eda

July 25, 2024

1 Loading the Data

[1]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import plotly.express as px
import plotly.graph_objects as go
```

[ ]:
```
home_prices = pd.read_csv('data/CSUSHPISA.csv', parse_dates=['DATE'])
federal_funds_rate = pd.read_csv('data/DFF.csv', parse_dates=['DATE'])
disposable_income = pd.read_csv('data/DSPIC96.csv', parse_dates=['DATE'])
housing_starts = pd.read_csv('data/HOUST1F.csv', parse_dates=['DATE'])
median_income = pd.read_csv('data/MEHOINUSA672N.csv', parse_dates=['DATE'])
mortgage_rate = pd.read_csv('data/MORTGAGE30US.csv', parse_dates=['DATE'])
housing_supply = pd.read_csv('data/MSACSR.csv', parse_dates=['DATE'])
residential_investment = pd.read_csv('data/PRRESCONS.csv', parse_dates=['DATE'])
unemployment_rate = pd.read_csv('data/UNRATE.csv', parse_dates=['DATE'])
personal_savings_rate = pd.read_csv('data/PSAVERT.csv', parse_dates=['DATE'])
real_disposable_personal_income = pd.read_csv('data/A229RX0.csv',␣
↪parse_dates=['DATE'])
```

[5]:
```
home_prices.set_index('DATE', inplace=True)
federal_funds_rate.set_index('DATE', inplace=True)
disposable_income.set_index('DATE', inplace=True)
housing_starts.set_index('DATE', inplace=True)
median_income.set_index('DATE', inplace=True)
mortgage_rate.set_index('DATE', inplace=True)
housing_supply.set_index('DATE', inplace=True)
residential_investment.set_index('DATE', inplace=True)
unemployment_rate.set_index('DATE', inplace=True)
personal_savings_rate.set_index('DATE', inplace=True)
real_disposable_personal_income.set_index('DATE', inplace=True)
```

[6]:
```
data_combined = pd.concat([home_prices, federal_funds_rate, disposable_income,␣
↪housing_starts,
                           median_income, mortgage_rate, housing_supply,␣
↪residential_investment,
```

```
                            unemployment_rate, personal_savings_rate,␣
 ↪real_disposable_personal_income], axis=1)
data_combined.columns = ['Home Prices', 'Federal Funds Rate', 'Disposable␣
 ↪Income', 'Housing Starts',
                         'Median Income', 'Mortgage Rate', 'Housing Supply',␣
 ↪'Residential Investment',
                         'Unemployment Rate', 'Personal Savings Rate', 'Real␣
 ↪Disposable Personal Income']
```

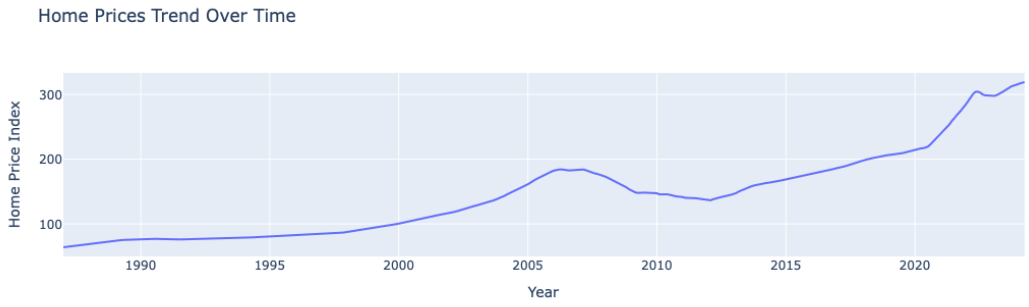
2 EDA

2.1 Line Plot for Individual Trends

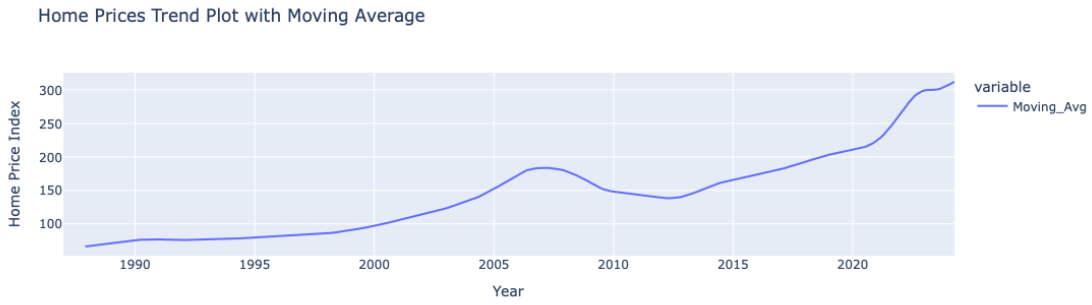
2.1.1 Home Prices Trend

Analyzing the trend of home prices over time helps us understand the general movement and cycles in the housing market. This provides a baseline for comparison with other factors.

[7]:
```
fig = px.line(home_prices, y=home_prices.columns[0], title='Home Prices Trend␣
 ↪Over Time')
fig.update_layout(xaxis_title='Year', yaxis_title='Home Price Index')
fig.show()
```



[8]:
```
home_prices['Moving_Avg'] = home_prices[home_prices.columns[0]].
 ↪rolling(window=12).mean()

fig = px.line(home_prices, y=['Moving_Avg'], title='Home Prices Trend Plot with␣
 ↪Moving Average')
fig.update_layout(xaxis_title='Year', yaxis_title='Home Price Index')
fig.show()
```

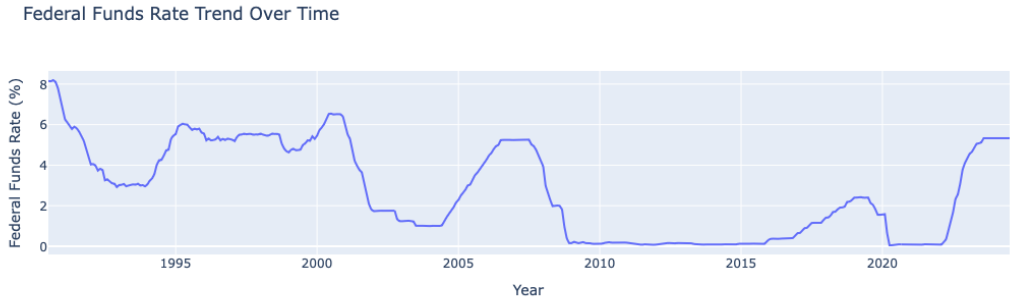


The sharp rise in home prices from the late 1990s to 2005 likely reflects the housing bubble in the USA. This was fueled by factors such as low interest rates, relaxed lending standards, and speculative buying. The subsequent plateau might indicate the beginning of the 2008 financial crisis.

2.1.2 Federal Funds Rate Trend

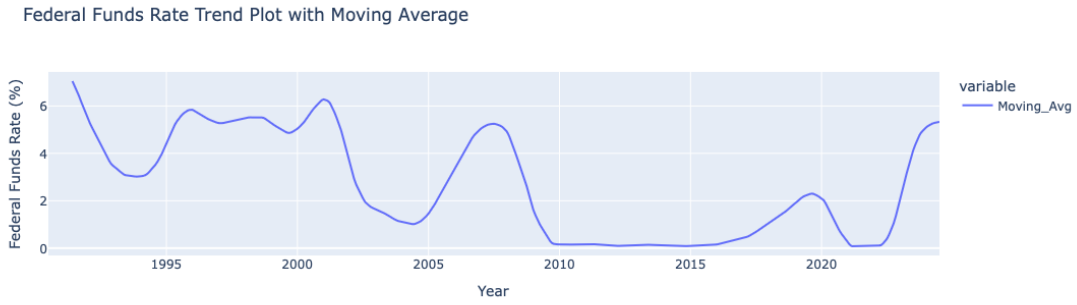
The federal funds rate is a key interest rate that influences other interest rates, including mortgage rates. Analyzing its trend helps understand how monetary policy impacts home prices.

[9]:
```
fig = px.line(federal_funds_rate, y=federal_funds_rate.columns[0],␣
↪title='Federal Funds Rate Trend Over Time')
fig.update_layout(xaxis_title='Year', yaxis_title='Federal Funds Rate (%)')
fig.show()
```



[10]:
```
federal_funds_rate['Moving_Avg'] = federal_funds_rate[federal_funds_rate.
↪columns[0]].rolling(window=12).mean()

fig = px.line(federal_funds_rate, y=['Moving_Avg'], title='Federal Funds Rate␣
↪Trend Plot with Moving Average')
```

