The Size of the Affordable Mortgage Market: 2015-2017 Enterprise Single-Family Housing Goals

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PREFACE

This Federal Housing Finance Agency (FHFA) research paper discusses the forecast models used in establishing housing goal benchmark levels for 2015 through 2017. The paper was prepared by Jay Schultz, Senior Economist, National Mortgage Database Team, Office of Chief Operating Officer.

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A. INTRODUCTION

The Federal Housing Enterprises Financial Safety and Soundness Act of 1992 (the Safety and Soundness Act), as amended, mandates that the Federal Housing Finance Agency (FHFA) establish housing goals for Fannie Mae and Freddie Mac (the Enterprises).[1] The goals for the single-family mortgage market are based on mortgages acquired by the Enterprises and include separate goals for home purchase and refinance mortgages. Only mortgages associated with 1-4 unit owner-occupied properties are counted.

This paper documents the methodology used to estimate the market size for the Low-Income Borrower Home Purchase Housing Goal (share of borrowers with incomes no greater than 80 percent of the area median income (AMI)), the Very Low-Income Borrower Home Purchase Housing Goal (share of borrowers with incomes no greater than 50 percent of AMI), the Low-Income Areas Home Purchase Housing Subgoal (share of borrowers living in low-income areas (where census tract median income is no greater than 80 percent of AMI) and of borrowers with incomes no greater than AMI living in high minority areas), and the Low-Income Borrower Refinance Housing Goal (share of borrowers with incomes no greater than 80 percent of AMI).[2]

The single-family housing goals are defined in terms of percentages of mortgages on owner-occupied properties, either home purchase or refinance, acquired by an Enterprise during a calendar year. For example, the low-income borrower home purchase goal is expressed as the

[1] 12 U.S.C. 4561(a).

[2] High minority areas are defined as census tracts where the percent minority is at least 30 percent of the population and the census tract median income is less than AMI. There is also a provision for designated disaster areas in the Low-Income Areas Home Purchase Goal.

percentage share of the Enterprise's total purchases of home purchase mortgages where the borrower's income is no greater than 80 percent of AMI. Likewise, an Enterprise's acquisitions of low-income borrower refinance mortgages are measured relative to all owner-occupied property refinance mortgages acquired by the Enterprise.[3] The results of the market estimation models are provided in **Table 1,** and the remainder of this paper describes the process used to produce these projections.

Section B describes the economic and market forecast data used to project the market size of each of the single-family mortgage housing goals. Section C presents the housing and mortgage market forecasts by government agencies and industry participants. Section D provides the four econometric time series models used to estimate affordability in the market. Finally, conclusions are provided in Section E.

[3] To be eligible to count toward the housing goals, mortgages acquired must meet certain counting rules. These counting rules are set forth in 12 CFR part 1282.

Table 1

Enterprise Single-Family Housing Goals
Market Estimates 2014 - 2017

Year [1]	Low-Income Borrower Home Purchase Goal	Very Low-Income Borrower Home Purchase Goal	Low-Income Areas Home Purchase Goal	Low-Income Borrower Refinance Goal
2004	27.2%	6.6%	16.7%	28.0%
2005	24.2%	5.7%	15.3%	26.0%
2006	24.0%	5.9%	15.8%	24.7%
2007	26.0%	6.1%	16.2%	24.2%
2008	25.3%	6.5%	14.1%	23.4%
2009	29.6%	8.8%	13.0%	20.8%
2010-11 Benchmarks	**27%**	**8%**	**13%**	**21%**
2010 [2]	27.2%	8.1%	12.1%	20.2%
2011 [2]	26.5%	8.0%	11.4%	21.5%
2012-14 Benchmarks	**23%**	**7%**	**11%**	**20%**
2012 [2]	26.6%	7.7%	13.5%	22.3%
2013 [2]	24.0%	6.3%	14.2%	24.3%
2014 [2]	22.0% +/- 2.0%	5.7% +/- 1.4%	14.0% +/- 0.6%	26.2% +/- 1.5%
2015 [3]	22.4% +/- 3.2%	5.9% +/- 2.5%	13.2% +/- 1.5%	21.8% +/- 2.7%
2016 [3]	22.9% +/- 4.2%	6.0% +/- 3.2%	13.6% +/- 2.8%	22.4% +/- 4.7%
2017 [3]	22.0% +/- 5.0%	5.7% +/- 3.8%	14.2% +/- 3.6%	22.8% +/- 6.2%

[1] Historical market performance is based on historical HMDA data for first-lien, conventional, ARRA-equivalent conforming limit loans, excluding higher-cost and HOEPA loans (see Section B).

