Permits vs the Macros: How Rates and Sentiment Reveal Austin's Building Trends

Comprehensive Report

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Executive Summary

Objective:

Quantify how macroeconomic conditions relate to monthly Austin building application permits for both residential & commercial (2009–2024) and identify the strongest drivers of permitting activity.

Data:

- Building permit data (residential / commercial / combined) for Austin, TX
- Economic Indicators:
  - 30-year mortgage rate
  - Prime rate
  - CPI inflation Rate
  - Consumer Confidence Index
  - NBER-defined recession indicator (0/1)
  - Austin, TX Unemployment Rate

Research Questions:

- Do higher mortgage rates reduce permits?
- How big of a factor is inflation when considering permit activity?
- Is permit activity seasonal?
- Does permit activity predict unemployment rates?
- How much of a factor is Consumer Confidence (CCI) when regarding permitting activity?

Model Results & Key Findings:

- Ordinary Least Squares (OLS): Strong model fit: $R^2 = 0.599$ (Adj. 0.591); overall F-test $p < 0.001$.
- Regression Coefficient Findings:
  - Mortgage rate: −128 permits per +1 percentage point ($p < 0.001$).
  - Consumer confidence: +63 permits per +1 index point ($p < 0.001$).
  - Unemployment: −35 permits per +1 percentage point ($p < 0.001$).
  - Inflation: +16 permits per +1 percentage point ($p < 0.05$) → Weak correlation
- The inflation rate has a very weak correlation with # of people that apply for permits.
- Mortgage rates have a strong correlation with # of people that apply for permits.

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1. Introduction

Permitting activity is a leading indicator of construction and local economic momentum. In Austin, monthly building permits respond to financing conditions, labor-market health, and household sentiment. This report analyzes how macroeconomic factors relate to Austin's permitting volume from 2009–2024, with the goal of identifying which indicators most strongly align with changes in permit applications and by how much.

Objective:
Quantify the relationship between monthly total building permits and key macro indicators—30-year mortgage rate, prime rate, CPI inflation, Consumer Confidence Index, and Austin unemployment rate—and provide clear, decision-oriented takeaways.

Audience and use case:
The analysis is designed for planners, lenders, developers, and analysts who need an evidence-based view of how macro conditions map to permitting volume. Findings can inform scenario discussion (e.g., a 1-percentage-point move in mortgage rates), monitoring dashboards, and communication with stakeholders.

Data scope:
The dataset is monthly and spans January 2009–December 2024. Variables include total, residential, and commercial permits (counts); national mortgage and prime rates (%); CPI inflation Rate (%); the Consumer Confidence Index; the Austin unemployment rate (%); and a recession indicator (0/1).

Research Questions:

- Do higher mortgage rates reduce permits?
- How big of a factor is inflation when considering permit activity?
- Is permit activity seasonal?
- Does permit activity predict future unemployment rates?
- How much of a factor is Consumer Confidence when regarding permitting activity?

2. Data Collection & Modification

Data Collection:
Data for building permits was collected (residential and commercial) in Austin, TX, and macro indicators were assembled on a month-by-month basis spanning years 2009–2024. Variables include total, residential, and commercial permits (counts); 30-year fixed mortgage rate (%); prime rate (%); CPI inflation rate (%); Consumer Confidence Index (baseline = 100); Austin unemployment (%); and a recession indicator (0/1).

Sources:

- Permit Activity for Austin, TX: https://catalog.data.gov/dataset/issued-construction-permits
- Monthly average for 30-year mortgage rate: https://fred.stlouisfed.org/series/MORTGAGE30US
- Monthly average for Prime rate: https://fred.stlouisfed.org/series/PRIME
- CPI inflation rate (%): https://www.usinflationcalculator.com/inflation/current-inflation-rates/
- Monthly average for Consumer Confidence Index: https://www.oecd.org/en/data/indicators/consumer-confidence-index-cci.html?oecdcontrol-b2a0dbca4d-var3=2008-12&oecdcontrol-b2a0dbca4d-var4=2024-12
- NBER-defined recession indicator (0/1): https://fred.stlouisfed.org/series/USREC
- Austin, TX Unemployment Rate: https://fred.stlouisfed.org/series/AUST448URN

Data Modification:
Original raw data downloaded from the source page was 1.4 gigabytes. The file contained 68 columns, and 1,048,576 rows worth of data. After removing irrelevant/unnecessary data, I was able to bring the file size down to 22.6 megabytes, a 98.42% reduction.

After cleaning the dataset, I had organized the metrics in the excel sheet titled “Breakdown”. The original building permit data was first broken down by year for years 2009-2024, and then split by commercial building permits and residential building permits. I then incorporated the economic indicators: [30-year fixed mortgage rate (%), prime rate (%), CPI inflation (%), Consumer Confidence Index (CCI), Austin unemployment rate (%), and a recession indicator (0/1)], and then broke all the variables down into a monthly basis, so I can have 192 unique datapoints per variable (12 months * 16 years). Month names were then standardized and tables were subsequently put in ascending order by Year-Month. The count tables (Rows 4 -20) of the Breakdown tab were calculated by using the COUNT function, which references the original (& reduced) dataset in the “Permit Applications” sheet. Each table, excluding the count tables at the top of the sheet, were then conditionally formatted for color scales to be able to visually discern variations of highs, lows, and patterns at a quick glance. Lastly, I set up a correlation chart (grouped and hidden on the left) within the “Correlation Matrix” sheet that is used by the Pearson correlation matrix to calculate correlation(r). The correlation chart is set up so all the data from all the variables can be seen in 1 table. Each row is identified by its month & year.

Other notes:

- No missing values in original dataset for years 2009-2024
- There were no outliers that required special treatment.
- I intentionally excluded Residential/Commercial as predictors when modeling **Total permits**, since **Total = Residential + Commercial**.

