17.976)	(25.997)	(10.970)	(5.156)	(12.376)	(2.453)	(1.926)	(1.638)
Inflation	56.089***	39.676***	31.938***	14.816	62.922***	124.207***	123.935***	106.290
	(22.449)	(17.149)	(5.493)	(1.123)	(12.901)	(18.876)	(7.212)	(1.590)
No. of observations	122245	107165	11331	2342	122245	107165	11331	2342
No. of disappearance	4030	4555	733	154	1049	684	116	9
Log likelihood	-43781.26	-49664.12	-6353.32	-1068.26	-11651.66	-7173.15	-943.34	-63.12

Note:
This table reports estimation results for a competing risk model for the hazards of exit through acquisition or failure. The sample includes all US commercial banks that were live in 1984. The observation period is 1984-2012.
The Cox (1972) proportional hazard model with time-varying covariates is estimated. The left-hand panel reports the acquisition hazard. The right-hand panel reports the failure hazard.
Estimated coefficients (not hazard ratios) are reported. z--statistics are reported in the parentheses. *, **, *** indicates coefficients significant at the 10%, 5% and 1% levels, respectively.
Detailed definitions of variables are in Appendix I.

Table 6 Gibrat's law coefficients by year, 1986-2012

	$s_{i,t-1}$				$s_{i,t-1} - s_{i,t-2}$				Lambda		
Year	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**
1986	-0.028***	-0.067***	-0.225***	-0.049***	0.263***	0.268***	0.150	0.498***	-0.095***	0.207***	0.607*
1987	-0.036***	-0.071***	-0.343***	-0.521***	0.192***	0.172***	0.149***	0.198	-0.198***	-0.078***	0.521**
1988	-0.028***	-0.070***	-0.304***	-0.417**	0.199***	0.192***	0.026	-0.032	-0.013	0.159***	-0.716
1989	-0.027***	-0.059***	-0.058***	-0.080***	0.208***	0.140***	0.022	-0.036	-0.049**	0.134***	-0.085
1990	-0.040***	-0.078***	-0.163***	-0.089***	0.187***	0.160***	0.130**	-0.013	-0.179***	-0.163***	0.121
1991	-0.038***	-0.086***	-0.249***	-0.564***	0.242***	0.096***	0.136*	-0.038	-0.043	-0.083**	0.562
1992	-0.042***	-0.062***	-0.225***	-0.043	0.138***	0.114***	0.052	-0.002	0.180***	-0.095**	-0.004
1993	-0.031***	-0.088***	-0.227***	-0.108**	0.181***	0.166***	0.009	0.157*	0.377***	0.200***	0.284*
1994	-0.035***	-0.099***	-0.234***	-0.324**	0.218***	0.152***	-0.010	-0.200	0.305***	0.163**	-0.093
1995	-0.048***	-0.111***	-0.363***	-0.211	0.119***	0.171***	0.127**	0.250***	0.314***	0.608***	0.273
1996	-0.056***	-0.096***	-0.338***	-0.503***	0.102***	0.109***	0.054	-0.089	0.180**	0.482***	0.126
1997	-0.056**	-0.080***	-0.278***	-0.621***	0.209**	0.168*	0.028	-0.043	0.961*	0.548***	0.242
1998	-0.053***	-0.068***	-0.331***	-0.350*	0.232***	0.192***	0.119	0.015	0.213***	0.402**	-0.746
1999	-0.073***	-0.093***	-0.329***	-0.324*	0.163***	0.224***	0.107**	-0.041	0.681*	0.495**	-0.014
2000	-0.015	-0.059***	-0.340***	-0.135***	0.315***	0.283***	0.017	0.147*	0.555***	0.418**	0.064
2001	-0.021	-0.092***	-0.182***	-0.244**	0.252***	0.229***	-0.045	0.042	0.677*	0.709***	0.052
2002	-0.039*	-0.057***	-0.107***	-0.037	0.343***	0.241***	0.282***	-0.009	0.738***	0.476**	-0.297*
2003	-0.016**	-0.093***	-0.087***	-0.021*	0.257***	0.288***	0.178***	0.412***	0.226**	0.754*	0.164
2004	-0.029	-0.044***	-0.187***	-0.000	0.303**	0.318***	0.007	0.291***	1.049	0.410**	-0.059
2005	-0.025*	-0.058***	-0.137***	-0.132	0.304***	0.352***	0.058	0.162	0.427*	0.585***	0.181
2006	-0.041***	-0.061***	-0.134***	-0.432***	0.135***	0.319***	0.030	0.012	0.338**	0.697*	-0.128
2007	-0.050***	-0.064***	-0.101***	-0.036*	0.189***	0.220***	0.065	0.093***	0.011	0.479**	0.149
2008	-0.032**	-0.056***	-0.127***	-0.038	0.204**	0.285***	0.006	0.028	0.435***	0.158***	0.214**
2009	-0.046***	-0.045***	-0.186***	-0.068	0.207***	0.221***	0.149**	-0.104	0.047	-0.179***	0.034
2010	-0.038***	-0.043***	-0.133***	-0.072	0.336***	0.239***	0.069	0.082	-0.277***	-0.304***	-0.404
2011	-0.031**	-0.036***	-0.148***	-0.067**	0.157**	0.285***	0.135***	-0.043	-0.334**	-0.256***	-0.277
2012	-0.036	-0.038*	-0.109	-0.018*	-0.389	0.331**	0.342***	0.013	-1.767	-0.528	-7.19e+05