```
fig.update_layout(xaxis_title='Year', yaxis_title='Federal Funds Rate (%)')
fig.show()
```

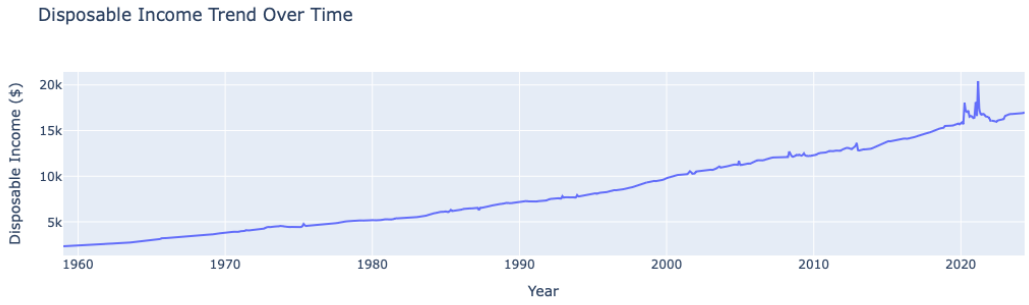


The decline in the Federal Funds Rate after 2000 was likely a response to the dot-com bubble burst and the 2001 recession. The Federal Reserve lowered rates to stimulate economic growth, which inadvertently may have contributed to the housing bubble.

2.1.3 Disposable Income Trend

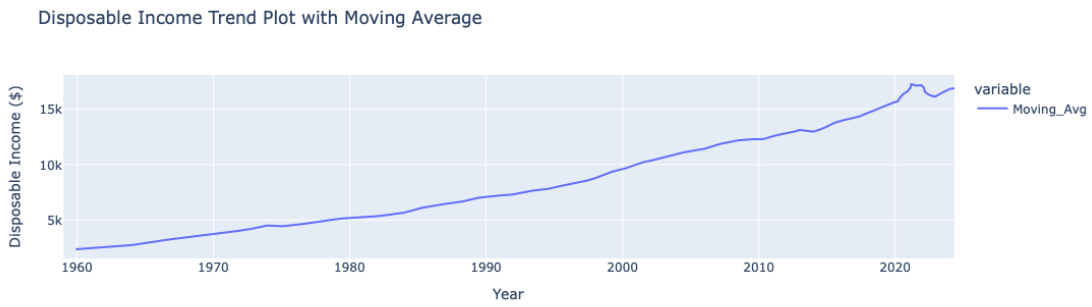
Disposable income represents the amount of money households have after taxes. Higher disposable income can lead to increased home affordability, impacting home prices.

[11]:
```
fig = px.line(disposable_income, y=disposable_income.columns[0],␣
↪title='Disposable Income Trend Over Time')
fig.update_layout(xaxis_title='Year', yaxis_title='Disposable Income ($)')
fig.show()
```



[12]:
```
disposable_income['Moving_Avg'] = disposable_income[disposable_income.
↪columns[0]].rolling(window=12).mean()
```

```
fig = px.line(disposable_income, y=['Moving_Avg'], title='Disposable Income␣
↪Trend Plot with Moving Average')
fig.update_layout(xaxis_title='Year', yaxis_title='Disposable Income ($)')
fig.show()
```

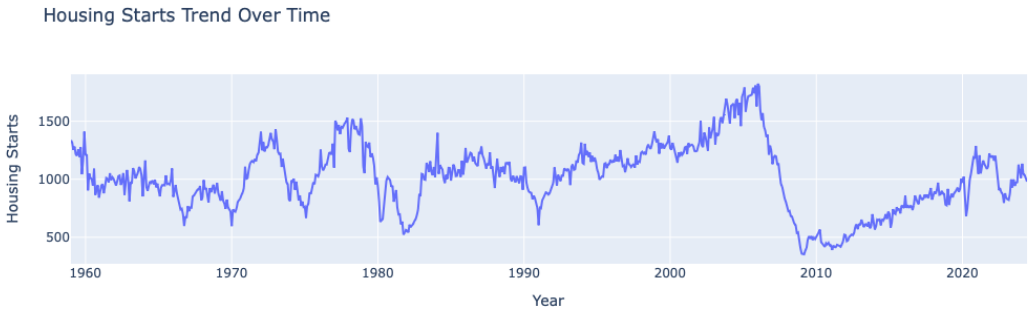


The steady increase from 1960 to 1990 reflects post-war economic prosperity, technological advancements, and productivity gains. Events like the Civil Rights movement and women entering the workforce in larger numbers may have contributed to this trend.

2.1.4 Housing Starts Trend

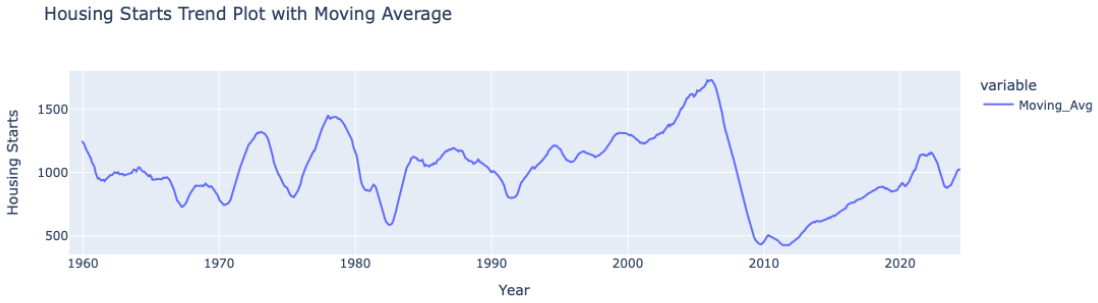
Housing starts indicate the number of new residential construction projects. It's a leading indicator of housing supply and economic activity, impacting home prices.

[13]:
```
fig = px.line(housing_starts, y=housing_starts.columns[0], title='Housing␣
↪Starts Trend Over Time')
fig.update_layout(xaxis_title='Year', yaxis_title='Housing Starts')
fig.show()
```



[14]:
```
housing_starts['Moving_Avg'] = housing_starts[housing_starts.columns[0]].
↪rolling(window=12).mean()
```