3. Methods

Analytical objective:
Estimate the concurrent relationships between monthly total building permits in Austin and macroeconomic indicators—30-year mortgage rate, prime rate, CPI inflation Rate, Consumer Confidence Index, and Austin unemployment rate—while quantifying statistical significance and practical effect sizes.

Data preparation:

- **Frequency & scope:** Monthly observations from 2009–2024.
- **Variables:**
  - Dependent: total permits, commercial permits, and residential permits
  - Predictors: mortgage rate, prime rate, inflation rate, consumer confidence, unemployment rate, and recession indicator.
- **Units:** Rates are in percentage points; confidence is an index level; permits are counts.
- **Quality controls:**
  - Records sorted by Year–Month
  - Standardized month labels

3.1 Exploratory statistics:
Means, standard deviations, and time-series plots were used to understand levels and volatility.

3.2 Pearson Correlation Coefficient:
The Pearson correlation coefficient (r) was used to summarize raw, bivariate associations between each variable. This was used to measure & quantify the strength & direction of a linear relationship between 2 variables, with a range from -1 to +1.

- Closer to +1: strong positive relationship
- Closer to –1: strong negative relationship
- Around 0: little to no linear relationship

This data can be seen in the "Correlation Matrix" sheet.

3.3 P-Value significance and T-Test:
I created a table that lists every pair of variables and reports the t-statistic and p-value for the relationship between them. This lets readers see which pairs are statistically significant at a glance.

- What p-value answers: "Is this relationship likely real or just noise?"
- How interpreted: Smaller p-values (e.g., $p < 0.05$) suggest the relationship between two variables is statistically significant.

For each pair, I computed the correlation and then the two-sided p-value using the standard t-test for correlation (tested against 0).
Results are summarized in a table within the "Variable Significance" sheet.

3.4 Regression Statistics:
I report the standard **Regression Statistics** from Excel's Analysis ToolPak to summarize model fit:

- **Multiple R:** The correlation between **actual** and **predicted** permits (overall association).
- **R Square (R^2):** Share of variation in permits explained by the model (e.g., **0.599 = 59.9%** explained).
- **Adjusted R Square:** R^2 adjusted for the number of predictors (useful for comparing models with different numbers of variables).
- **Standard Error (of the regression):** Typical prediction error in permit units (roughly the average size of residuals). A lower value indicates tighter predictions.

This data can be seen in the "Regression Analysis" sheet.

3.5 Residuals vs. Fitted Plot:
This was used to check the validity of the regression model on the "Regression Analysis" tab. Predicted values were calculated from the regression equation, and residuals were computed as the difference between actual and predicted values. Plotting residuals against fitted values helps identify whether model assumptions are met: residuals should scatter randomly around zero with no clear pattern. Random scatter suggests the model is appropriate, while systematic patterns (curvature, funnel shapes, or outliers) may indicate non-linearity, unequal variance, or influential points affecting the model's accuracy.

3.6 Ordinary Least Squares (OLS):
I used Ordinary Least Squares (OLS) to estimate how permits relate to the drivers at the same time (controlling for the other drivers) to see how a change in the drivers will affect permit applications.

- What it does: Fits a straight line that minimizes the sum of squared errors between actual and predicted permits.
- Why use it: Provides effect sizes (coefficients) for each driver and p-values to judge significance while holding the other variables constant.
- How to read coefficients: A coefficient shows the expected change in permits for a 1-unit change in that driver, with the others held fixed (e.g., "−103 per +1 percentage-point mortgage rate").

This data can be seen in the "Residual Testing" sheet.

3.7 Unemployment Lag Test:
A 6-month lag test was done to test correlation between unemployment rate and total permits to see if the number of permits people apply for on a monthly basis can be a predictor of future unemployment rate.
This data can be seen in the "Unemployment Lag Test" sheet.

3.8 ANOVA / F-test (Model Significance):
This reports whether the model, as a whole, explains a meaningful amount of variation in permits.

- F-test: Tests the null hypothesis that all coefficients are zero. If that is the case, it would signify that the model has no explanatory power.

Result: Small Significance F (e.g., < 0.001): the model is statistically significant overall.
This data can be seen in the "Residual Testing" sheet.

4. Ordinary Least Squares (OLS): Key Findings and Model Results

4.1 Correlation overview (raw relationships):

Pearson correlations (monthly, 2009–2024):

- **Permits ↔ Mortgage rate: r = −0.629**, $p < 0.001$ → higher mortgage rates align with fewer permits.
- **Permits ↔ Consumer confidence: r = +0.572**, $p < 0.001$ → stronger sentiment aligns with more permits.
- **Permits ↔ Unemployment: r = −0.327**, $p < 0.001$ → weaker labor markets align with fewer permits.
- **Permits ↔ Prime rate: r = −0.399**, $p < 0.001$ → negative, but overlaps with mortgage.
- **Permits ↔ Inflation: r = −0.047**, $p = 0.52$ → no meaningful raw linear relationship.

Interpretation. The strongest raw associations are mortgage (negative) and confidence (positive). These patterns set expectations for the regression results below, which estimate partial effects after controlling for the other variables.

4.2 Model summary (controlled effects):

Regression Analysis:

- Dependent Variable being tested: Total Permits
- Independent Variables: mortgage rate + consumer confidence + inflation rate + unemployment rate + intercept

Fit & error: R^2 = 0.599 (Adjusted **0.591**); typical error (**Standard Error / RMSE**) ≈ **161 permits/month**.

Key coefficients (permits per +1 unit, holding others constant):

- **Mortgage rate: −128** permits per +1 percentage point (**p < 0.001**)
- **Consumer confidence: +63** per +1 index point (**p < 0.001**)
- **Unemployment rate: −35** per +1 percentage point (**p < 0.001**)
- **Inflation Rate: +16** per +1 percentage point (*p = 0.033*)

Overall model test. F-test *p* < 0.001 → the predictors jointly explain a meaningful share of variation.

5. Research Questions

Question 1) Do higher mortgage rates reduce permits?

