Where is your Money, and Why?

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Abstract

Inspired to learn more about the U.S. banking system following Silicon Valley Bank's failure in March 2023, we used 30 years of FDIC data to visualize the components of the U.S. banking system we found most interesting. We visualized U.S. bank assets' locations using historical financial data obtained through the FDIC API, finding some surprising results. Next, we dive deeper into why bank geographical locations resulted in the configuration. From there, we sought further to explore the changes within the concentration of assets and demonstrate how big banks have grown to hold a far more significant proportion of assets than they did 30 years ago. Finally, we used the equity capital ratio to understand the differing needs of various banks and how they can improve their financial position to respond to potential problems.

Introduction

On Friday, March 10th, 2023, U.S. regulators seized Silicon Valley Bank (SVB) in the largest U.S. bank failure since the 2008 financial crisis.[1] The 40-year-long bank operation suddenly stopped after depositors panicked when learning that the bank was short on capital. The public quickly turned its attention to the Federal Deposit Insurance Corporation (FDIC), which provides a standard insurance amount of $250,000 per depositor, per insured bank. The insurance fund has accomplished the goal of no depositor losing a penny of insured funds due to a failure since 1934.[2] The case of the FDIC showcased just one of the fascinating aspects of the U.S. banking system that was largely unknown to the general public. It also inspired us to carry out this project.

We aim to inform our audience of several distinguishing facts about the U.S. banking system and to do so in a visually captivating manner. First, we seek to provide insight into the complexity of where money is in the U.S. and what it means to have a location in this context. Then, we delve into the distribution of assets in the banking system and explore their concentration. Next, we switch our discussion to deposits and visualize their behavior over time. Lastly, we navigate bank health metrics and analyze the state of the U.S. banking sector.

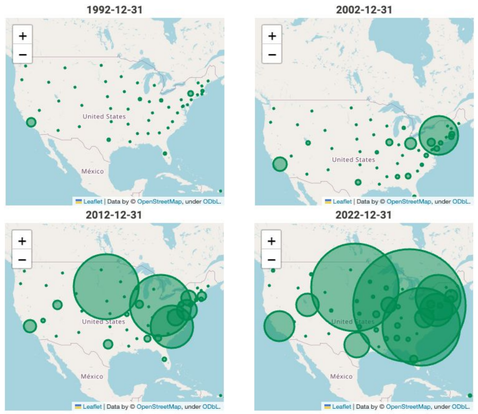

Figure 1: shows a 2x2 grid of Folium maps depicting the relative size of fourth-quarter U.S. bank assets per state every ten years since 1992. *Made with Folium.*

Methods

We gathered the data from the FDIC's API[3] to answer our research questions. The API allows querying financial institutions' general and structural data, historical financial information, and bank failure information. In this study, we focused on historical financial information. We constructed our own Python API client to make the process faster using the Python *requests* library. We then collected the quarterly financial information for all insured banks from Q1 1992 to Q4 2022 (30 years). Next, we cleaned the data to combine the 30 years' worth of data, which totaled 1,014,549 rows. Lastly, we collected coordinate data for developing geospatial visualizations consisting of zip codes and cartographic boundaries.

To address our questions, we developed a collection of interactive data visualizations that allow us to obtain an initial eagle-eye view of the data and then narrow the focus for deeper exploration. Tools used include the Folium and Geopandas Python libraries for geospatial visualization, Altair, and the Plotly libraries for R and Python.

Where is Money Located?

In this study, we adopted the Federal Reserve's definition of a bank's location: its main office, as listed in the bank's charter. Figure 1 shows expected behavior from 1992 to 2002: Assets growing in the U.S. on the main financial hubs of New York and California. However, something alluring started to happen in 2012. Assets start rapidly growing in South Dakota, Ohio, and North Carolina. What is happening? In Figure 2, we take a deeper dive into what's going on. In Figure 2, we dive deeper into what is happening. We can see in the heatmap layer that banks aggregate in many places in the U.S. However, we can quickly determine that the quantity of banks does not correlate with the number of assets in a state.

The largest bubbles in the plot represent Citibank and Wells Fargo in South Dakota, JP Morgan Chase in Ohio, and Bank of America in North Carolina. To explore why, we look closer at the states where we would expect the assets to be and where they are in the next section.