```
fig = px.line(housing_starts, y=['Moving_Avg'], title='Housing Starts Trend␣
↪Plot with Moving Average')
fig.update_layout(xaxis_title='Year', yaxis_title='Housing Starts')
fig.show()
```

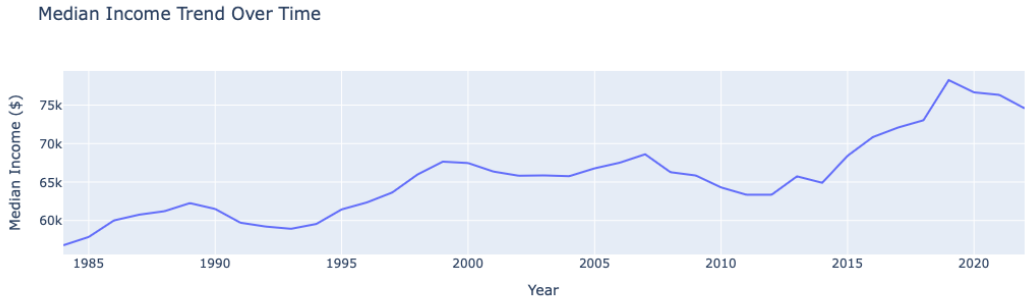


Peaks and troughs in housing starts often correspond to economic cycles. The notable dip in the early 1980s might be related to the recession and high interest rates of that period. Peaks could be associated with periods of economic optimism and population growth. Also dip in 2010 might be due to burst of housing bubble.

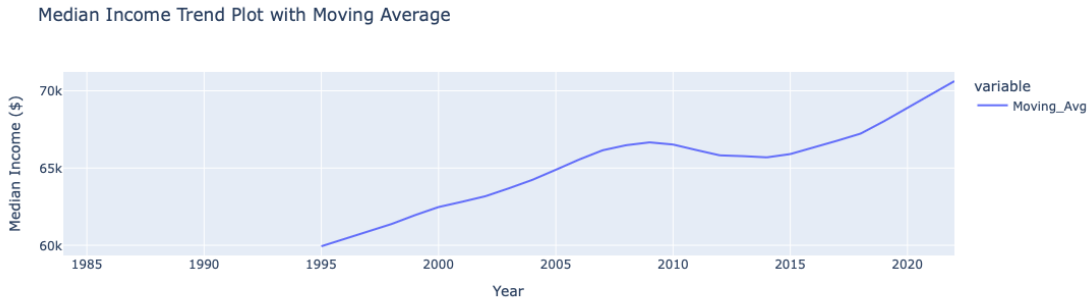
2.1.5 Median Income Trend

Median income is a measure of the average income of households. Higher median income can increase housing affordability and demand, influencing home prices.

[15]:
```
fig = px.line(median_income, y=median_income.columns[0], title='Median Income␣
↪Trend Over Time')
fig.update_layout(xaxis_title='Year', yaxis_title='Median Income ($)')
fig.show()
```



[16]:
```
median_income['Moving_Avg'] = median_income[median_income.columns[0]].
↪rolling(window=12).mean()

fig = px.line(median_income, y=['Moving_Avg'], title='Median Income Trend Plot␣
↪with Moving Average')
fig.update_layout(xaxis_title='Year', yaxis_title='Median Income ($)')
fig.show()
```

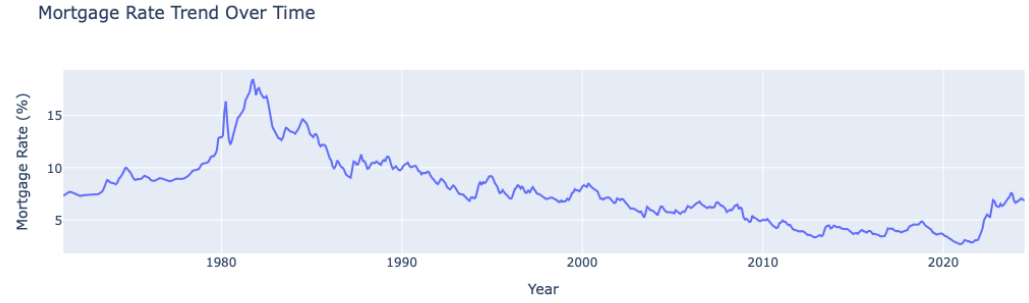


The overall increase from 1985 to 2000 might reflect the economic boom of the 1990s, driven by factors such as technological advancements (particularly the rise of personal computers and the internet) and globalization.

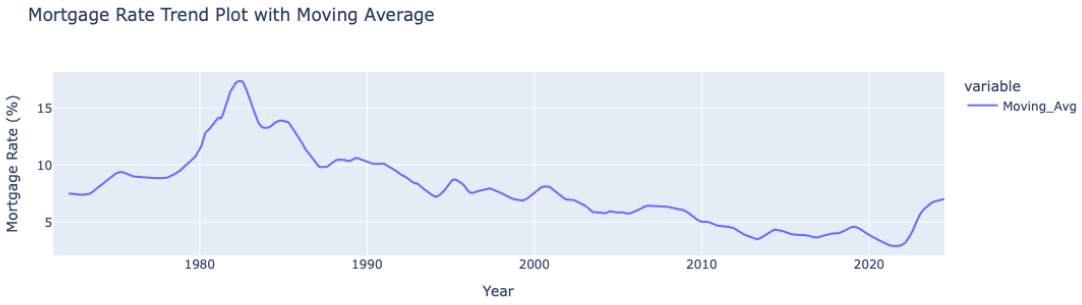
2.1.6 Mortgage Rate Trend

Mortgage rates directly affect the cost of financing a home. Analyzing their trend helps understand how changes in borrowing costs influence home prices.

[17]:
```
fig = px.line(mortgage_rate, y=mortgage_rate.columns[0], title='Mortgage Rate␣
↪Trend Over Time')
fig.update_layout(xaxis_title='Year', yaxis_title='Mortgage Rate (%)')
fig.show()
```



[18]:
```
mortgage_rate['Moving_Avg'] = mortgage_rate[mortgage_rate.columns[0]].
↪rolling(window=12).mean()

fig = px.line(mortgage_rate, y=['Moving_Avg'], title='Mortgage Rate Trend Plot␣
↪with Moving Average')
fig.update_layout(xaxis_title='Year', yaxis_title='Mortgage Rate (%)')
fig.show()
```

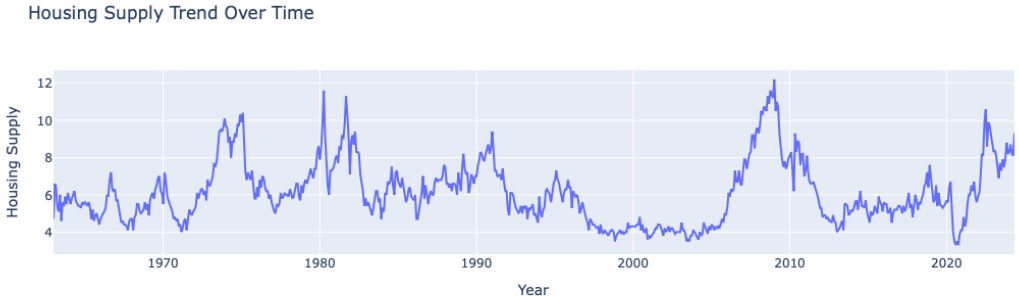


The significant decline from 1980 to 1990 likely reflects the Federal Reserve's efforts to combat the high inflation of the early 1980s, followed by a period of economic stabilization and growth.

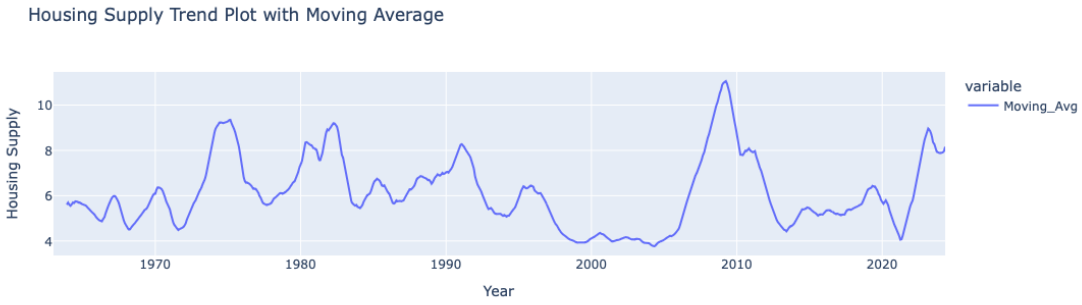
2.1.7 Housing Supply Trend

Housing supply affects the availability of homes in the market. Analyzing its trend helps understand the balance between supply and demand, impacting home prices.

[19]:
```
fig = px.line(housing_supply, y=housing_supply.columns[0], title='Housing␣
↪Supply Trend Over Time')
fig.update_layout(xaxis_title='Year', yaxis_title='Housing Supply')
fig.show()
```



[20]:
```
housing_supply['Moving_Avg'] = housing_supply[housing_supply.columns[0]].
↪rolling(window=12).mean()

