RECURSION

"A powerful agency loan level database in the cloud"

Loan Count by Guarantor (millions)

Legend: fhl · fnm · gnm · gnm hecm
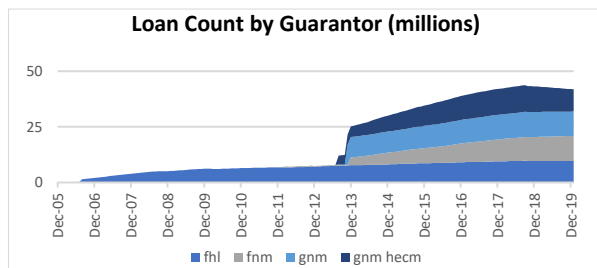
Today's Loan Level Coverage (%)

	FHL	FNM	GNM II	GNM I
30 Year	97.9	80.6	100.0	100.0
15 Year	100.0	79.3	100.0	100.0

Recursion Co. was founded as the country's preeminent provider of analytic data tools in the mortgage industry. Using high-performance data warehousing technology in the cloud, Recursion's clients have efficient access to its collection of large datasets containing over 400 million loans covering a substantial and growing share of outstanding agency pools.

Moreover, users can utilize a centralized financial company database to analyze the activities of over 30 thousand finance institutions in multiple roles as servicers, originators and sellers.

Recursion's proprietary products, notably Cohort Analyzer, Agency X-Ray and Recursion DataCloud, allow investors, servicers and originators to identify profit-making opportunities and gain an edge in a highly competitive marketplace. Moreover, regulators and financial institutions can use the tools to monitor both systemic and idiosyncratic risks.
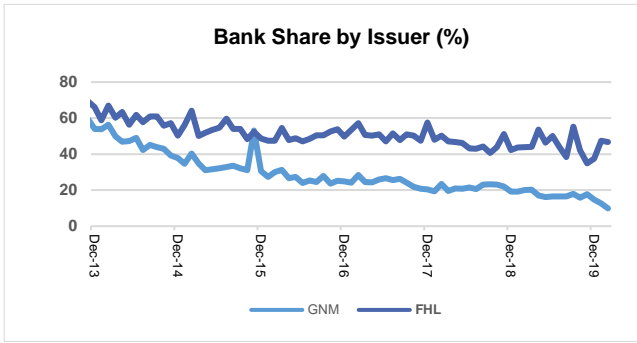
Recursion's clients have direct access to the market insights and customized solutions developed by the team of mortgage finance specialists led by CEO Li Chang and Chief Research Officer Richard Koss.
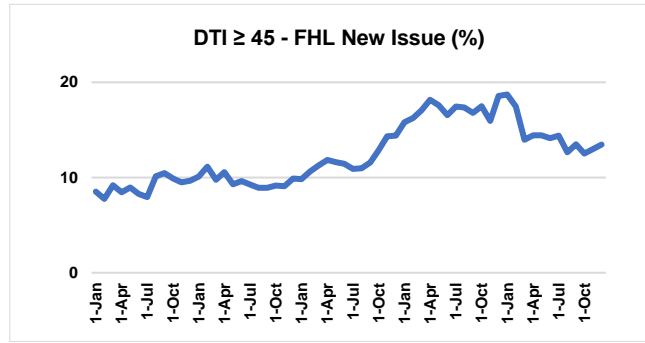
Our Solutions

- **Cohort Analyzer**
    - A powerful tool to build cohorts (issuer, product type, bank/non-bank, geography, etc) from loan-level data at high speed and with great flexibility
    - Complex queries across multiple characteristics of the cohort (UPB, credit data, CPR, etc) can be computed in an extremely efficient manner

- **Agency XRay**
    - Loan-level stratification of pools and CMO's for performance analysis
    - Graphical representation of product characteristics

- **Recursion DataCloud**
    - Loan-level eMBS mortgage database hosted in a high-performance data warehouse in the cloud
    - Daily updates of the database via eMBS's FTP service
    - Straightforward integration of the database into the client's IT infrastructure, a cost and time efficient alternative to creating and maintaining an internal database