Answer: Yes—material and statistically significant.

Evidence:

- Correlation: **r = −0.629**, $p < 0.001$.
- OLS Table Result: **−128 permits** per +1pp mortgage, **p < 0.001**.

Implication & Explanation: Mortgage rate and building permit applications are strongly correlated. A +1pp rate move is associated with roughly ~103 fewer permits per month, all else equal.

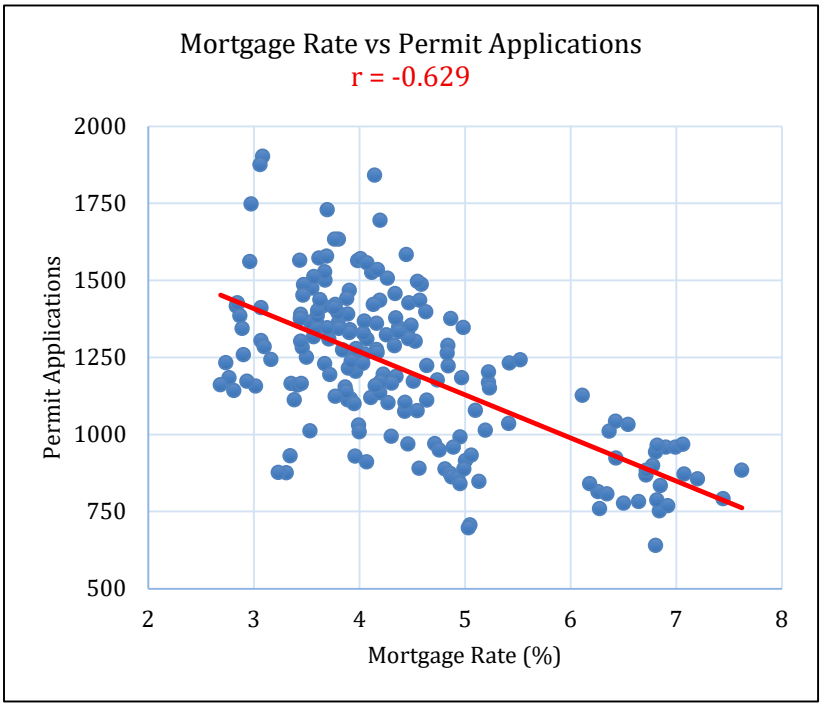

Figure 1: Mortgage Rate vs Permits correlation

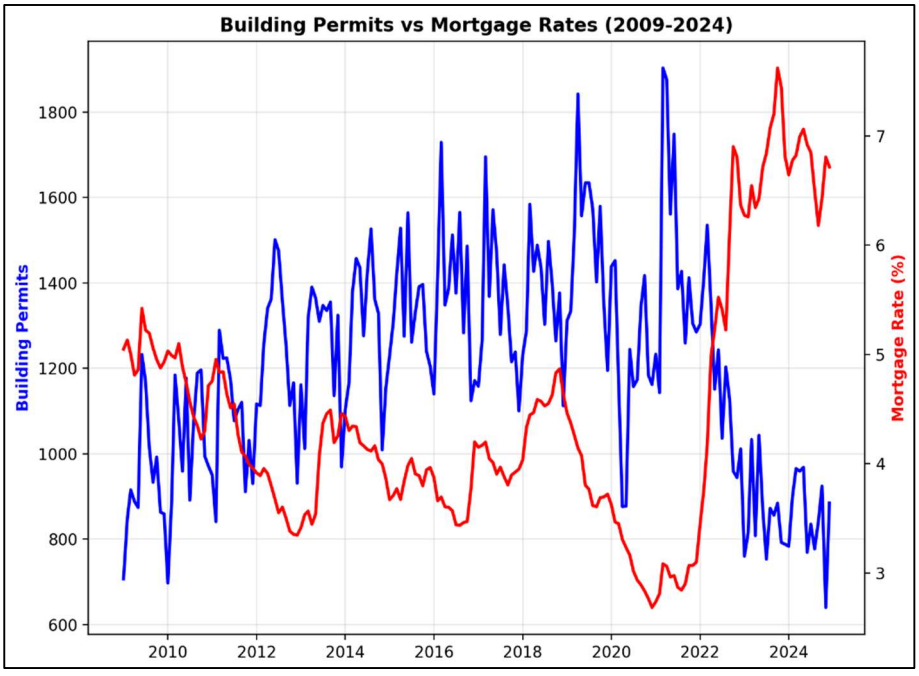

Figure 2: Mortgage vs Permits displaying inverse relationship

Question 2) How big of a factor is inflation when considering permit activity?

Answer: Extremely weak.

Evidence:

- Correlation: **r = −0.047**, $p < 0.52$.
- OLS Table Result: **16 permits** per +1pp inflation, **p < 0.029**.

Implication & Explanation: Inflation provides context but is a secondary factor. It shows little bivariate relationship and a small positive partial effect after controls (~+16 permits per +1pp; p≈0.03). Decisions should lean more on financing conditions and sentiment.

Inflation shows little bivariate relationship and only a small positive partial effect after controls; it is modest compared with rates and confidence.

