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<u>Non-Technical Report</u>

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Introduction

Bank of America is the second largest financial holding company in the world by assets, serving individuals, small and medium businesses, global corporations, and even governments.[1] The bank boasts over 68 million customers, including approximately 95% of the United States Fortune 1000 companies and 73% of the Global Fortune 500 companies.[2] It began in 1904 when Amadeo Peter Gianni established a modest bank in San Francisco, California, called the "Bank of Italy." The idea behind the Bank of Italy was to provide financial services to clients who had been turned down by other companies. The majority of these immigrants were farmers from Italy, which is how the Bank of Italy got its name.[3] This paper explores the current structure of Bank of America, its balance sheet, regulators, and associated risk exposures.

Business Lines

The bank has eight different businesses within its broader structure: four serving individuals, three for companies, and one for broader institutions. The first of the business lines for people is the retail bank. The retail bank serves U.S. customers, aiming for convenience and a high-touch experience, rewarding loyal customers.[4] They do this through a combination of an award-winning digital banking system and many brick-and-mortar branches. Next is the Preferred bank, intended for clients with up to a quarter of a million dollars in assets or small businesses with up to five million dollars in revenues. Through this line, they provide cash management and investing solutions for their slightly more affluent clients. The investing aspect of this business is done through either Merrill Edge Self-Directed accounts or through Merrill Guided Investing. They use a digital system as well as a network of financial advisors, aiming to build relationships with their "most valued clients with their specialized needs."[5] Merrill Lynch Wealth Management is a business line open to clients with over a quarter million dollars of investable assets, with no upper bound. They manage trillions of dollars in total balances, offering a personal advisor for each client. This business line intends to create a very individualized approach to helping clients meet their financial goals. The Private Bank provides customers with ultra-high net worth, over three million dollars in investable assets, with comprehensive wealth management and investing solutions. They specifically give these customers insights and recommendations to help safeguard their money for future generations through a highly tailored, team-based service. Some of the people who meet the requirements of being served by the private bank may still opt for the wealth management solution because they prefer their personal advisor and the Merrill Lynch banking system as opposed to a fully independent team.

For companies the Business Banking line serves businesses with between five and fifty million dollars of annual revenue. They offer both financial solutions as well as strategic advice to these businesses. Bank of America's Global Commercial Banking line is used by middle-market companies between fifty million and two billion dollars in annual revenues. The commercial banking business line offers treasury, lending, leasing, investment banking, risk management, and international subsidiary banking services to these companies across all major industries. These clients receive coverage from local relationship managers in addition to the whole capabilities of Bank of America through GCB. Finally,

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[1] *Top 100 largest financial holding company rankings by total assets.* SWFI News. (2023)
[2] *Bank of America & Bofa Securities: Our Businesses, Capabilities & Regions.* Bank of America Merrill Lynch.
[3] *Bank of America Organizational Structure [Interactive Chart].* Organimi.
[4] *8 lines of business: For People, Companies & Investors.* Bank of America
[5] *8 lines of business: For People, Companies & Investors.* Bank of America

Global Corporate and Investment Banking serves companies of over two billion dollars in annual revenue, which includes municipalities and governments. To these clients, they offer treasury services, lending, leasing, advisory, and debt and equity underwriting solutions. They have clients in 38 different countries, representing some of the world's highest-value businesses.[6] For institutions, Bank of America's Global Markets line works with the world's debt, equity, commodity, and foreign exchange markets. This involves providing liquidity, hedging strategies, industry-leading insights, analytics, and competitive pricing to hedge funds, asset management firms, pensions, and other financial institutions, providing access to capital for all types of clients.

Corporate Structure

Bank of America has a hierarchical management structure overseen by chairman and CEO Brian Moynihan. Under him are four vice chairs and a full C-suite of officers and executives. Adjacent to the C-suite and vice chairs are presidents of each of the eight business lines mentioned previously, as well as a head of fixed income, currencies, and commodities, a president of the international side for Merrill Lynch, and a president of regional banking. They also list the general council as adjacent to these other three groups. Bank of America uses a hybrid unitary form structure, hierarchical in nature, with direction coming from the top down, as in most businesses. The hybrid aspect is that they have several holding companies and adopt somewhat of a divisional arrangement. This allows each independent business line to operate almost as though it is independent, improving the flexibility and agility of each business line. There are also subgroups within these holding companies, splitting some businesses of their businesses by region. The hybrid structure helps the bank stay competitive, ensuring that each division has nearly full autonomy to help build towards broader, unified, firm-wide goals.