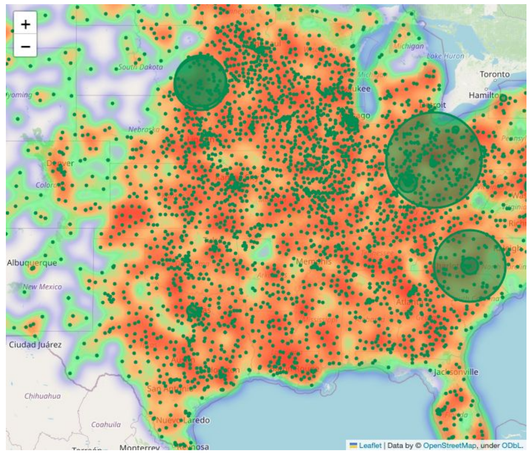

Figure 2: shows dots representing the ZIP Code of the FDIC-insured banks' location within the U.S., where the bubbles represent the relative size of the assets, allowing one to see the location of the largest banks. *Made with Folium.*

A Deeper Dive by State

Intuition may suggest that California, Texas, and New York should have significantly more bank deposits than smaller states like South Dakota, given their respective populations and GDP. However, large banks such as Wells Fargo and Citibank have their main offices in Sioux Falls, South Dakota. The deposits in these banks entirely envelop the rest of the deposits in the state. Similarly, JP Morgan Chase's main office is in Ohio, and Bank of America is in North Carolina, making up the vast majority of the total deposits in the state.

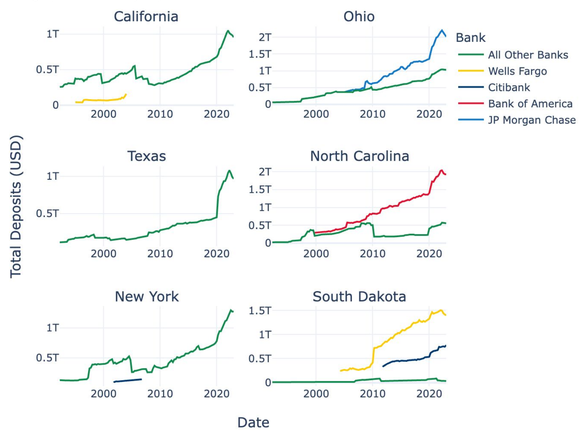

Figure 3: shows deposits across six notable states, highlighting the incredible size of the four largest banks in the United States compared to their home states. *Made with Plotly for Python.*

In the 1980s, South Dakota eliminated the cap on interest rates and fees to attract investment during an economic recession. Citibank was the first to answer. The success of this move prompted other banks such as Wells Fargo, Capital One, and First Premier to move to the state, which, in 2013, held more bank assets than any other state in the U.S.[4] Bank of America's main office is in Charlotte, North Carolina, for similar regulatory reasons, which is now the second largest state by bank asset size.[5] Figure 3 shows the effect of these moves on state deposits.

While not central to Figure 3, we noted a rapid deposit growth in 2020 due to various stimulus efforts. It is important to notice the difference in the y-axis between the two columns. The left column features the three largest states by GDP, while the right features the three states we found to be most notable.[6] Namely, these states house the four largest banks by total deposits. We can easily detect the differences between states. However, in the next section, we discuss the overall structure of the market and the relative significance of the top banks in the system.

A Story About the Top Banks

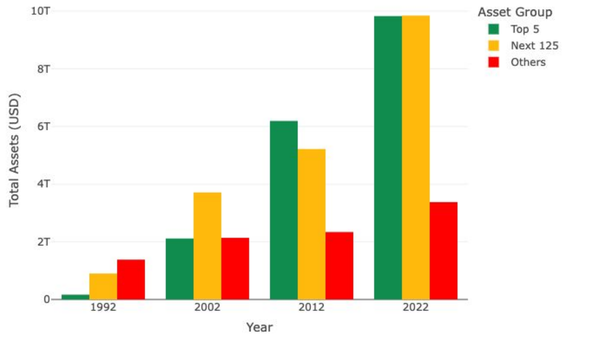

Figure 4: shows the temporal trends in the market structure of the banking industry, grouping banks in the descending order by the amount of assets they possess. *Made with Plotly for R.*

Figure 4 breaks down U.S. banks by placing them into one of three groups based on the number of assets they held. The total assets these banks hold determine the groups and rankings for each year over the past three decades. Examining the plot, we see that in the most recent decade, the top 5 banks in the U.S. hold the same amount in assets as the subsequent 125 banks and have about three times as many assets as every other bank in the country, amounting to 4,031 banks. We observe a strong skew in the distribution of assets across the country, and this shows how concentrated the banking industry is right at the top. We also notice how a few banks, including Bank of America, Citibank, and JP Morgan, held the most assets during the period examined.