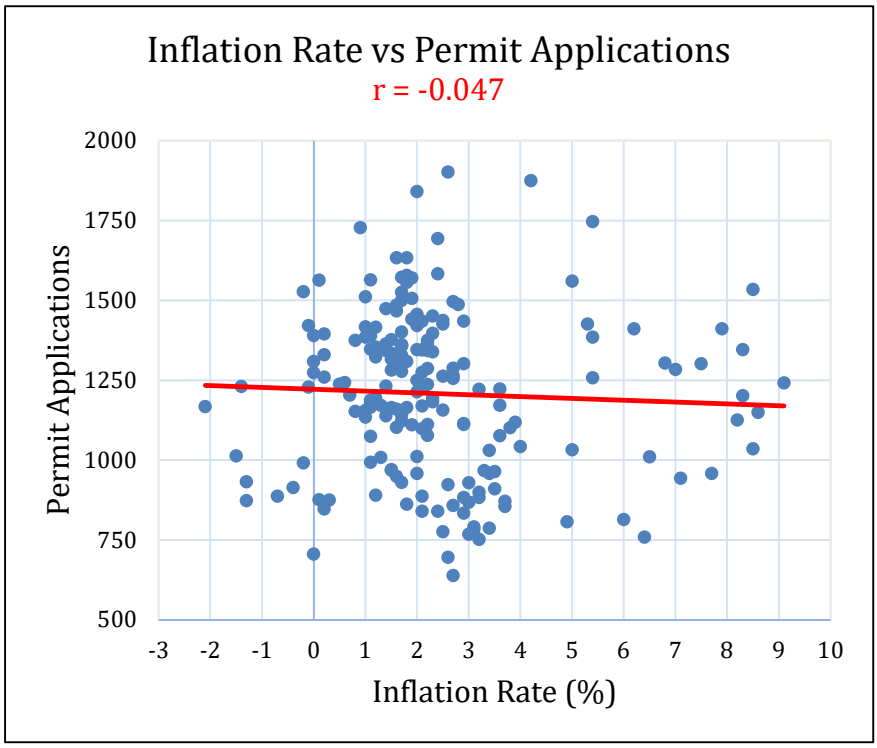

Figure 3: Inflation Rate vs Permits correlation

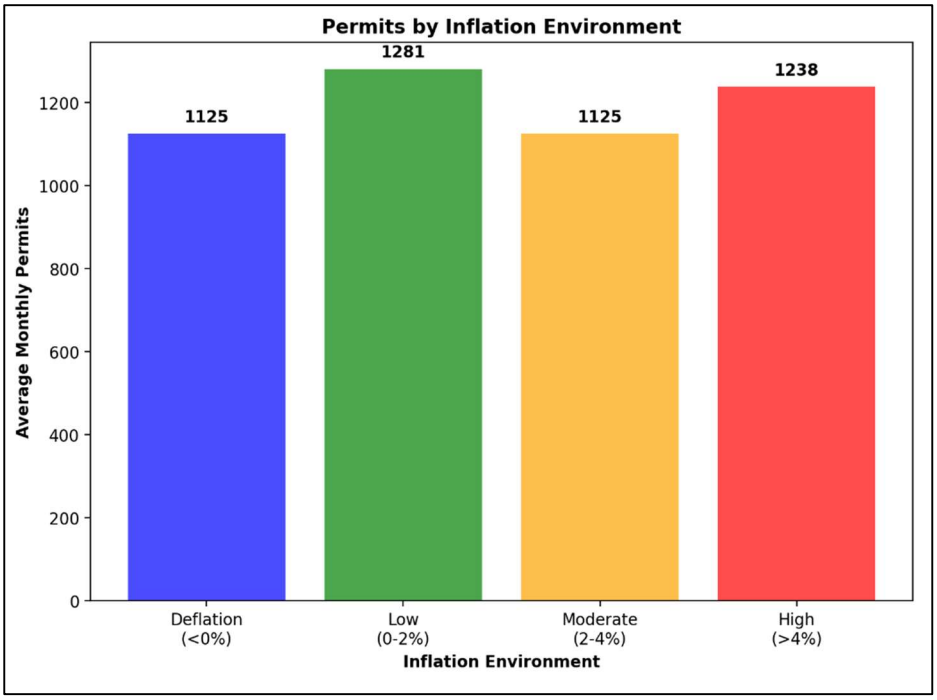

Figure 4: Permits by Inflation Rate environment

Question 3) Is permit activity seasonal?

Answer: Yes.

Evidence: March is consistently the peak month, averaging 1,367, while December is the lowest, averaging 1,045, a 30% seasonal swing.

Implication & Explanation: This pattern is so consistent that it can be used for economic forecasting and resource planning in the construction industry. A few reasons that most likely explain the seasonal difference is that during the winter, there is:

- Harsh weather
- Holiday season – reduced business activity
- Frozen ground can prevent foundation work
- Higher heating costs on construction site
- Shorter daylight limit work time

The surge in permit activity in spring (March) suggest pent-up demand from winter and fall.

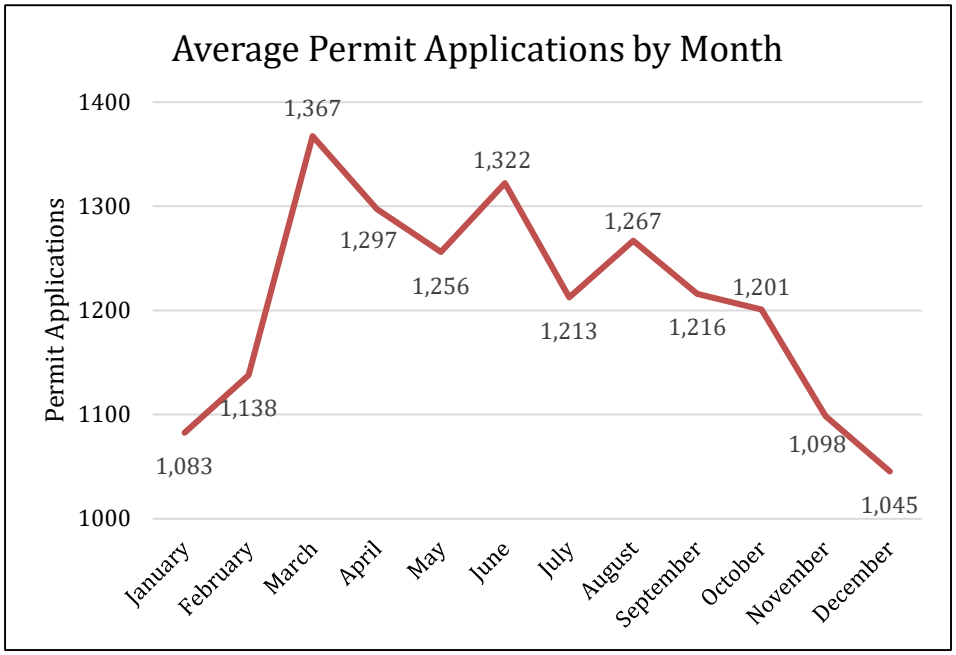

Figure 5: Permits by Month

Question 4) Does permit activity predict future unemployment rates?