- **Supplemental Data**
    - Other large data sources, including HMDA (Home Mortgage Disclosure Act), the FHA Portfolio Snapshot and the Bank Call Report Data.
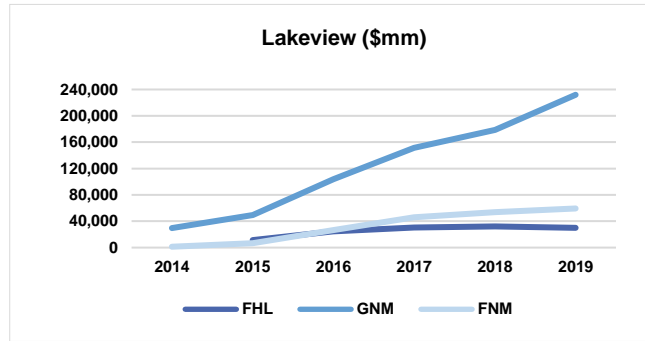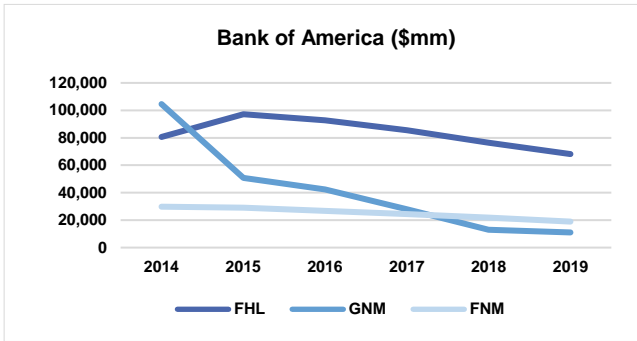
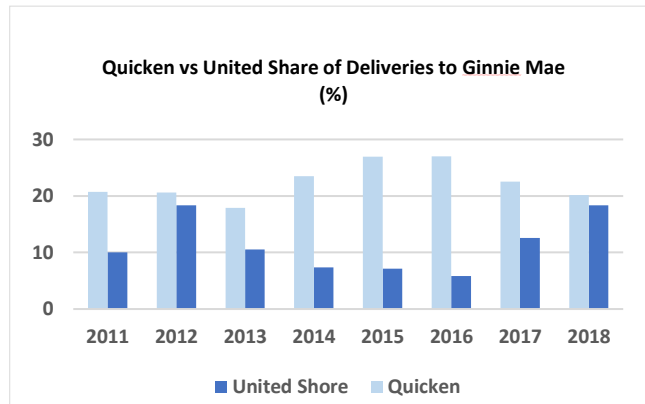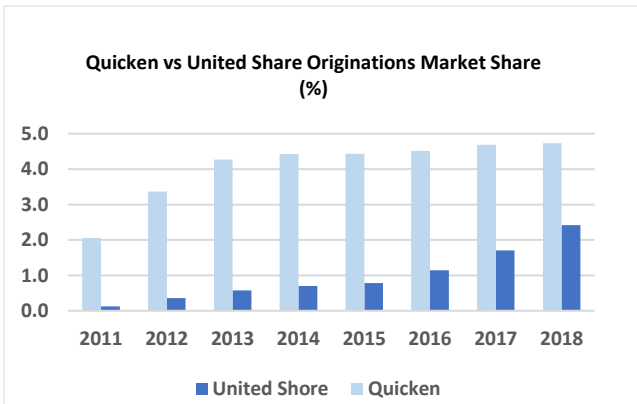# COHORT ANALYZER

- ## Industry Overview

Bank Share by Issuer (%)

- ## Risk Management

DTI ≥ 45 - FHL New Issue (%)

- ## Servicer Analysis

Bank of America ($mm)

Lakeview ($mm)

- ## Supplemental Data

Overall Supply Amount ($b)

Market Shares of DTI Ranges by Income Buckets - 2018 Origination for Purchase (GSE)

Quicken vs United Share Originations Market Share (%)