fig = px.line(housing_supply, y=['Moving_Avg'], title='Housing Supply Trend␣
↪Plot with Moving Average')
fig.update_layout(xaxis_title='Year', yaxis_title='Housing Supply')
fig.show()
```

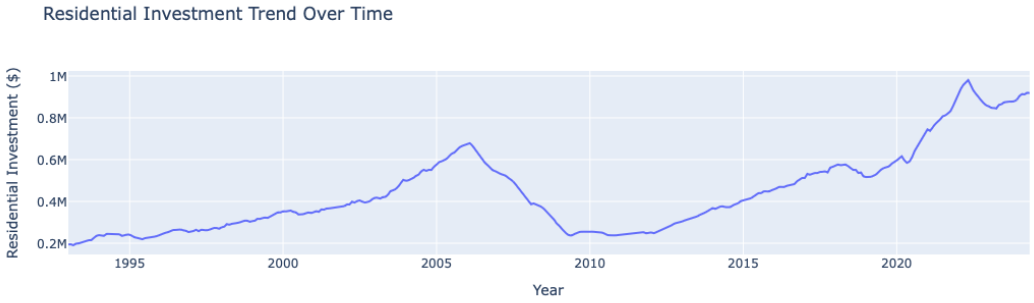


Fluctuations between 1970 and 1990 could be influenced by factors such as changes in zoning laws, shifts in urban development policies, and responses to demographic changes like the aging of the Baby Boomer generation.

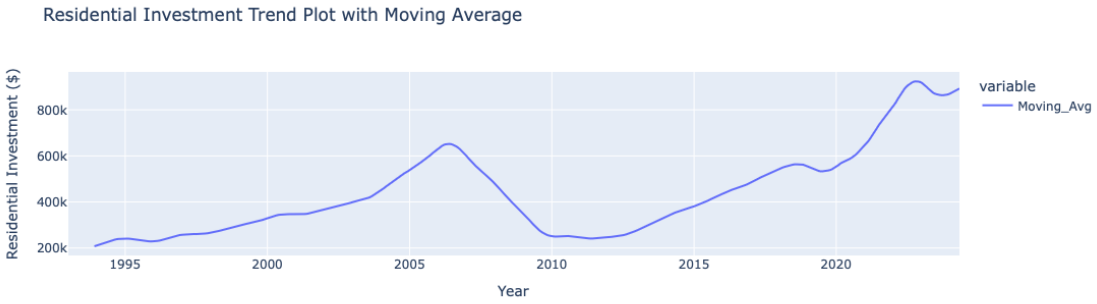
2.1.8 Residential Investment Trend

Residential investment includes spending on residential buildings and structures. Its trend indicates economic investment in housing, influencing home prices.

[21]:
```
fig = px.line(residential_investment, y=residential_investment.columns[0],␣
↪title='Residential Investment Trend Over Time')
fig.update_layout(xaxis_title='Year', yaxis_title='Residential Investment ($)')
fig.show()
```



[22]:
```
residential_investment['Moving_Avg'] =␣
↪residential_investment[residential_investment.columns[0]].rolling(window=12).
↪mean()

fig = px.line(residential_investment, y=['Moving_Avg'], title='Residential␣
↪Investment Trend Plot with Moving Average')
fig.update_layout(xaxis_title='Year', yaxis_title='Residential Investment ($)')
fig.show()
```

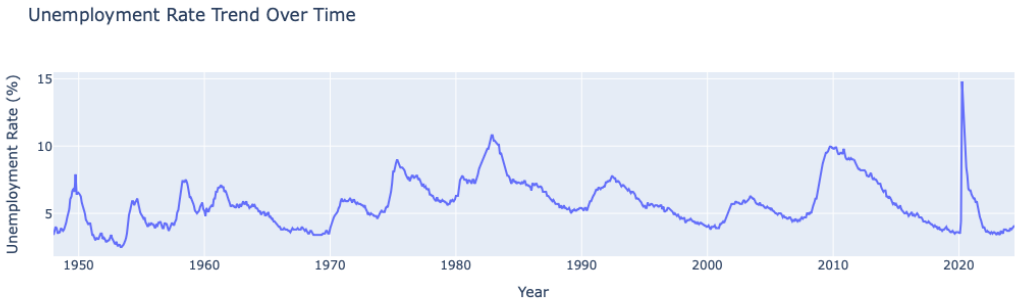


The increase from 1995 to 2005 aligns with the housing boom. This could be attributed to factors such as low interest rates, population growth, and a general belief in ever-increasing home values.

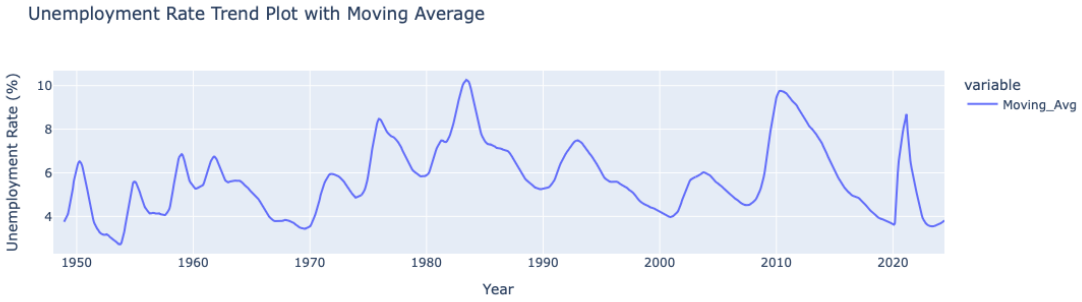
2.1.9 Unemployment Rate Trend

The unemployment rate is a measure of economic health. Higher unemployment can reduce income and housing demand, impacting home prices.

[23]:
```
fig = px.line(unemployment_rate, y=unemployment_rate.columns[0],␣
↪title='Unemployment Rate Trend Over Time')
fig.update_layout(xaxis_title='Year', yaxis_title='Unemployment Rate (%)')
fig.show()
```



[24]:
```
unemployment_rate['Moving_Avg'] = unemployment_rate[unemployment_rate.
↪columns[0]].rolling(window=12).mean()

fig = px.line(unemployment_rate, y=['Moving_Avg'], title='Unemployment Rate␣
↪Trend Plot with Moving Average')
fig.update_layout(xaxis_title='Year', yaxis_title='Unemployment Rate (%)')
fig.show()
```

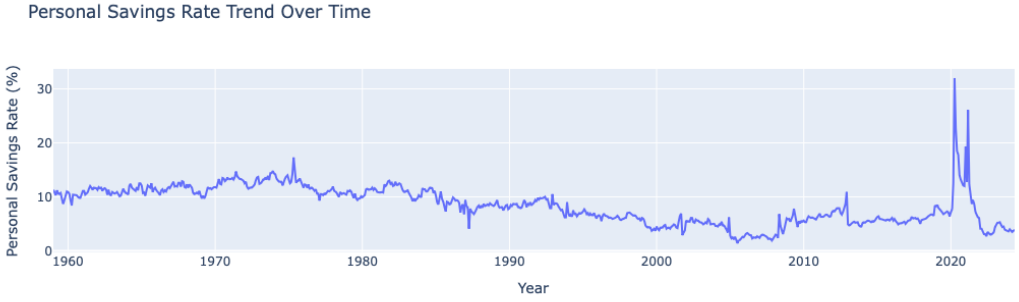


Fluctuations from 1950 to 1980 reflect various economic events, including the post-war boom, the oil crises of the 1970s, and periods of recession and recovery. The peak in the early 1980s likely corresponds to the recession of that period.

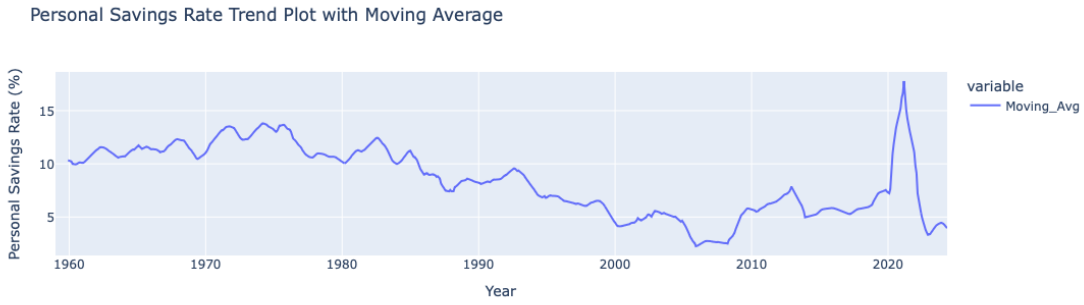
2.1.10 Personal Savings Rate Trend

The personal savings rate indicates the portion of disposable income saved by households. It reflects financial security and can impact housing affordability and home prices.

[25]:
```
fig = px.line(personal_savings_rate, y=personal_savings_rate.columns[0],␣
↪title='Personal Savings Rate Trend Over Time')
fig.update_layout(xaxis_title='Year', yaxis_title='Personal Savings Rate (%)')
fig.show()
```



[26]:
```
personal_savings_rate['Moving_Avg'] =␣
↪personal_savings_rate[personal_savings_rate.columns[0]].rolling(window=12).
↪mean()