Answer: Yes, a moderate correlation.

Evidence: When comparing the 2 variables of total permits and unemployment rates on a monthly basis, it shows a moderate correlation of -0.346, $p < 0.001$ (extremely significant) when a 6-month lag test is completed.

Implication & explanation: Permits have a moderate correlation of predicting unemployment 6 months in advance. Higher permits today = Lower unemployment in 6 months

Question 5) How much of a factor is Consumer Confidence (CCI) when regarding permitting activity?

Answer: Major Factor.

Evidence:

- Correlation: **r = +0.572**, $p < 0.001$
- OLS Table Result: **63 permits** per +1 per index point, **p < 0.001**.

Implication & explanation: The number of permits people have a very high correlation with the consumer confidence index, reflecting that permits increase by 63 per month per +1 index point, all else equal. This makes sense as people make decisions on buying/building property with sentiment on how the economy is doing at that moment in time and how it will perform in the future.

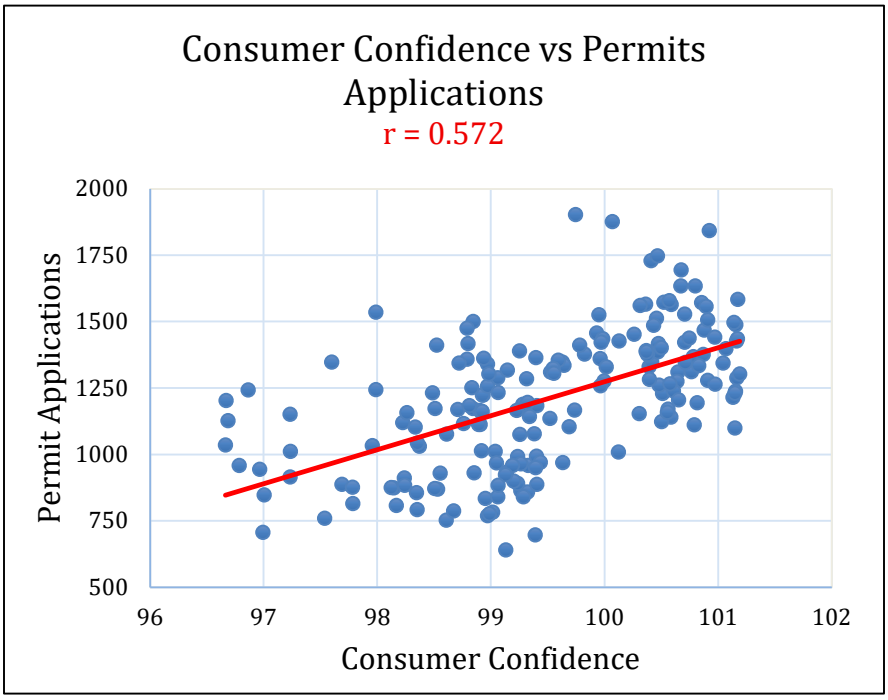

Figure 6: Consumer Confidence Index (CCI) vs Permits correlation

6. Diagnostics & Robustness

6.1 Residual diagnostics

Residuals (actual minus model-predicted permits) were examined using a Residuals vs. Fitted plot. Points are centered around zero with no pronounced curvature and a broadly even spread across fitted values.

Interpretation: A linear specification provides an adequate summary of the relationships captured in the model.

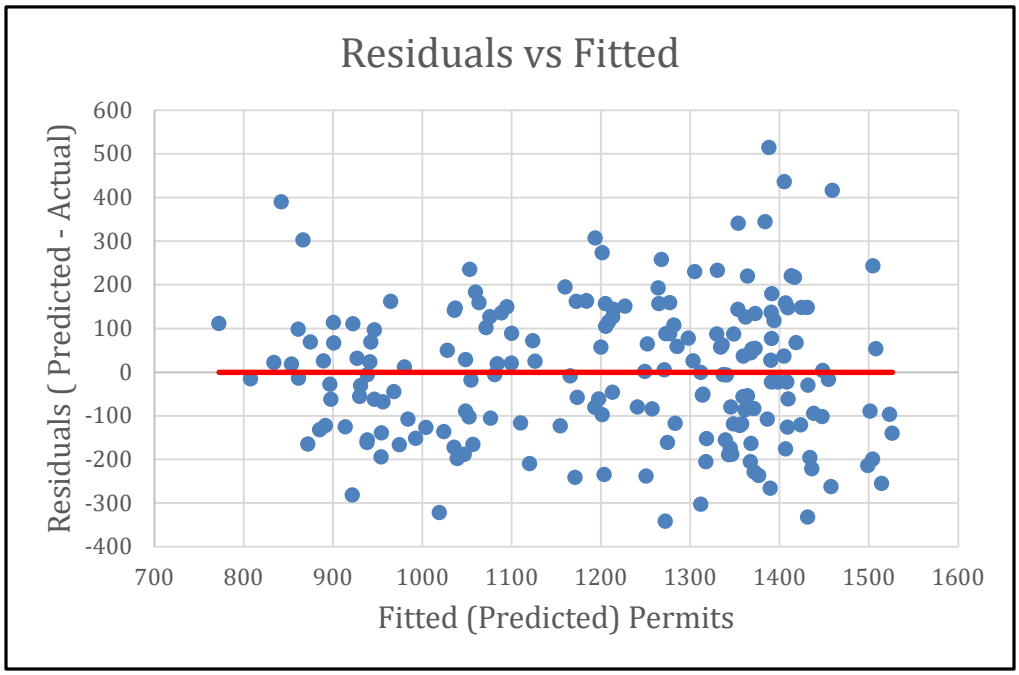

Figure 7: Residuals vs Fitted plot

6.2 Magnitude of model error

The model's standard error (RMSE) is approximately 161 permits per month. As a practical rule of thumb, a ±2×RMSE band (≈ ±320 permits) indicates the scale within which most month-level predictions are expected to fall.

