

Mortgage delinquency rate and Unemployment Rate in the US

Problem Statement

1. Problem Statement: To investigate the relationship between the mortgage delinquency rate in single households and the unemployment rate (focused on Black or African Americans)
2. Hypothesis: An increase in unemployment rate in the Black community is most likely to lead to an increase in mortgage delinquency rate in single households.
3. Introduction: The cyclical nature of unemployment within a business cycle has a significant impact on mortgage payments, particularly in times of economic downturns. Notably, during the Great Financial Crisis of 2008, an increase in mortgage defaults was observed, especially among borrowers with high loan-to-value ratios, predominantly in minority groups (especially, Blacks and Hispanics groups). The mortgage delinquency rate surged to a record-high at 14.4 per cent. Furthermore, as the Mortgage Bankers Association reported, the delinquency rate was up to 8.22% in the second quarter of 2020. This study aims to investigate the relationship between unemployment rates and high mortgage delinquency rates.

Data Collection

The following data sets were collected by from FRED data:

1. [FRED Delinquency Rate on Single-Family Residential Mortgages, Booked in Domestic Offices, All Commercial Banks](#)
2. [Unemployment Rate - Black or African American](#)

Investigation

1. Data Collection (using FRED API)
2. Data Cleaning
3. Data Visualisation
4. Findings

Data Collection

```
In [1]: !pip install chart-studio

# Import libraries
import pandas as pd
import chart_studio.plotly as py
import plotly.graph_objs as go

Requirement already satisfied: chart-studio in ./opt/anaconda3/lib/python3.9/site-packages (1.1.0)
Requirement already satisfied: requests in ./opt/anaconda3/lib/python3.9/site-packages (from chart-studio) (2.2.6.0)
Requirement already satisfied: retrying>=1.3.3 in ./opt/anaconda3/lib/python3.9/site-packages (from chart-studio) (1.3.4)
Requirement already satisfied: plotly in ./opt/anaconda3/lib/python3.9/site-packages (from chart-studio) (5.8.0)
Requirement already satisfied: six in ./opt/anaconda3/lib/python3.9/site-packages (from chart-studio) (1.16.0)
Requirement already satisfied: tenacity>=6.2.0 in ./opt/anaconda3/lib/python3.9/site-packages (from plotly>chart-studio) (8.0.1)
Requirement already satisfied: certifi>=2017.4.17 in ./opt/anaconda3/lib/python3.9/site-packages (from requests->chart-studio) (2021.10.8)
Requirement already satisfied: charset-normalizer~2.0.0 in ./opt/anaconda3/lib/python3.9/site-packages (from requests->chart-studio) (2.0.4)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in ./opt/anaconda3/lib/python3.9/site-packages (from requests->chart-studio) (1.26.7)
Requirement already satisfied: idna<4,>=2.5 in ./opt/anaconda3/lib/python3.9/site-packages (from requests->chart-studio) (3.2)
```

Install FRED API

```
In [2]: !pip install fredapi

Requirement already satisfied: fredapi in ./opt/anaconda3/lib/python3.9/site-packages (0.5.2)
Requirement already satisfied: pandas in ./opt/anaconda3/lib/python3.9/site-packages (from fredapi) (1.3.4)
Requirement already satisfied: python-dateutil>=2.7.3 in ./opt/anaconda3/lib/python3.9/site-packages (from pandas->fredapi) (2.8.2)
Requirement already satisfied: pytz>=2017.3 in ./opt/anaconda3/lib/python3.9/site-packages (from pandas->fredapi) (2021.3)
Requirement already satisfied: numpy>=1.17.3 in ./opt/anaconda3/lib/python3.9/site-packages (from pandas->fredapi) (1.20.3)
Requirement already satisfied: six>=1.5 in ./opt/anaconda3/lib/python3.9/site-packages (from python-dateutil>=2.7.3->pandas->fredapi) (1.16.0)
```

```
In [3]: #import FRED API
from fredapi import Fred
fred_key = 'b4a932dd43aaa0ab9400ac241a790dca'
fred = Fred(api_key=fred_key)
```

```
In [4]: mortgage_deliq = fred.get_series(series_id = 'DRSFRMACBS')
mortgage_deliq = pd.DataFrame(mortgage_deliq)
mortgage_deliq = mortgage_deliq.reset_index()
mortgage_deliq.columns = ['Date', 'Mortgage Delinquency Rate_Single Family']
mortgage_deliq['Date'] = pd.to_datetime(mortgage_deliq['Date']) # Convert to datetime
mortgage_deliq = mortgage_deliq[(mortgage_deliq['Date'] >= '2005-03-01') & (mortgage_deliq['Date'] <= '2024-01-01')]

unempBA = fred.get_series(series_id = 'LNS14000006')
unempBA = pd.DataFrame(unempBA)
unempBA = unempBA.reset_index()
unempBA.columns = ['Date', 'Unemployment Rate_Black']
unempBA['Date'] = pd.to_datetime(unempBA['Date']) # Convert to datetime
unempBA = unempBA[(unempBA['Date'] >= '2005-03-01') & (unempBA['Date'] <= '2024-01-01')]
```