fig = px.line(personal_savings_rate, y=['Moving_Avg'], title='Personal Savings␣
↪Rate Trend Plot with Moving Average')
fig.update_layout(xaxis_title='Year', yaxis_title='Personal Savings Rate (%)')
fig.show()
```

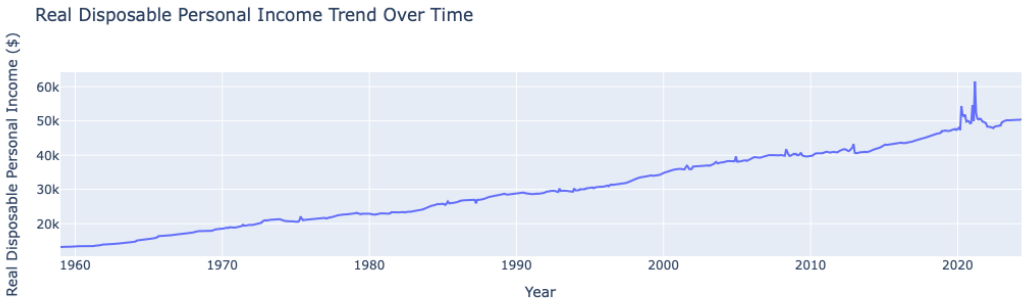


The general decline from 1960 to 1990 might be due to factors such as increased access to credit, rising consumerism, and potentially a growing sense of economic security that reduced the perceived need for savings.

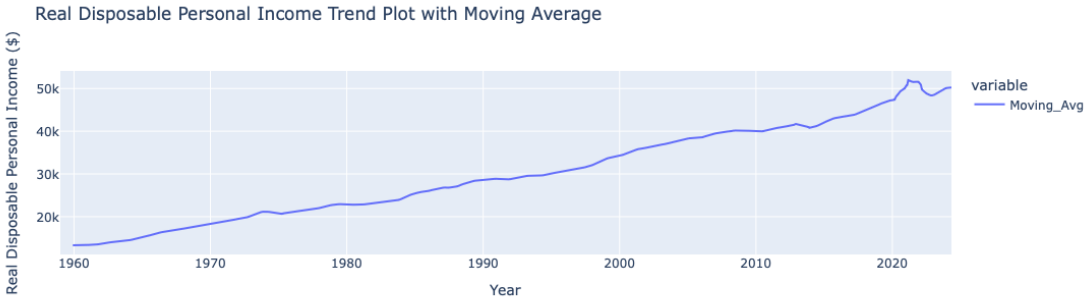
2.1.11 Real Disposable Personal Income Trend

Real disposable personal income is adjusted for inflation and represents the purchasing power of households. Analyzing its trend helps understand its impact on housing affordability and home prices.

[27]:
```
fig = px.line(real_disposable_personal_income,␣
↪y=real_disposable_personal_income.columns[0], title='Real Disposable␣
↪Personal Income Trend Over Time')
fig.update_layout(xaxis_title='Year', yaxis_title='Real Disposable Personal␣
↪Income ($)')
fig.show()
```



[28]:
```
real_disposable_personal_income['Moving_Avg'] =␣
↪real_disposable_personal_income[real_disposable_personal_income.columns[0]].
↪rolling(window=12).mean()

fig = px.line(real_disposable_personal_income, y=['Moving_Avg'], title='Real␣
↪Disposable Personal Income Trend Plot with Moving Average')
fig.update_layout(xaxis_title='Year', yaxis_title='Real Disposable Personal␣
↪Income ($)')
fig.show()
```



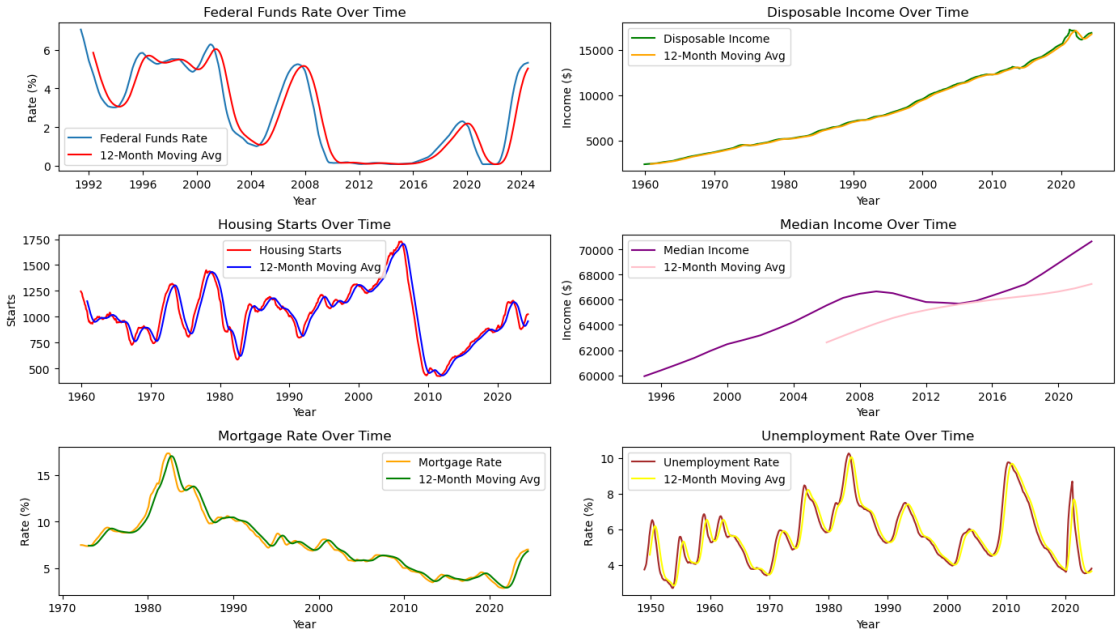
The steady increase from 1960 to 1990 reflects overall economic growth, productivity gains, and improvements in living standards. This period encompasses events like the Space Race, which drove technological advancements, and the expansion of social programs. THe dip in 2020-2021 might be due to outbreak of covid.

2.1.12 Time Series Plots: Factors Over Time

[29]:
```
plt.figure(figsize=(14, 8))

plt.subplot(3, 2, 1)
```

```
sns.lineplot(data=federal_funds_rate, x='DATE', y=federal_funds_rate.
 ↪columns[1], label='Federal Funds Rate')
sns.lineplot(data=federal_funds_rate, x='DATE',␣
 ↪y=federal_funds_rate[federal_funds_rate.columns[1]].rolling(window=12).
 ↪mean(), color='red', label='12-Month Moving Avg')
plt.title('Federal Funds Rate Over Time')
plt.xlabel('Year')
plt.ylabel('Rate (%)')
plt.legend()

plt.subplot(3, 2, 2)
sns.lineplot(data=disposable_income, x='DATE', y=disposable_income.columns[1],␣
 ↪label='Disposable Income', color='green')
sns.lineplot(data=disposable_income, x='DATE',␣
 ↪y=disposable_income[disposable_income.columns[1]].rolling(window=12).mean(),␣
 ↪color='orange', label='12-Month Moving Avg')
plt.title('Disposable Income Over Time')
plt.xlabel('Year')
plt.ylabel('Income ($)')
plt.legend()

plt.subplot(3, 2, 3)
sns.lineplot(data=housing_starts, x='DATE', y=housing_starts.columns[1],␣
 ↪label='Housing Starts', color='red')
sns.lineplot(data=housing_starts, x='DATE', y=housing_starts[housing_starts.
 ↪columns[1]].rolling(window=12).mean(), color='blue', label='12-Month Moving␣
 ↪Avg')
plt.title('Housing Starts Over Time')
plt.xlabel('Year')
plt.ylabel('Starts')
plt.legend()

plt.subplot(3, 2, 4)
sns.lineplot(data=median_income, x='DATE', y=median_income.columns[1],␣
 ↪label='Median Income', color='purple')
sns.lineplot(data=median_income, x='DATE', y=median_income[median_income.
 ↪columns[1]].rolling(window=12).mean(), color='pink', label='12-Month Moving␣
 ↪Avg')
plt.title('Median Income Over Time')
plt.xlabel('Year')
plt.ylabel('Income ($)')
plt.legend()

plt.subplot(3, 2, 5)
sns.lineplot(data=mortgage_rate, x='DATE', y=mortgage_rate.columns[1],␣
 ↪label='Mortgage Rate', color='orange')
```