Interpretation: Results are suitable for understanding direction and relative changes, rather than for precise month-ahead counts.

6.3 Seasonality

Monthly averages indicate clear seasonality—higher permitting activity in spring/summer and lower levels in winter. Year-over-year comparisons in the Results & Key Findings section are therefore made on a same-month basis (e.g., March vs. March) to avoid seasonal bias.

6.4 Specification checks

To assess robustness, several reasonable alternatives to the base model were evaluated. Core conclusions are unchanged.

- Excluding prime rate: Given overlap with mortgage rates, omitting prime does not alter the sign or significance of the main effects: mortgage remains materially negative; consumer confidence positive; unemployment negative; inflation modest.
- Segment models: When modeled separately, residential permits exhibit a clear and significant negative association with mortgage rates, whereas commercial permits do not show a statistically meaningful rate effect once other factors are included.

6.5 Event windows

Two complementary views were considered to contextualize pandemic-era dynamics:

- COVID window (Mar 2020–Dec 2021). Average permits were higher than in other months, consistent with unusually low financing costs and strong housing demand during that period.
- Recession months. Marked recession months are associated with lower permitting after accounting for other factors and seasonality.

Implication: The brief recession coincided with a dip, while the broader COVID window—much of it outside the formal recession—was characterized by elevated activity driven by financial conditions.

7. Discussion & Implications

7.1 Interpreting the main drivers

The analysis indicates that financing conditions and household sentiment are the primary concurrent signals for Austin permitting:

- **Mortgage rate (primary, negative):** A +1 percentage-point change in the 30-year mortgage rate is associated with roughly **128 fewer permits per month**, holding other factors constant. This is the most influential single driver in the model.
- **Consumer confidence (supporting, positive):** A +1-point increase in the index is associated with **~63 more permits** per month, suggesting sentiment amplifies or dampens permitting beyond rates alone.
- **Unemployment (cyclical, negative):** Higher local unemployment aligns with fewer permits (≈ **−35 per +1pp**), consistent with cyclical slowdowns.
- **Inflation (modest):** The partial association is statistically detectable but small relative to rates and confidence mentioned above.

Implication: For planning and stakeholder communication, prioritize mortgage rates and consumer confidence as leading indicators, with unemployment as a concurrent check on macro conditions.

7.2 Segment implications: residential vs. commercial

Residential permits exhibit a **clear and significant** negative relationship with mortgage rates; commercial permits do **not** show a statistically meaningful rate effect once other factors are included.

Implication:

- **Residential:** Expect visible volume shifts as mortgage rates move; scenario planning should translate rate paths into directional volume ranges.
- **Commercial:** Rate changes are less predictive: market-specific factors (project pipeline, financing structures, sector demand) likely dominate.

7.3 Seasonality and benchmarking

Permitting is seasonal (spring/summer highs; winter lows). Month-to-month comparisons can mislead.

7.4 COVID and recession context

The brief recession coincided with lower permitting after controls, while the broader COVID window (which includes non-recession months with unusually low rates) shows higher average volume.

7.5 Using the model for decisions

- **Sensitivity guidance:** As an example regarding mortgage rates, treat **±1pp mortgage** changes as **~±128 permits/month** directionally. Use this for planning ranges rather than exact forecasts.

8. Limitations

Study design (association, not causation):
This is an observational, concurrent analysis. Coefficients describe associations, not proof of cause-and-effect. Some relationships may reflect confounding or reverse causality (e.g., macro conditions and permitting moving together for shared reasons).

Scope of data:
Monthly data span 2009–2024. Only eight recession months fall in this window, so recession estimates carry wider uncertainty. Results are Austin-specific; generalizing to other markets should be done cautiously.

Measurement & proxies:
Permits are local; several drivers are national series (mortgage rate, prime, consumer confidence, CPI). Local factors not captured by national proxies may matter (e.g., local credit conditions, builder sentiment).

Model form:
The model is linear and concurrent. Nonlinearities and lead–lag dynamics may exist but are only touched on in robustness checks; the main specification does not model them explicitly.

Overlap among predictors:
Some predictors move together (e.g., mortgage and prime). This overlap can make it harder to isolate each variable's unique contribution and can widen uncertainty on individual coefficients.

Seasonality:
Permitting is seasonal. Although results are framed with same-month year-over-year comparisons, any remaining seasonal effects not fully captured may affect month-to-month interpretation.

Error magnitude.
Typical month-level prediction error is ≈162 permits (RMSE). Use results as directional and for sensitivity, not precise month-ahead forecasts.

National vs local indexes:
The macro indicators used such 30-year mortgage rates, prime rates, inflation rates, Consumer Confidence Index data, and the recession indicators were national indexes. However, for the unemployment rate, I used the local rate for Austin, TX, specifically.

Original Dataset at Capped max file capacity:
Only had complete data for years 2009-2024. The max excel file size is 1,048,576 rows, and the data file I downloaded was at max capacity. This likely indicates that I only had full-year data for years 2009 to 2024. I had deleted years 1978-2008 from the year parameters as the data for those years were sparse, likely reason being it was cut off due to max file size. However, I did not see anywhere I could download the rest of the missing data. Due to that, the only years I could include in this research data project was for years 2009-2024.

9. Conclusion

This project quantified how macroeconomic conditions relate to monthly Austin building permits (2009–2024). Using Pearson correlations and a multiple OLS model, the analysis explains a substantial share of variation in permitting activity and translates statistical results into practical guidance.