Furthermore, looking at temporal trends, we also notice that the top 5 banks in the U.S. have not always wholly dominated all the other banks; this distribution has progressively gotten more and more concentrated at the top. For example, for 1992 and 2002, we noticed a far smaller concentration level in the industry. However, in 2022, we see a complete change, as the top 5 banks hold more assets than the other groups. These developments may cause concern for the health of competition in the industry.

The Health of the System

A bank's equity capital ratio is the amount of its equity as a percent of its total capital. It measures a bank's financial strength and ability to withstand economic downturns and absorb losses. Banking regulation often requires a minimum 4% tier-1 equity capital ratio, a variation of the equity capital ratio that weights bank assets by risk, to ensure the bank can navigate negative economic scenarios without risking depositors' money. The equity capital ratio is an important figure to help assess the stability of a bank.

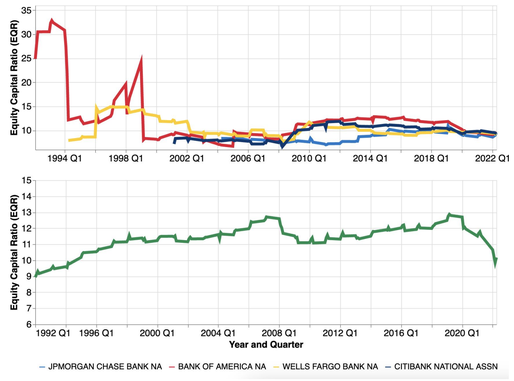

Figure 5: Top plot shows the equity capital ratio by quarter over the past 31 years for each of the top banks. Bottom plot shows average equity capital ratio for all banks in dataset. *Made with Altair.*

Figure 5 examines the relationship between the equity capital ratio of the top 4 banks in total assets and the average equity capital ratio of all banks in our data. We notice that the equity capital ratio of these banks falls in line with the average, most notably over the past decade or so. None of the banks reached an equity capital ratio over 13 after 2004, and all have been between 8 and 10 each quarter since 2020, slightly below the overall average. We also notice that the overall average remains relatively high over the period we have examined and that changes in the overall average are inconsistent with any significant change in the larger banks.

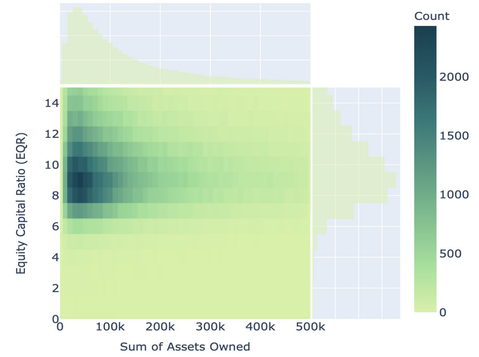

Figure 6: Joint distribution plot for banks with average of $500 million or fewer in total assets. Figures in thousands. *Made with Plotly for Python.*

For the following two figures, we focus on the capitalization of smaller banks, which have less access to capital and credit due to their overall size and relative market position and may need to sustain higher capitalization ratios. Figure 6 shows only the smaller banks in terms of total assets owned. We notice that most banks fall within the average equity capital ratio of 8 and 12. These numbers show no significant trend in bank size and equity capitalization ratio.

Figure 7: Bubble plot showing the classification by bank class, displays equity capital on x-axis and equity capital ratio on y-axis. *Made with Plotly for Python.*

Figure 7 compares the equity capital to the equity capital ratio for the fourth quarter of 2022, colored by bank class. We notice that savings banks have a high equity capital ratio but low equity capital, and state banks tend to have a lower equity capital ratio. Except for a few outliers, we can see that most small banks fulfill typical regulatory capitalization requirements in excess.

Conclusions

In this project, we examined several fascinating aspects of the U.S. banking system. First, we found that South Dakota and Ohio bank assets have grown rapidly compared to more populated states like New York and California. Once broken down by bank, we found the reason to be that the largest banks in the country had moved to these smaller states. We then compared the highest GDP states to the states that house the four largest banks and found that these banks make up almost all those states' total deposits. The same large bank's total deposits also far exceed all deposits in those higher GDP states. Further research shows this is due to relaxed banking regulations and lower tax rates.[7]

We also explored the temporal trends in the concentration of assets held by U.S. banks. We identified how a few top players dominate the industry entirely and how this trend has worsened over the last three decades. Finally, we noted no significant differences in equity capital ratio between top banks, especially over the past few decades, as these banks have scaled in size. We found the cause to be differing immediate needs between larger and smaller banks. Our main takeaway for our audience is that the banking system tells a story of financial wellness while also raising caution on the concentration of resources and regulatory arbitrage.

References

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