Balance Sheet Breakdown

Regarding Bank of America's assets, the largest asset category they hold is approximately 1.7 trillion dollars in investments. These include mainly almost 40% mortgage-backed securities, about 17.5% Trading Account Securities, about 15.8% Federal Funds Sold, about 9.4% Treasury Securities, about 18% other securities and investments. In 2022, their investments actually went down a total of 9.67%. The next largest class of assets they hold are their loans, having lent out slightly over a trillion dollars. About 37% of these loans are Commercial & Industrial Loans, almost 32% are Real Estate Mortgage Loans, about 19% are Consumer & Installment Loans, only about 1% are leasing financing loans, and 12% are foreign loans. They only have a loss reserve of about 12.6 billion dollars, which is basically only 1% of the total they have lent out, luckily their loan growth rate from 2022 was +6.86%. Beyond these two groups, they hold another 253 billion in other/intangible assets and about 30 billion in cash.[7] Their total assets add up to 3 trillion.

As far as liabilities, unsurprisingly, Bank of America's largest liabilities are over 1.9 trillion dollars in deposits, down by 6.5% from the previous year. About 61% of these deposits are savings accounts and Certificates of deposits, a third of them are demand deposits which can be withdrawn at any time, and the rest are Foreign Office Deposits. Bank of America also has about half a trillion dollars in other debts. 47% of these debts are short-term or current long-term debts, meaning they had about 240 billion dollars in debts that needed to be paid in 2023, primarily short-term debts. The rest of their debts, about 268 billion dollars worth, were long-term, meaning they did not have to be paid off for a year or more from when the balance sheet was released. They have another 337 billion of "other liabilities, totaling their liabilities to about 2.7 trillion dollars. They balance the rest of their assets with equity, primarily 244 billion dollars in common equity, mostly retained earnings and common stock. They also have over 28 billion dollars of preferred stockholder value.[8] Their total liabilities and equity add up to 3 trillion as well.

[6] *8 lines of business: For People, Companies & Investors*. Bank of America
[7] The Wall Street Journal. (2022). BAC Financials Annual Balance Sheet.
[8] The Wall Street Journal. (2022). BAC Financials Annual Balance Sheet.

Risk Assessment

The primary functions of banks as financial institutions are deposit taking and lending, which entails a number of risks, including credit, market, operational, and liquidity risks. Bank risks might lead to insolvency without an efficient risk management system. The stability of the entire economic system relies upon the banks to effectively manage these risks and stay resilient in a dynamic market. 2021 saw the financial sector confront fresh threats due to COVID-19's effects, which complicated fund flows. Due to the fact that a large number of people and businesses were unable to make their loan repayments on time, loan default rates rose, and financial institutions' asset quality declined along with many global stock indices.[9] The bank has a concrete risk framework outlining the seven types of risk they face, as well as a risk appetite statement.[10] Having these concrete definitions of their risk profile helps mitigate their overall risk and keep different business units aligned and stable.

The primary risk the banks take by creating loans is credit risk. This refers to the risk that those to whom they've lent money will be unable to repay the loan principal and interest during the loan term. As seen in their balance sheet, a third of their total assets are loans that Bank of America has given out, which all assume some degree of credit risk. This is quite a standard risk all banks take, and Bank of America has a particularly rigorous screening process in order to minimize their credit risk on each loan. Beyond this, a huge portion of their investments, about 40% is in mortgage backed securities, which inherently rely on people to repay their mortgages, furthering the bank's indirect credit risk. The 8 different business lines of banking that they have helps diversify their loan portfolio, which helps decrease their risk exposure. They have many different types of customers to whom they lend, ranging from individuals to billion-dollar companies to governments. Their credit portfolio spans practically every major industry, region, and product type, and a robust credit risk monitoring system helps them mitigate their exposure.

Another major aspect of Bank of America's risks is those related to the overall market. More than half of the bank's assets are in investments and securities, all of which fluctuate in value with the market. As of October 2023, the bank had reported an unrealized loss on securities this year of nearly 132 billion dollars.[11] Luckily, these losses are not hugely meaningful for the overall bank because they can essentially hold these securities as long as they want, assuming that eventually, their values will rise again. These losses are only realized if they were to cut their losses and sell the securities at a lower market value than they were purchased. Their portfolio is strongly tied to interest rates, as rising interest rates typically mean a decrease in bond value. Similarly, they have nearly 300 billion dollars invested in trading account securities, so the value of this investment is completely tied to the equities market. Being a bank with global investments, including 124 billion dollars in foreign loans, they also face risks associated with fluctuating foreign exchange rates. They hedge their risks associated with interest rates and the stock market by taking positions in swaps, options, and futures to alleviate damages from fluctuations. To hedge against changes in foreign exchange rates, it also uses futures, options, and forward contracts. They also maintain an entire Global Markets division devoted to building the most accurate and cutting-edge global market analysis to monitor these risks and develop strategies.