```
sns.lineplot(data=mortgage_rate, x='DATE', y=mortgage_rate[mortgage_rate.
 ↪columns[1]].rolling(window=12).mean(), color='green', label='12-Month Moving␣
 ↪Avg')
plt.title('Mortgage Rate Over Time')
plt.xlabel('Year')
plt.ylabel('Rate (%)')
plt.legend()

plt.subplot(3, 2, 6)
sns.lineplot(data=unemployment_rate, x='DATE', y=unemployment_rate.columns[1],␣
 ↪label='Unemployment Rate', color='brown')
sns.lineplot(data=unemployment_rate, x='DATE',␣
 ↪y=unemployment_rate[unemployment_rate.columns[1]].rolling(window=12).mean(),␣
 ↪color='yellow', label='12-Month Moving Avg')
plt.title('Unemployment Rate Over Time')
plt.xlabel('Year')
plt.ylabel('Rate (%)')
plt.legend()

plt.tight_layout()
plt.show()
```



My Comment on the Time Series Plot for major factors Over Time with potential reasons or events reflecting the trends shown:

1. Federal Funds Rate (1970-2024): The Federal Funds Rate shows significant fluctuations over the decades. Notable events include the high rates in the early 1980s to combat inflation, and

the near-zero rates from 2008 to 2016 in response to the financial crisis. The sharp drop in 2020 likely reflects the Fed's reaction to the COVID-19 pandemic.

2. Housing Starts (1960-2020): Housing starts exhibit cyclical patterns, reflecting economic conditions and demographic shifts. The sharp decline in the early 1980s coincides with a recession, while the dramatic drop around 2008-2009 clearly shows the impact of the subprime mortgage crisis and Great Recession.

3. Mortgage Rate (1980-2020): Mortgage rates show a general downward trend from the 1980s through the 2010s. The extremely high rates in the early 1980s correspond to a period of high inflation, while the stability at low levels in the 2010s reflects the prolonged period of low interest rates following the 2008 financial crisis.

4. Disposable Income (1960-1990): Disposable income shows a steady increase from 1960 to 1990. This trend reflects the post-war economic boom, technological advancements increasing productivity, and significant demographic shifts such as Baby Boomers entering their prime earning years and more women joining the workforce.

5. Median Income (1985-2000): Median income generally increased from 1985 to 2000, with some fluctuations. This trend aligns with the economic boom of the 1990s, driven by factors such as the tech boom and increased globalization, which created new high-paying jobs and opened new markets for U.S. companies.

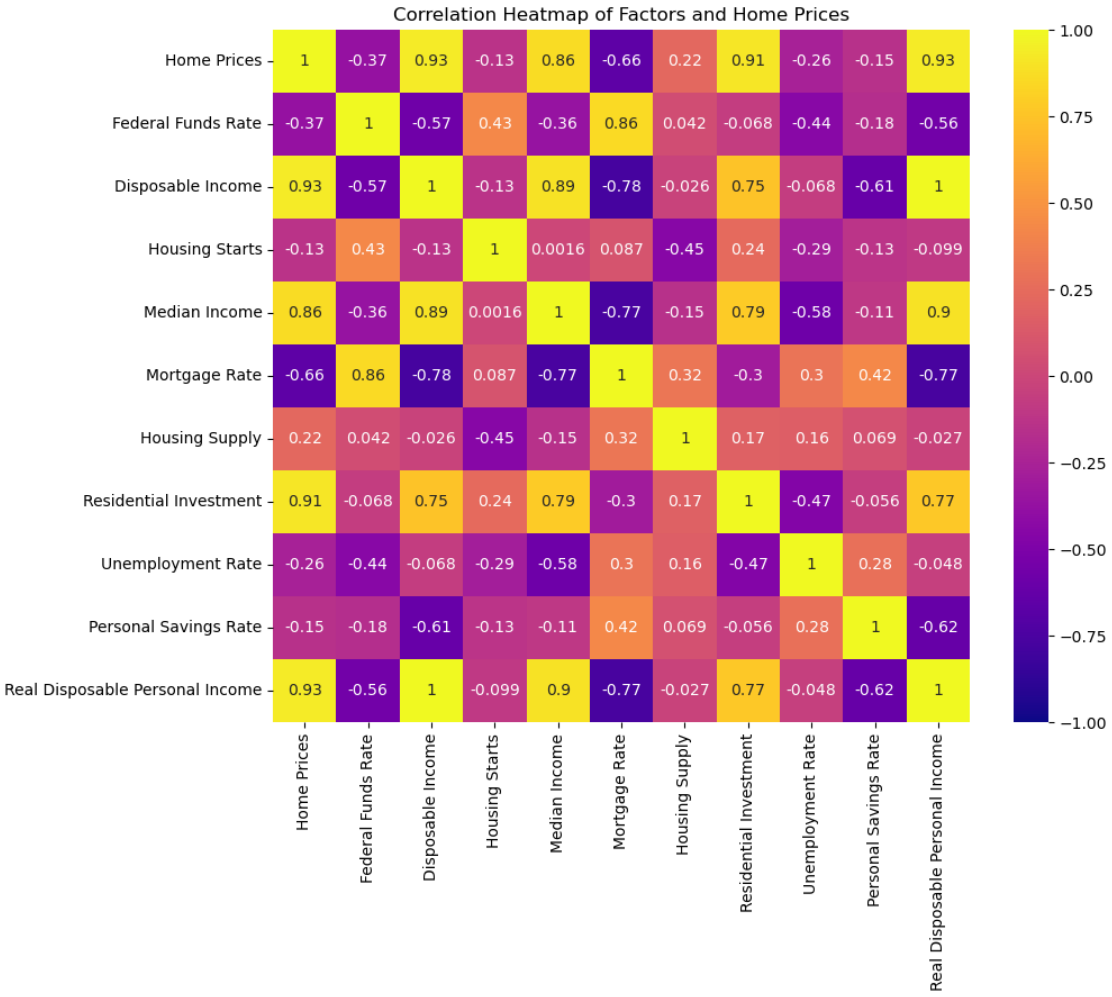
6. Unemployment Rate (1950-1980): The unemployment rate fluctuated significantly from 1950 to 1980. These changes reflect various economic cycles, including several recessions, as well as major events like the oil crises of the 1970s and the entry of the Baby Boomer generation into the workforce.

[30]:
```
fig = go.Figure()