What matters most: Financing conditions and sentiment have the highest correlation with permit activity.

rates ↓/confidence ↑ = permits up

rates ↑/confidence ↓ = permits down

Segment insights: The rate sensitivity is concentrated in the residential segment; commercial permitting does not show a statistically meaningful mortgage-rate effect after controls. This suggests planning and communications should place greater emphasis on residential dynamics when rates move.

Context and patterning: Permitting is seasonal (spring/summer highs, winter lows), so progress should be assessed on a same-month year-over-year basis rather than raw month-to-month changes. Event windows help interpret recent history: the brief recession coincided with lower permitting after controls, while the broader COVID period—characterized by unusually low mortgage rates—saw higher average volumes.

How to use this work: Treat the results as **directional and sensitivity-oriented** rather than precise forecasts. A practical planning rule is **-128 permits per +1pp mortgage-rate move**. For monitoring, focus on **mortgage rate**, **consumer confidence**, **unemployment**, and **seasonality (month of year)**.

Bottom line: Mortgage rates and household sentiment are the clearest concurrent signals for Austin's permitting volume.

Appendix A: Terminology

- **Total Permits**: Monthly count of all building permits filed in Austin (Residential + Commercial) from 2009 to 2024
- **Total Commercial Permits**: Monthly count of permits for non-residential projects (office, retail, industrial, etc.) from 2009 to 2024
- **Prime Rate**: U.S. bank prime lending rate for the month for commercial loans (%); commonly ≈ federal funds rate + 3%
- **Total Residential Permits**: Monthly count of permits for homes/apartments and residential renovations from 2009 to 2024
- **Mortgage Rate**: Average 30-year fixed U.S. mortgage interest rate for the month (%)
- **Consumer Confidence Index**: Reflects average consumer confidence in economy, where 100 is the baseline. The lower it is under 100, the more pessimistic people are re. the economy. The higher it is over 100, the more optimistic people are re. the economy.
- **US Inflation Rate**: Year-over-year change in the Consumer Price Index (CPI), monthly (%)
- **Unemployment Rate**: Share of the labor force unemployed in the Austin–Round Rock–Georgetown metro area, monthly (%)
- **US Recession Indicator**: 1 if the month is within an NBER-defined U.S. recession; 0 otherwise