Note:

This table reports the coefficients on lagged bank size, lagged growth, and the correlation between the stochastic components of the survivorship and growth regressions.

Separate estimations of equation (4) are reported for each year, and for banks in each of the four asset size bands.

The results for the first-step Heckman sample-selection regressions are not reported; these are largely consistent with the results reported in Table 5.

Asset size bands are defined in real terms, measured in 2012 prices, as follows:

Band 1, assets below $100 million;

Band 2, assets between $100m and $1bn;

Band 3, assets between $1bn and $10bn;

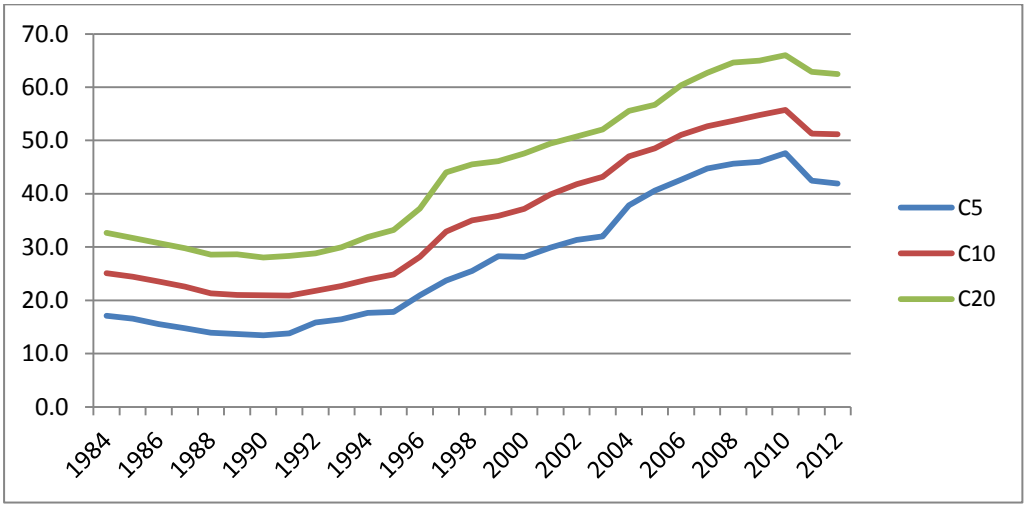
Band 4, assets above $10bn.

All price conversions are based on the US GDP deflator.