fig.add_trace(go.Scatter(x=federal_funds_rate.loc['1990':'2020'].index,␣
 ↪y=federal_funds_rate.loc['1990':'2020']['DFF'], mode='lines', name='Federal␣
 ↪Funds Rate'))
fig.add_trace(go.Scatter(x=disposable_income.loc['1990':'2020'].index,␣
 ↪y=disposable_income.loc['1990':'2020']['DSPIC96'], mode='lines',␣
 ↪name='Disposable Income'))
fig.add_trace(go.Scatter(x=housing_starts.loc['1990':'2020'].index,␣
 ↪y=housing_starts.loc['1990':'2020']['HOUST1F'], mode='lines', name='Housing␣
 ↪Starts'))
fig.add_trace(go.Scatter(x=median_income.loc['1990':'2020'].index,␣
 ↪y=median_income.loc['1990':'2020']['MEHOINUSA672N'], mode='lines',␣
 ↪name='Median Income'))
fig.add_trace(go.Scatter(x=mortgage_rate.loc['1990':'2020'].index,␣
 ↪y=mortgage_rate.loc['1990':'2020']['MORTGAGE30US'], mode='lines',␣
 ↪name='Mortgage Rate'))
fig.add_trace(go.Scatter(x=unemployment_rate.loc['1990':'2020'].index,␣
 ↪y=unemployment_rate.loc['1990':'2020']['UNRATE'], mode='lines',␣
 ↪name='Unemployment Rate'))

fig.update_layout(title='Multiple Factors Over Time (1990 - 2020)',
```

```
                  xaxis_title='Year',
                  yaxis_title='Values',
                  xaxis_rangeslider_visible=True)

fig.show()
```

2.1.13 Correlation Heatmap

[31]:
```
plt.figure(figsize=(10, 8))
corr_matrix = data_combined.corr()
sns.heatmap(corr_matrix, annot=True, cmap='plasma', vmin=-1, vmax=1)
plt.title('Correlation Heatmap of Factors and Home Prices')
plt.show()
```



2.1.14 The correlation heatmap displays the relationships between various economic factors and home prices in the USA. Here are the key observations:

1. Home Prices correlations:
   - Strongest positive correlations are with Disposable Income (0.93), Real Disposable Personal Income (0.93), Residential Investment (0.91), and Median Income (0.86).
   - This suggests that as households have more money to spend and invest, home prices tend to rise.
   - The strong negative correlation with Mortgage Rate (-0.66) indicates that lower borrowing costs are associated with higher home prices.
   - Interestingly, there's a weak positive correlation with Housing Supply (0.22), which might seem counterintuitive but could reflect that supply often increases in response to rising prices.
2. Federal Funds Rate:
   - Shows a strong positive correlation with Mortgage Rate (0.86), reflecting how the Fed's monetary policy directly influences borrowing costs.

- Negative correlations with Disposable Income (-0.57) and Real Disposable Personal Income (-0.56) suggest that higher interest rates might constrain household spending power.

3. Disposable Income and Real Disposable Personal Income:
   - Perfect correlation (1.00) with each other, as expected.
   - Strong positive correlations with Median Income (0.89 and 0.90) and Residential Investment (0.75 and 0.75).
   - Negative correlations with Mortgage Rate (-0.78 and -0.77) and Personal Savings Rate (-0.61 for both).
4. Housing Starts:
   - Surprisingly low correlations with most factors, including a weak negative correlation with Home Prices (-0.13).
   - Highest correlation is with Federal Funds Rate (0.43), which is somewhat unexpected.
5. Median Income:
   - Strong negative correlation with Mortgage Rate (-0.77) and Unemployment Rate (-0.58).
   - This suggests that higher incomes are associated with lower unemployment and lower mortgage rates.
6. Unemployment Rate:
   - Negative correlations with most factors, including Home Prices (-0.26) and Median Income (-0.58).
   - Positive correlation with Mortgage Rate (0.30), suggesting that periods of higher unemployment might coincide with higher borrowing costs.
7. Personal Savings Rate:
   - Negative correlations with most factors, including Home Prices (-0.15) and Disposable Income (-0.61).
   - This could indicate that during periods of economic growth and rising home prices, people tend to save less.
8. Housing Supply:
   - Relatively weak correlations with most factors, with the strongest being a positive correlation with Mortgage Rate (0.32).

2.1.15 Pair Plot

[32]:
```
pairplot = sns.pairplot(data_combined,
                        vars=['Federal Funds Rate', 'Disposable Income',␣
 ↪'Housing Starts', 'Median Income',
                              'Mortgage Rate', 'Housing Supply', 'Residential␣
 ↪Investment', 'Unemployment Rate',
                              'Personal Savings Rate', 'Real Disposable Personal␣
 ↪Income', 'Home Prices'])

for ax in pairplot.axes.flatten():
    ax.set_xlabel(ax.get_xlabel(), labelpad=10, fontsize=8, rotation=45)
    ax.set_ylabel(ax.get_ylabel(), labelpad=10, fontsize=8, rotation=45)

plt.subplots_adjust(top=0.95)
pairplot.fig.set_size_inches(14, 14)
```

```
pairplot.fig.suptitle('Scatter Matrix of Factors and Home Prices', y=1.02)

plt.show()
```

The pair plot provides a matrix of scatter plots showing relationships between multiple variables. Key observations include:

1. Home Prices vs. Federal Funds Rate: Negative relationship with a slight curve, suggesting non-linear effects at higher rates.

2. Home Prices vs. Disposable Income: Strong positive relationship with a fairly tight clustering

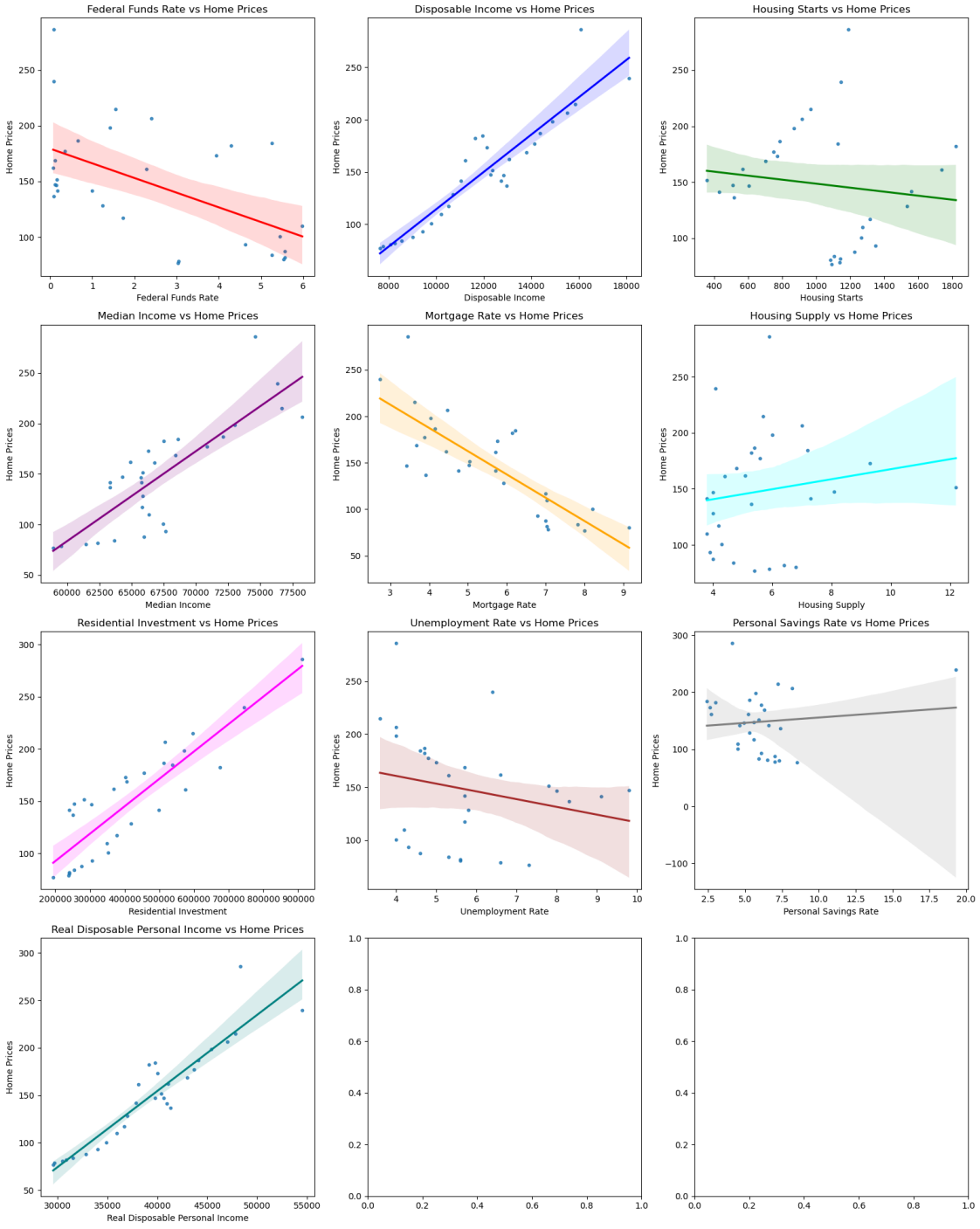
of points.

3. Home Prices vs. Median Income: Positive relationship, but with more scatter than disposable income.
4. Home Prices vs. Mortgage Rate: Negative relationship with a pronounced curve, indicating stronger effects at higher rates.
5. Home Prices vs. Residential Investment: Strong positive relationship with some clustering at higher values.
6. Home Prices vs. Real Disposable Personal Income: Very strong positive relationship, almost linear with tight clustering.
7. Federal Funds Rate vs. Mortgage Rate: Strong positive relationship, as expected given their interconnected nature in the financial system.
8. Disposable Income vs. Real Disposable Personal Income: Near-perfect positive linear relationship, reflecting their similar measures.
9. Median Income vs. Disposable Income: Positive relationship but with more scatter, suggesting some divergence in these income measures.
10. Residential Investment vs. Disposable Income: Positive relationship with some clustering, indicating a connection between income and housing investment.
11. Personal Savings Rate vs. other factors: Generally shows weak or unclear relationships with most other variables.

[34]:
```
home_prices = pd.read_csv('data/CSUSHPISA.csv', parse_dates=['DATE'])
federal_funds_rate = pd.read_csv('data/DFF.csv', parse_dates=['DATE'])
disposable_income = pd.read_csv('data/DSPIC96.csv', parse_dates=['DATE'])
housing_starts = pd.read_csv('data/HOUST1F.csv', parse_dates=['DATE'])
median_income = pd.read_csv('data/MEHOINUSA672N.csv', parse_dates=['DATE'])
mortgage_rate = pd.read_csv('data/MORTGAGE30US.csv', parse_dates=['DATE'])
housing_supply = pd.read_csv('data/MSACSR.csv', parse_dates=['DATE'])
residential_investment = pd.read_csv('data/PRRESCONS.csv', parse_dates=['DATE'])
unemployment_rate = pd.read_csv('data/UNRATE.csv', parse_dates=['DATE'])
personal_savings_rate = pd.read_csv('data/PSAVERT.csv', parse_dates=['DATE'])
real_disposable_personal_income = pd.read_csv('data/A229RX0.csv',␣
 ↪parse_dates=['DATE'])