Data Cleaning

```
In [5]: #shape of the data
mortgage_deliq.shape
```

```
Out[5]: (76, 2)
```

```
In [6]: unempBA.shape
```

```
Out[6]: (227, 2)
```

```
In [7]: mortgage_deliq.head()
```

```
Out[7]: Date Mortgage Delinquency Rate_Single Family
57 2005-04-01 1.55
58 2005-07-01 1.59
59 2005-10-01 1.64
60 2006-01-01 1.61
61 2006-04-01 1.62
```

```
In [8]: unempBA.head()
```

```
Out[8]: Date Unemployment Rate_Black
398 2005-03-01 10.5
399 2005-04-01 10.3
400 2005-05-01 10.1
401 2005-06-01 10.2
402 2005-07-01 9.2
```

```
In [9]: mortgage_deliq.describe()
```

```
Out[9]: Mortgage Delinquency Rate_Single Family
count 76.000000
mean 5.050000
std 3.314975
min 1.550000
25% 2.290000
50% 3.660000
75% 8.082500
max 11.480000
```

```
In [10]: unempBA.describe()
```

```
Out[10]: Unemployment Rate_Black
count 227.000000
mean 10.068722
std 3.425224
min 4.800000
25% 7.400000
50% 9.200000
75% 13.000000
max 16.900000
```

```
In [11]: #checking for missing values
mortgage_deliq.isnull().sum()
```

```
Out[11]: Date Mortgage Delinquency Rate_Single Family 0
dtype: int64
```

```
In [12]: unempBA.isnull().sum()
```

```
Out[12]: Date Unemployment Rate_Black 0
dtype: int64
```

Explore the relationship from the mortgage fixed rates and unemployment from 2008-2024

Interactive plot to compare mortgage delinquency rate_single family and unemployment rate

```
In [13]: #Define the layout for the plot
layout = go.Layout(
    height=600,
    width=800,
    title='Mortgage Delinquency Rate and Unemployment Rate',
    xaxis=dict(title='Date'),
    yaxis=dict(
        title='Residential Commercial Mortgage Delinquency Rate on Single-Family',
        color='red',
        range=[0, 20] # Adjust range for better visualization
    ),
    yaxis2=dict(
        title='Unemployment Rate (Black/African American)',
        color='blue',
        overlaying='y',
        side='right',
        range=[0, 20] # Adjust range for better visualization
    ),
    legend=dict(
        x=1.05, # Move the legend farther to the right
        xanchor='left', # Anchor the legend to the left side of its position
        y=1, # Position the legend vertically at the top
        yanchor='top' # Anchor the legend to the top side of its position
    )
)

# Create traces for both y-axes
trace1 = go.Scatter(
    x=mortgage_deliq['Date'],
    y=mortgage_deliq['Mortgage Delinquency Rate'],
    name='Mortgage Delinquency Rate',
    yaxis='y', # Maps to the left y-axis
    line=dict(color='red')
)

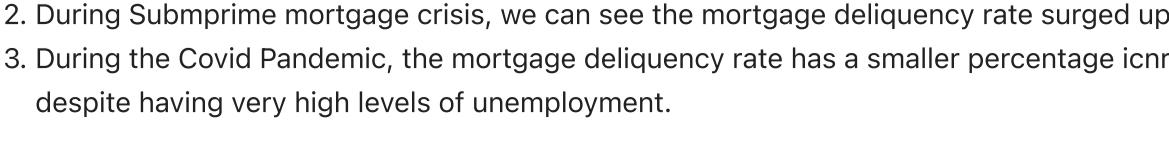
trace2 = go.Scatter(
    x=unempBA['Date'],
    y=unempBA['Unemployment Rate_Black'],
    name='Unemployment Rate',
    yaxis='y2', # Maps to the right y-axis
    line=dict(color='blue')
)

# Create figure with both traces and layout
fig = go.Figure(data=[trace1, trace2], layout=layout)

# Add vertical lines - for dates
dates_for_lines = [
    '2007-04-01': 'Subprime Mortgage Crisis',
    '2020-01-01': 'COVID Pandemic'
]

for date, label in dates_for_lines.items():
    fig.add_vline(
        x=date, # Use string format for date
        line=dict(color='gray', dash='dash')
    )
    fig.add_annotation(
        x=date,
        y=1, # Adjust y value according to your data range
        text=f'{label}', # Label for the vertical line
        showarrow=True,
        arrowhead=2
    )

# Plot the figure
fig.show() # This will display the plot in your local environment
```



```
In [14]: #printing out the plotly as html
fig.write_html("mortgage_unemploymentBlack.html")
```

Findings

1. There is a correlation between unemployment in the Black community and mortgage delinquency rate in single households.
2. During Subprime mortgage crisis, we can see the mortgage delinquency rate surged up around 200%.
3. During the Covid Pandemic, the mortgage delinquency rate has a smaller percentage increase due to forbearance scheme, despite having very high levels of unemployment.

Future investigations

1. Perform a Predictive model: using a time series forecasting and regression analysis
2. Advise solutions based on data analysis results, and scholar journals and articles