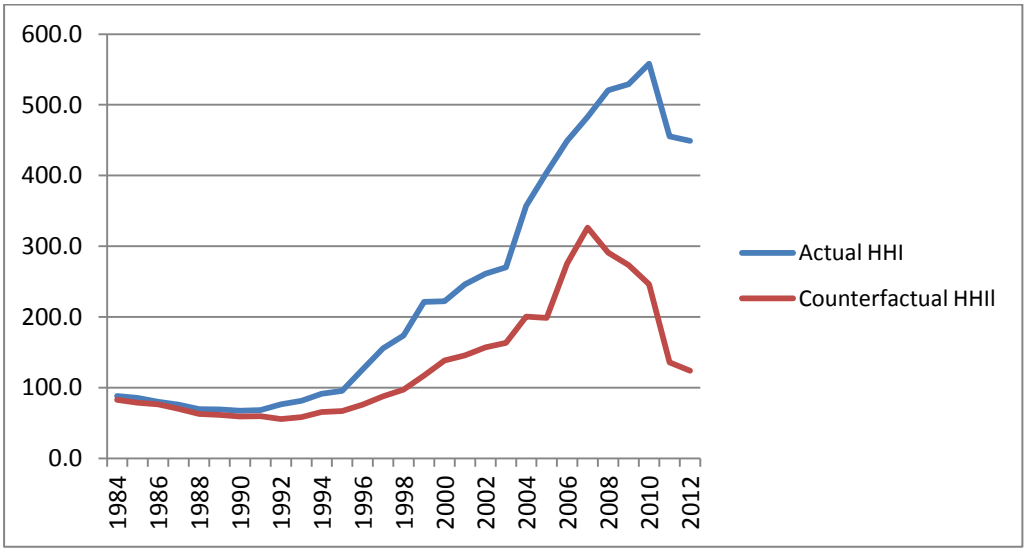
The Heckman sample-selection model is used for Bands 1, 2 and 3, while OLS is used for Band 4, owing to the small number of exits from the latter. The start-year is 1986: two year-observations have been lost through the inclusion of current and lagged growth in Equation (4). *, **, *** indicates significance at the 10%, 5% and 1% levels, respectively.

Figure 1 Analysis of U.S bank concentration ratios from 1984 to 2012

Panel A



Panel B



Notes:

C5, C10 and C20 represent the 5-, 10-, and 20-bank concentration ratios, respectively.

HHI represents the Herfindahl-Hirschman Index.

For the purposes of calculating the counterfactual HHI, each acquired bank is assumed to have continued to operate as a separate entity to the end of 2012. A proportion of the combined assets of the acquirer at each data-point after the merger took place are reallocated to the (counterfactually surviving) acquired bank. This proportion is based on the relative asset sizes of the acquirer and the acquired bank at the data point immediately preceding the merger (the final data point at which separate assets data are available for both banks).

Appendix I Definition of Variables

Variable	Definition
ln(Total Assets)	The natural logarithm of total assets.
Asset growth	The growth rate of total assets
lnage	The natural logarithm of bank age (the difference between the current year and the year when the bank established)
Equity/Assets	The ratio of bank equity to total assets.
Liquid assets/assets	(cash + securities for sale + federal funds sold)/ total assets
Diversification	The ratio of non-interest income over total operating income.
Loans/Assets	Total loans as a percentage of total assets.
Nonperforming loans/assets	The ratio of loans overdue 90 days to total assets
ROA	The ratio of net income on total assets
Noninterest expense/assets	The ratio of non-interest expense over total assets.
De Novo	A newly established bank that has been in operation for five years or less. (http://www.chicagofed.org/webpages/banking/supervision_and_regulation/de_novo_banks.cfm)
GDP growth	Real GDP growth, calculated as the percentage change of real GDP
Inflation	Inflation ratio, calculated as the percentage change of GDP deflator
HHIbank	A measure of bank local market power, calculated as the bank-level Herfindahl-Hirschman Index (HHI) of deposit concentration for the local markets in which the bank is present

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