Quicken vs United Share of Deliveries to Ginnie Mae (%)
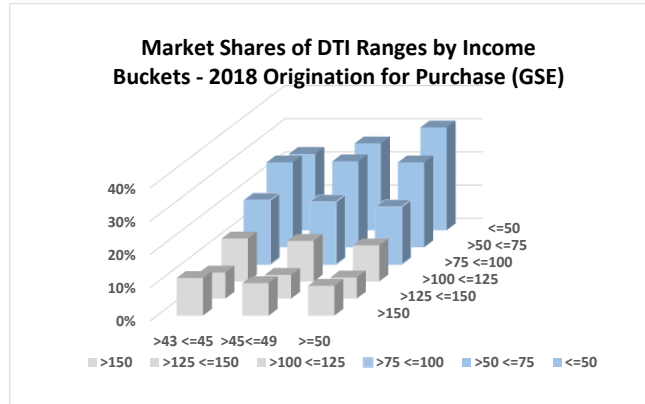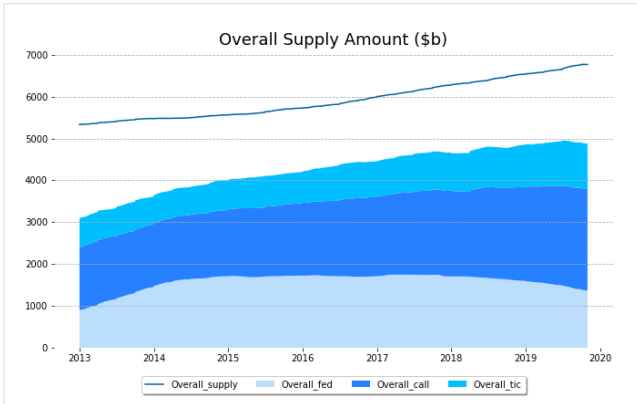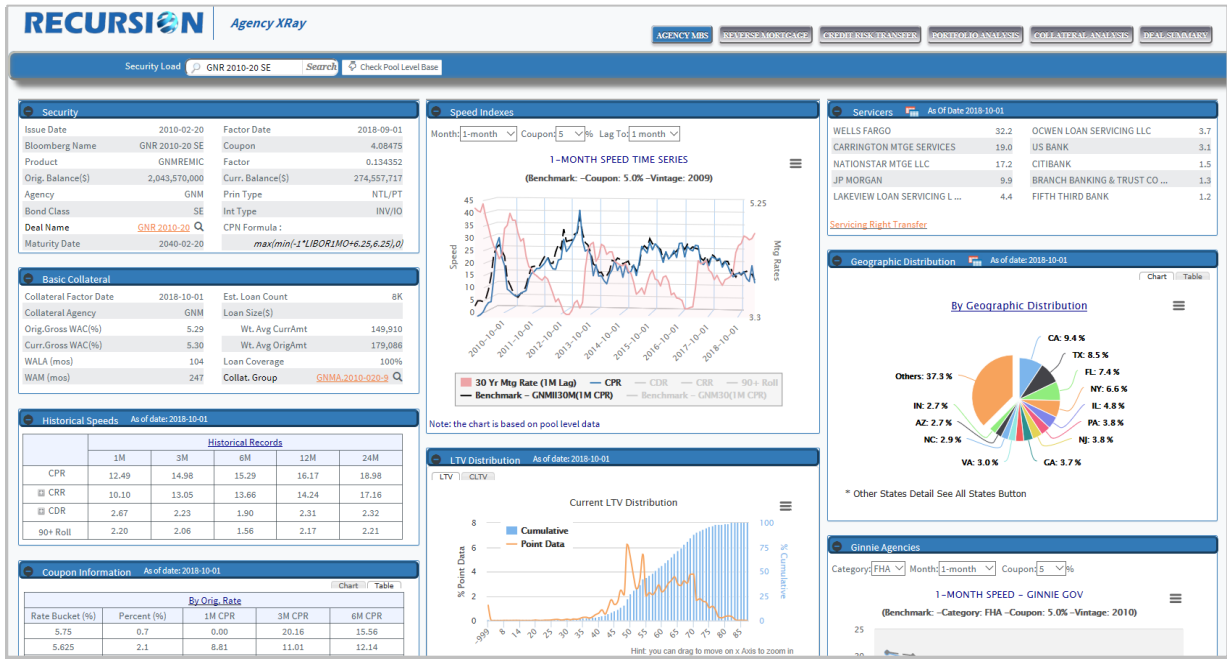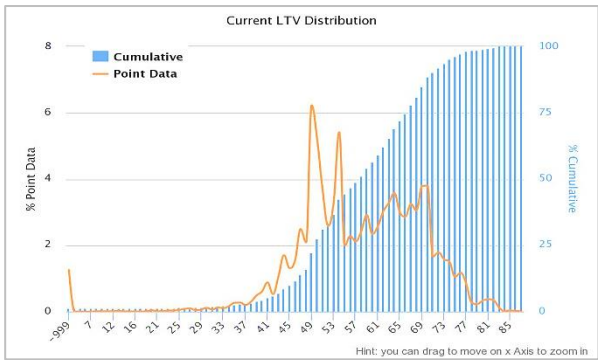
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AGENCY X-RAY

- **Pools, Strips, CMOs**

- **Credit Risk Transfer**

- **HMBS**

Chief Executive Officer: Li Chang

Prior to founding Recursion in 2015, Li was a senior trader managing ABS portfolio for hedge fund Altum Capital Management. Before joining Altum, she traded CMBS for Paulson & Co. Li gained her extensive cross-product understanding on both business and analytics/technology from her earlier experience through working at the proprietary trading desk at Bear Stearns, running the financial engineering team of mortgage desk at Citadel, and conducting quantitative research at Morningstar.

Li holds a PhD degree in Mathematics from University of Illinois at Chicago, and a B.Arch. from Tsinghua University in China. She also joined the Gabelli School at Fordham University as an Industry Expert in Residence.

Chief Research Officer: Richard Koss

Richard comes to Recursion with a strong track record of business acumen and quantitative approaches. Prior to joining Recursion, Koss worked as the head of capital markets research at Fannie Mae. He has over 20 years of experience as a fixed income portfolio manager for Wall Street firms, and recently served as IMF Visiting Scholar and Director of the Global Housing Watch.

Richard has a PhD degree in economics from the University of Pennsylvania and a B.S. from of Mathematics and Statistics from Case Western Reserve University. He is also an Adjunct Professor at the School of International and Public Affairs at Columbia University.

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