Appendix B: Additional Tables & Figures

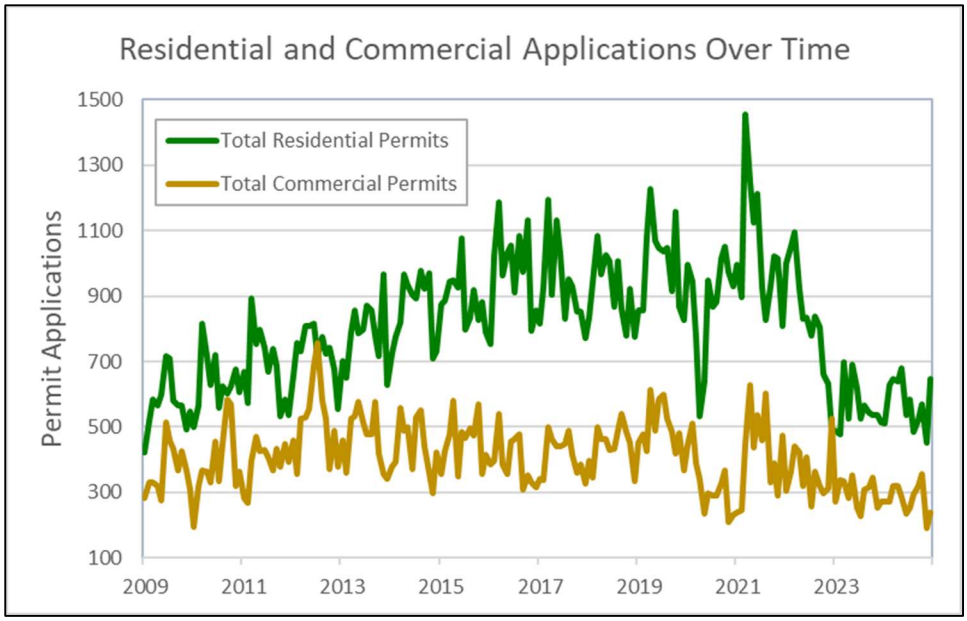

Figure 8: Residential and Commercial Permits over time

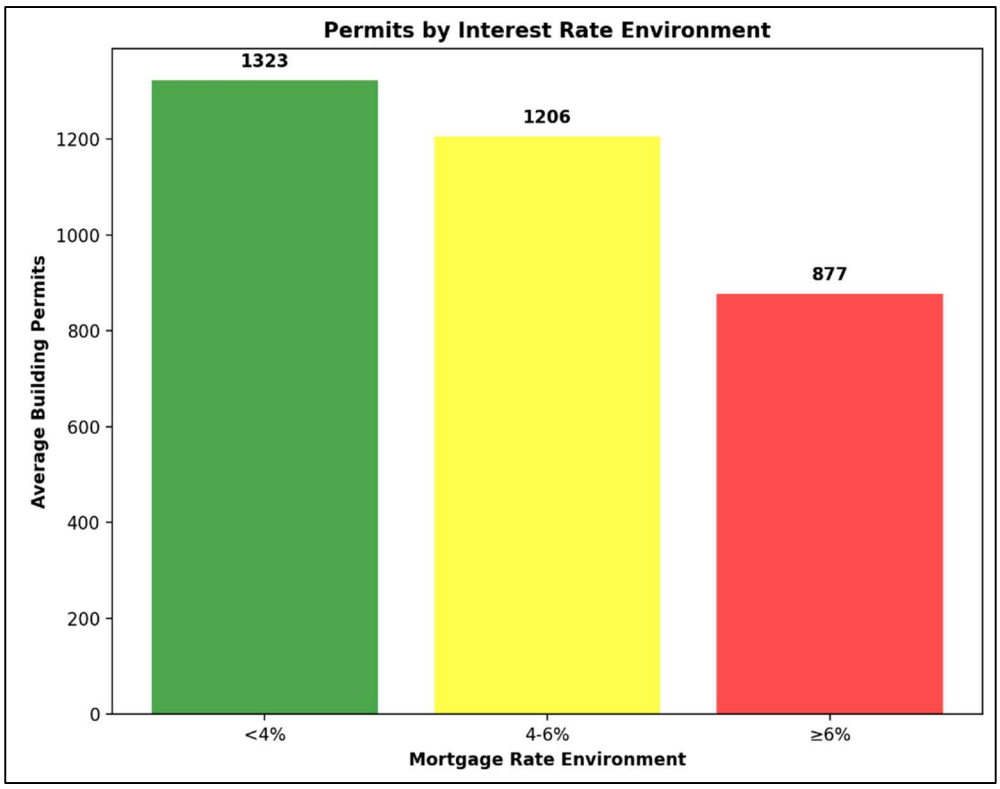

Figure 9: Permits by Interest Rate Environment

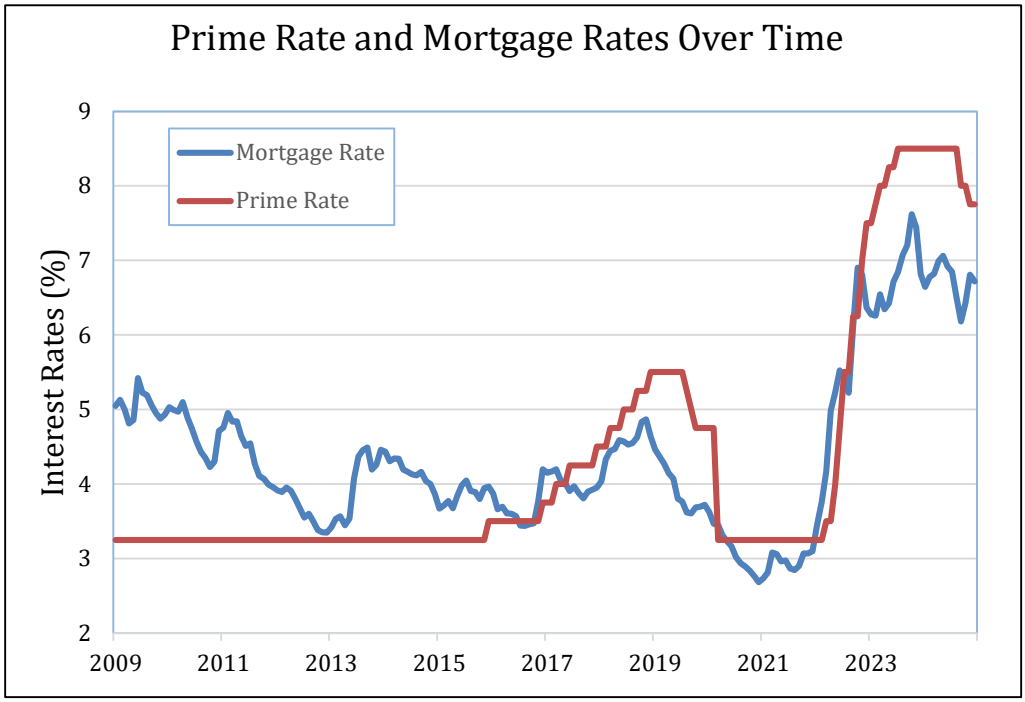

Figure 10: Prime Rate and Mortgage Rates over Time

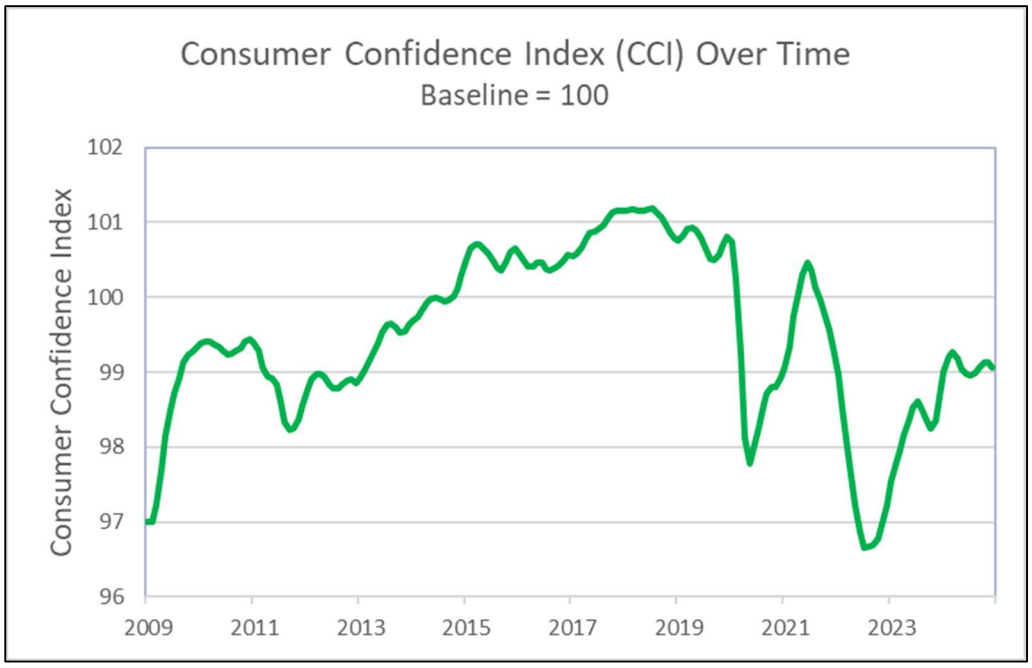

Figure 11: CCI Over Time