data = home_prices.merge(federal_funds_rate, on='DATE', suffixes=('_HP', '_FF'))
data = data.merge(disposable_income, on='DATE', suffixes=('', '_DI'))
data = data.merge(housing_starts, on='DATE', suffixes=('', '_HS'))
data = data.merge(median_income, on='DATE', suffixes=('', '_MI'))
data = data.merge(mortgage_rate, on='DATE', suffixes=('', '_MR'))
data = data.merge(housing_supply, on='DATE', suffixes=('', '_HS'))
data = data.merge(residential_investment, on='DATE', suffixes=('', '_RI'))
data = data.merge(unemployment_rate, on='DATE', suffixes=('', '_UR'))
data = data.merge(personal_savings_rate, on='DATE', suffixes=('', '_PS'))
```

```
data = data.merge(real_disposable_personal_income, on='DATE', suffixes=('',␣
 ↪'_RD'))

data.columns = ['DATE', 'Home Prices', 'Federal Funds Rate', 'Disposable␣
 ↪Income', 'Housing Starts',
                'Median Income', 'Mortgage Rate', 'Housing Supply',␣
 ↪'Residential Investment',
                'Unemployment Rate', 'Personal Savings Rate', 'Real Disposable␣
 ↪Personal Income']

fig, axes = plt.subplots(nrows=4, ncols=3, figsize=(16, 20))

sns.regplot(data=data, x='Federal Funds Rate', y='Home Prices', ax=axes[0, 0],␣
 ↪scatter_kws={'s':10}, line_kws={'color':'red'})
axes[0, 0].set_title('Federal Funds Rate vs Home Prices')

sns.regplot(data=data, x='Disposable Income', y='Home Prices', ax=axes[0, 1],␣
 ↪scatter_kws={'s':10}, line_kws={'color':'blue'})
axes[0, 1].set_title('Disposable Income vs Home Prices')

sns.regplot(data=data, x='Housing Starts', y='Home Prices', ax=axes[0, 2],␣
 ↪scatter_kws={'s':10}, line_kws={'color':'green'})
axes[0, 2].set_title('Housing Starts vs Home Prices')

sns.regplot(data=data, x='Median Income', y='Home Prices', ax=axes[1, 0],␣
 ↪scatter_kws={'s':10}, line_kws={'color':'purple'})
axes[1, 0].set_title('Median Income vs Home Prices')

sns.regplot(data=data, x='Mortgage Rate', y='Home Prices', ax=axes[1, 1],␣
 ↪scatter_kws={'s':10}, line_kws={'color':'orange'})
axes[1, 1].set_title('Mortgage Rate vs Home Prices')

sns.regplot(data=data, x='Housing Supply', y='Home Prices', ax=axes[1, 2],␣
 ↪scatter_kws={'s':10}, line_kws={'color':'cyan'})
axes[1, 2].set_title('Housing Supply vs Home Prices')

sns.regplot(data=data, x='Residential Investment', y='Home Prices', ax=axes[2,␣
 ↪0], scatter_kws={'s':10}, line_kws={'color':'magenta'})
axes[2, 0].set_title('Residential Investment vs Home Prices')

sns.regplot(data=data, x='Unemployment Rate', y='Home Prices', ax=axes[2, 1],␣
 ↪scatter_kws={'s':10}, line_kws={'color':'brown'})
axes[2, 1].set_title('Unemployment Rate vs Home Prices')

sns.regplot(data=data, x='Personal Savings Rate', y='Home Prices', ax=axes[2,␣
 ↪2], scatter_kws={'s':10}, line_kws={'color':'grey'})
```

```
axes[2, 2].set_title('Personal Savings Rate vs Home Prices')

sns.regplot(data=data, x='Real Disposable Personal Income', y='Home Prices',␣
 ↪ax=axes[3, 0], scatter_kws={'s':10}, line_kws={'color':'teal'})
axes[3, 0].set_title('Real Disposable Personal Income vs Home Prices')

for i in range(3, 3):
    for j in range(3, 3):
        axes[i, j].axis('off')

plt.tight_layout()
plt.show()
```



Regression Line Plots

1. Federal Funds Rate vs. Home Prices: Downward sloping regression line, confirming the negative relationship.
2. Median Income vs. Home Prices: Upward sloping line, showing a clear positive relationship.

3. Residential Investment vs. Home Prices: Steep upward slope, indicating a strong positive relationship.
4. Real Disposable Personal Income vs. Home Prices: Steepest upward slope, suggesting this has the strongest positive relationship with home prices.
5. Disposable Income vs. Home Prices: Similar to real disposable personal income, with a strong positive slope.
6. Housing Starts vs. Home Prices: Slight negative slope, indicating a weak inverse relationship.
7. Mortgage Rate vs. Home Prices: Downward sloping line, similar to federal funds rate but potentially steeper.
8. Housing Supply vs. Home Prices: Nearly flat or slightly positive slope, suggesting a weak relationship.
9. Unemployment Rate vs. Home Prices: Slightly negative slope, indicating a weak inverse relationship.
10. Personal Savings Rate vs. Home Prices: Slightly negative slope, suggesting higher savings rates correlate with slightly lower home prices.
11. Federal Funds Rate vs. Mortgage Rate: Strong positive slope, confirming the close relationship between these interest rates.

[ ]: