

# Forecasting Housing Starts using Real GDP, and Average Fixed Mortgage Rates

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This research analyzes the short and long run relationships between new housing starts (HOUS), real gross domestic product (RGDP), and average 30 year fixed mortgage rates (AFM), over the period 1972:Q2 to 2018:Q3 in order to forecast housing starts for the fourth quarter of 2018. After concluding all three series exhibit unit roots, a cointegrating regression was used to test for a long run relationship between the variables. The hypothesis that HOUS, RGDP, and AFM are not cointegrated was rejected at the 5% level, indicating they maintain a long run relationship. Next, a Vector Error Correction Model (VECM) was estimated and used to forecast HOUS for the fourth quarter of 2018. The forecasted value of 1,333,000 new housing units compares favorably to the actual value of 1,151,000 new units with a forecast error of less than 15%.

## **I. Introduction**

The purpose of this research is to forecast Housing Starts in the US using the independent variables; average 30 year fixed mortgage rate, and real gross domestic product. This paper analyzes the short and long run relationships between new housing starts (HOUS), real gross domestic product (RGDP), and average 30 year fixed mortgage rates (AFM), from the second quarter of 1972 to the third quarter of 2018 in order to forecast housing starts for the fourth quarter of 2018. A cointegrating regression was used to test for a long run relationship between the variables, then a Vector Error Correction Model (VECM) was estimated and used to forecast housing starts for Q4:2018.

The subsequent section of this paper provides a review of existing supporting literature. The following model and theory section provides definitions and explanations for the model and variables, and the discussion of theory supporting it's specification. After this, the data, results, and forecast section presents a discussion of the results and forecast. Finally, the paper ends with a concluding section.

## **II. Literature Review**

Housing starts is used as a leading indicator for GDP. Cheung & Granovski (2016) study the relationship between new housing registrations and how they influence the British Columbia economy. They find that the new housing registrations are stronger indicators and provide more predictive content than housing starts. The research concludes that new housing registrations provide significant predictive content and a strong leading indicator for British Columbia's economic growth when aggregated quarterly. The monthly series was found to be a much weaker indicator. It is stated that in an out of sample model, the quarterly new housing registration data

does no better than housing starts and building permits, however including it in the function reduces errors in the forecast up to four quarters ahead.

A study by Bolkol (2015) examined and discussed the causal relationship between construction production and GDP in Turkey. Evidence was found to suggest a causal relationship. Because the construction sector includes many sub-sectors, it is considered a major driver for economic growth. Using a Granger causality model, it was found that the relationship is as follows; GDP leads building production and building production Granger causes non-building production, not vice versa. Because there is no long run relationship between the variables, these results are based on the short run. The article states there is limited data and therefore these are suggestive results rather than conclusive.

### III. Vector Error Correction Model and Theory

$$\Delta\text{HOUS}_t = \sum_{i=1}^4 \alpha_i \Delta\text{HOUS}_{t-i} + \sum_{i=1}^4 \beta_i \Delta\text{RGDP}_{t-i} + \sum_{i=1}^4 \gamma_i \Delta\text{AFM}_{t-i} + \lambda \text{ET}_{t-1} + u_t$$

Variables;

- *Housing starts* (HOUS): The dependent variable is total housing starts in the United States, housing is defined as being started when excavation begins.
- *Average 30 Year Fixed Mortgage Rates US* (AFM): This interest rate is represented as a percentage, and reflects the average interest on a 30 year fixed mortgage rate loan in the United States.
- *Real GDP* (RGDP): Real GDP is the dollar value for all final goods and services produced within the geographic confines of a country within a given year, adjusted for inflation.
- *Error Correction Term* (ET): This is a residual error term from a cointegrating regression which found that RGDP and AFM are cointegrated and have a long run relationship with HOUS.

Theory;

It is expected that 30 year average fixed mortgage rate will cause changes in housing starts in both the long and short runs. As the cost of borrowing money for their home-loan rises, potential home builders will more strongly consider waiting until the interest rate drops, and vice versa. People have expectations about what will happen with interest rates, and if they anticipate the rates to drop in upcoming time periods, those time periods are more desirable for beginning their new housing starts. With low rates, home builders are eager to start their projects before they rise again. Consumers are more willing to borrow money when the price of borrowing that money is low, as we know from the law of demand. Therefore we can expect this to have an affect on housing starts, and the relationship would be inversely related; As the mortgage rate rises, housing starts will fall, and as the rate decreases, housing starts will increase.

There is less research to suggest GDP will have a causal effect on housing starts; the opposite relationship is more commonly discussed. Theoretically, if a nation has growing GDP and consumers perceive the overall strength of the economy to be doing well, it is anticipated that home builders would see this trend and have confident expectations for starting their projects. When consumers are feeling secure and confident that they can maintain payments and the value of their purchase will remain stable, they are more willing to begin these projects. When consumers are unsure of the strength of the economy and are feeling insecure about long term or large purchases they will be less willing to begin building new homes.

#### **IV. Data, Empirical Results, and Forecast**

*Data*

The data is listed quarterly from the 2nd quarter of 1972 to the 3rd quarter of 2018. All the data is collected from the St. Louis Federal Reserve Database (<https://fred.stlouisfed.org>) and after adjustments, the total observations used in the analysis was 185.

### *Empirical Results*

$$\Delta\text{HOUS}_t = \sum_{i=1}^4 \alpha_i \Delta\text{HOUS}_{t-i} + \sum_{i=1}^4 \beta_i \Delta\text{RGDP}_{t-i} + \sum_{i=1}^4 \gamma_i \Delta\text{AFM}_{t-i} + \lambda \text{ET}_{t-1} + u_t$$

This research used a Vector Error Correction Model (VECM) which includes lagged variables to test the short run relationships between variables. In order to do this, a cointegrating regression was ran first to find the long run relationships between the variables. This was a time series equation specified in levels with no lagged variables. The Error Correction Term (ET) from this model was gathered and tested for stationarity which suggests whether these variables trend together over time. An Augmented Dickey-Fuller test rejected that ET has a unit root at the 5% significance level. This demonstrates that the data is stationary, which leads to the conclusion that HOUS, RGDP, and AFM are cointegrated and have a long run relationship. All variables were run through Augmented Dickey-Fuller tests to test for stationarity. These tests concluded that all three (HOUS, AFM, RGDP) exhibit unit roots at the 5% significance level, therefore the data was converted into first differences ( $\Delta\text{HOUS}$ ,  $\Delta\text{RGDP}$ ,  $\Delta\text{AFM}$ ) to correct for the possibility of spurious results. After taking unit root tests once again on the converted data, it was ensured that the variables were in fact now stationary. It should be noted that the ET variable was statistically significant in the cointegrating regression, and exhibited a negative sign. This was what was expected, and shows that the ET variable will correct for shocks in the short run to maintain the long run relationship in the VECM. The Vector Error Correction Model was then ran, results of which are shown in the table below;

Variable	Coefficient	P-value
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<b>C</b>	1.3287	0.9353
$\Delta\text{HOUS}_{t-1}$	0.0428	0.5967
$\Delta\text{HOUS}_{t-2}$	0.1288	0.1142
$\Delta\text{HOUS}_{t-3}$	0.0969	0.2290
$\Delta\text{HOUS}_{t-4}$	0.2359	0.0021
$\Delta\text{AFM}_{t-1}$	-98.7667	0.0000
$\Delta\text{AFM}_{t-2}$	-4.3628	0.8166
$\Delta\text{AFM}_{t-3}$	4.9391	0.7918
$\Delta\text{AFM}_{t-4}$	20.4851	0.2696
$\Delta\text{RGDP}_{t-1}$	0.0538	0.6709
$\Delta\text{RGDP}_{t-2}$	-0.0105	0.9065
$\Delta\text{RGDP}_{t-3}$	-0.1747	0.1654
$\Delta\text{RGDP}_{t-4}$	0.0502	0.6779
$ET_{t-1}$	-0.6741	0.0055
<b>Adjusted R-Squared:</b>	0.247730	

Wald tests were run to test if the coefficients of the AMF variables have a chance of jointly being equal to 0, and if the coefficients of RGDP variables have a chance of being jointly equal to 0. These Wald Test results suggest that average 30 year fixed mortgage rates Granger-Cause housing starts in the short run, but real GDP growth does not help predict housing starts in the short run. It was found that the coefficients of the average fixed mortgage rate variables have a 0% chance of jointly being equal to 0. However, the same cannot be said about the real GDP coefficients. Because this study failed to reject the hypothesis that the RGDP coefficients were jointly equal to 0, it cannot be concluded that in the short run real GDP does not help in predicting housing starts.

### *Forecast*

The estimated VECM was used to forecast housing starts for the fourth quarter of 2018. The forecasted value was 1,333,000 new housing units. Actual data shows that 1,151,000 houses were started. The difference between the forecasted value and the actual value of housing starts for the fourth quarter of 2018 indicates a forecasting error of 13.65%.

### **V. Conclusion**

This research shows that average 30 year fixed mortgage rate Granger-Causes housing starts in both the long and short runs, and real GDP growth does not help predict housing starts in the short run, but they are cointegrated in the long run.

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### **VI. References**

- Bolkol, H. (2015). Causal Relationship between Construction Production and GDP in Turkey. *International Journal of Research in Business and Social Science* (2147-4478), 4(3), 42-53. <https://doi.org/10.20525/ijrbs.v4i3.21>
- Calista Cheung & Dmitry Granovsky, 2016. "New Housing Registrations as a Leading Indicator of the BC Economy," Discussion Papers 16-3, Bank of Canada.

Freddie Mac, 30-Year Fixed Rate Mortgage Average in the United States [MORTGAGE30US],  
retrieved from FRED, Federal Reserve Bank of St. Louis;

<https://fred.stlouisfed.org/series/MORTGAGE30US>, December 10, 2018.

Klijin, J, (2012). *Building Permits: Useful Indicator or Meaningless Information? Indiana Business Research Center at IU's Kelley School of Business.*

U.S. Bureau of Economic Analysis, Real Gross Domestic Product [GDPC1], retrieved from  
FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/GDPC1>,  
December 10, 2018.

U.S. Bureau of the Census and U.S. Department of Housing and Urban Development, Housing  
Starts: Total: New Privately Owned Housing Units Started [HOUST], retrieved from  
FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/HOUST>,  
December 10, 2018.