A form of uncertainty prevalent in all businesses, including Bank of America, is operational risk. This refers to the risk of loss through any business operations, such as human error, technical or nontechnical interruptions, and damages from processes or systems. In a bank, this could refer to simple mistakes by tellers in retail banks, cybersecurity breaches, and pretty much every aspect of their business in one way or another. This could be unintentional mistakes by employees or intentional fraudulent activity.

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[9] Yang, L. (2023). Risk Assessment on Bank of America.
[10] Bank of America Corporation. (2022, March 7). Regulatory & other filings.
[11] Azhar, S., & Anand, N. (2023, October 17). Bank of America's unrealized losses on securities rose to $131.6 BLN.

The Bank also faces liquidity risk, essentially the risk that they cannot come up with cash in a timely manner to meet demands, whether this is from demand deposit holders, lenders, or borrowers. A bank's liquidity coverage ratio, or LCR is the measurement of their ability to sustain 30-day stress situations, of which Bank of America had a good score of 137% as of late 2021. Their net stable funding ratio, or NSFR, is the ratio of stable funding sources to the bank's required stable funding amount, which depends on the residual maturities of the institution's assets and liquidity profile. Bank of America also passes regulatory requirements, having an NSFR of 116% as of 2021.[12] Their liquidity risk is evaluated, along with all the other aforementioned types of risk, annually through a stress test, the Dodd-Frank Act Annual Stress Test.[13] This test, along with a diversified portfolio of liquid assets, including cash on hand, various securities, and external credit lines, contribute to alleviating liquidity risk. They also have an emergency funding plan in place in the event of severe stress.

In their risk framework, Bank of America also addresses strategic, compliance, and reputational risk. Strategic risk focuses on how systems, processes, and implementation strategies can potentially decrease the bank's value. Compliance risk is the possibility of losing earnings or assets due to violating regulations. The bank has a robust framework to ensure compliance is met throughout all its business operations. Finally, reputational risk is the risk of negative publicity causing a loss in earnings and capital. In all, Bank of America covers its basis, devoting energy to measuring, stress testing, and hedging against each of these risks individually and on a big-picture scale as well. Thinks like the Dodd-Frank Act Annual Stress Test allow them to measure their theoretical performance in different severity level situations, simulating all types of stress aspects across different risk dimensions simultaneously.

Roles and Responsibilities
Quantitative Finance Analyst

The role of a Quantitative Finance Analyst in Bank of America is usually in the Risk Analytics team. It involves applying quantitative methods to develop capabilities that align with line of business, risk management, and regulatory requirements. Quantitative Financial Analysts are tasked with independently conducting quantitative analytics and modeling projects. Furthermore, the role encompasses maintaining and continuously enhancing the capabilities of the developed models over time. This dynamic aspect reflects the need to adapt to changing portfolios, economic conditions, and emerging risks. Another responsibility is understanding and executing activities throughout the end-to-end model development and use life cycle. This involves not only the initial development but also the implementation, execution, and monitoring of the models in real-world scenarios. Analysts are expected to contribute to the design of systems that can run the developed models effectively, demonstrating a comprehensive understanding of the entire lifecycle.

The roles also exhibit notable differences in their specific areas of focus and the nature of their responsibilities. The positions within the Enterprise Risk Analytics team center on Anti-Money Laundering (AML) model development. The analysts are tasked with performing in-depth analysis on the bank's AML model suite and communicating model performance to various stakeholders, including risk management, model development, and senior management. On the other hand, the Quantitative Financial Analyst role within the Global Risk Analytics (GRA) function is positioned within the Consumer Loss Forecasting (CLF) team. This role involves conducting research and analysis to improve the understanding of loan portfolios, developing and maintaining models, managing infrastructure and processes for forecasts and analytics, and collaborating with various stakeholders. The emphasis here is

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[12] Yang, L. (2023). Risk Assessment on Bank of America.
[13] Bank of America 2023 Dodd-Frank Act Annual Stress Test Results. Bank of America Corporation. (2023, July 3)

on consumer loss forecasts, financial planning, and risk management activities, with a focus on stress testing and Comprehensive Capital Analysis & Review (CCAR) submissions.

In summary, the responsibilities of Quantitative Financial Analysts include conducting quantitative analytics and modeling projects, continuously enhancing models to adapt to changing conditions, understanding and executing activities throughout the model lifecycle, and communicating effectively with various stakeholders across the organization. While the positions share a foundation in quantitative analytics and modeling, the differences lie in their specific applications, such as AML model development or Consumer Loss Forecasting, and the distinct responsibilities tied to their respective areas of expertise within risk management and financial analysis.

Skills and Competencies

The required and desired skills for the Quantitative Financial Analyst roles highlight a blend of technical expertise, analytical acumen, and effective communication capabilities. One of the central prerequisites is a graduate degree in a quantitative discipline, such as Mathematics, Economics, Engineering, Finance, or Physics. Additionally, experience in model development, statistical work, data analytics, or quantitative research, or a Ph.D., underscores the importance of practical experience in applying quantitative methodologies to real-world scenarios.

Strong programming skills are a consistent requirement across the roles, with proficiency in languages like R, Python, SAS, SQL, or others. This technical competency is vital for developing, implementing, and maintaining quantitative models..

Desired skills further extend to knowledge of advanced quantitative techniques, including predictive modeling, statistical sampling, optimization, and machine learning. The inclusion of artificial intelligence techniques suggests an openness to leveraging innovative technologies in the modeling process.

Effective communication and presentation skills are emphasized as desired competencies. Analysts are expected to communicate quantitative findings and insights to a diverse audience, ranging from non-technical stakeholders to senior management. This proficiency in conveying complex quantitative concepts in a clear and accessible manner is crucial for fostering understanding and collaboration across different teams within the organization.

Finally, effective prioritization, time management, and project management skills are highlighted. The nature of the roles suggests that analysts should be adept at managing multiple tasks, balancing competing priorities, and delivering results within specified timelines. This competency is crucial for maintaining agility in responding to evolving portfolios, economic conditions, and emerging risks.

Data Engineer

The Data Engineer position within the Chief Investment Office (CIO) encompasses a range of responsibilities crucial to supporting the quantitative infrastructure. With a focus on system architecture and an entrepreneurial mindset, the associate collaborates extensively with various CIO teams, including due diligence, portfolio construction, platform management, technology, and risk teams. The role involves managing multiple projects simultaneously and finding innovative solutions to complex problems in a fast-paced environment.

Key responsibilities include the analysis and organization of raw data from diverse sources, maintenance of SQL databases, and the construction of data systems and pipelines. Automation of reports and processes, along with monitoring and debugging, are integral tasks. The associate plays a pivotal role in communicating the needs and specifications of processes to the technology team and exploring ways to enhance data quality, reliability, and efficiency. Identifying opportunities for data acquisition and

developing analytical tools and programs are essential components, requiring collaboration with data scientists and architects on various projects.

Additionally, the role encompasses performing unit tests and participating in code reviews to ensure rigorous design, elegant coding, and effective performance tuning. The associate is expected to exhibit extreme attention to detail and organizational prowess, executing projects both independently and collaboratively within a team.

Skills and Competencies

The role of a Data Engineer demands a robust set of skills and competencies to navigate the intricacies of data engineering and quantitative analysis. A fundamental requirement is a strong foundation in computer science or a relevant field, highlighting the need for technical acumen to excel in the responsibilities associated with designing, constructing, and analyzing data pipelines. With experience in Extract, Transform, Load (ETL) and/or Extract, Load, Transform (ELT) processes, the role necessitates a deep understanding of data engineering practices and proficiency in design and architectural patterns.

Proficiency in database management languages such as SQL and NoSQL is essential, underlining the importance of effectively handling and manipulating large datasets. The role requires extensive experience with object-oriented programming (OOP) and scripting languages like R, Python, Bash, and/or Matlab, showcasing the ability to leverage diverse programming languages for various aspects of data engineering and analysis.

The responsibilities of this role also call for experience in working across multiple technology deployment lanes, from development through production, highlighting the importance of a holistic understanding of the data engineering lifecycle. Proficiency in code versioning tools such as Git/Bit Bucket and a keen eye for extreme attention to detail demonstrate the role's emphasis on precision and accuracy in executing tasks.

Data engineering certification, familiarity with financial data vendors (e.g., FactSet, Morningstar, Bloomberg) are considered valuable additional qualifications, which our education might be lacking of.

Comparison

The Data Engineer and Quantitative Analyst roles, while both integral to data-driven processes, exhibit distinct focuses and responsibilities within the financial domain. The Data Engineer, in essence, is tasked with constructing and managing data pipelines, maintaining SQL databases, and automating reports and processes to ensure efficiency. This role places a significant emphasis on the technical aspects of data engineering, with responsibilities spanning from debugging processes to enhancing data quality and reliability.

Conversely, the Quantitative Analyst role is centered around developing and maintaining quantitative models for risk management and decision-making. With a foundation in a quantitative discipline, this analyst applies advanced quantitative techniques such as predictive modeling and machine learning. Their responsibilities extend to analyzing and organizing raw data, contributing to the end-to-end model development life cycle, and effectively communicating findings to stakeholders.

Data Engineer's focus lies more in the realm of data infrastructure, automation, and database management. On the other hand, the Quantitative Analyst is closely tied to quantitative modeling and statistical analysis within the financial landscape. The Data Engineer ensures the robustness and efficiency of data processes, while the Quantitative Analyst leverages data to inform risk management strategies and decision-making processes.

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