[2] Historical market performance, the refinance goal market performance does not include the impact of loan modifications.

[3] Estimated (95% confidence), does not include adjustment for loan modifications.

B. ECONOMIC AND MORTGAGE MARKET DATA

Historical monthly time series data used in the housing goals forecast models were obtained from a variety of sources. Gross Domestic Product (GDP), the unemployment rate, inflation rates, median prices for new homes, housing starts and new housing sales came from the Census Bureau, the Bureau of Economic Analysis and the Bureau of Labor Statistics.[4] Constant maturity interest rates on Government notes and bonds came from the U.S. Department of the Treasury, while mortgage interest rates were provided by Freddie Mac's Primary Mortgage Market Survey.[5] Median house prices for existing homes and the Housing Affordability Index were obtained from the National Association of Realtors (NAR), and FHFA produces House Price Indices for all transactions and for home purchase loans. For 2013 and previous years, the refinance rate and FHA market share were calculated from Home Mortgage Disclosure Act (HMDA) data.[6] Preliminary refinance rates for 2014 are as reported by the Mortgage Bankers Association. Preliminary 2014 FHA market shares in the home purchase and refinance markets were derived using home sales, FHA endorsement data and the refinance rate.[7] For the complete list of data sources, see **Appendix F**.

FHFA measures the market performance for the single-family, owner-occupied property mortgage housing goals by analyzing HMDA data. HMDA data are loan level records of mortgage applications, originations and acquisitions that occurred during a calendar year and are

[4] U.S. Department of Commerce and the U.S. Department of Labor.
[5] U.S. Treasury constant maturity interest rates were obtained from the Federal Reserve Bank of St. Louis' FRED database.
[6] HMDA data are made available from the Federal Financial Institutions Examination Council, http://www.ffiec.gov/hmda/default.htm.
[7] HUD. FHA Production Report (May 2013 – October 2014). Prior years' data came from the FHA Outlook Report.

considered to be broadly representative of the mortgage market in the United States.[8] The Federal Financial Institutions Examination Council (FFIEC) has made available a monthly nationwide time series from the loan level HMDA records with various attributes and specifications, including the performance of the four single-family housing goals and the one subgoal. For purposes of estimating the single-family mortgage market for goal-qualifying loans, FHFA defines the market as conventional conforming first lien, prime home purchase (or refinance) mortgages.[9]

The HMDA data used to produce the market affordability forecasts begin in 2004, when HMDA data began including (1) rate-spread information for high-cost loans, (2) an indicator for manufactured housing loans, and (3) an identifier for first-lien mortgages. The rate-spread and manufactured housing information help to better identify subprime and chattel loans.

One of the issues with regard to HMDA data is the considerable delay in release of the database. At this time, the most current, publicly available HMDA data are for 2013. To inform the forecasted estimates with more current information, two supplemental data time series were used. Estimates of the goal-qualifying shares for the three home purchase goals and subgoal were calculated from FHFA's Monthly Interest Rate Survey (MIRS) data through April 2015. The refinance goal time series was also extended using the combined Enterprise goal performance through April 2015.

[8] Bhutta, Neil and Daniel R. Ringo "The 2013 Home Mortgage Disclosure Act Data." Federal Reserve Bulletin, (November 2014) Vol. 100, No 6. The 2013 HMDA data covered 7,190 home lenders including the nation's largest mortgage originators.

[9] To be consistent with the conforming loan limits established in the American Recovery and Reinvestment Act (ARRA 2009), the conforming loan limit is defined as 1.15 times the Area Median House Price (from NAR), where the maximum (ceiling) must not exceed 1.75 times the original conforming limit for the given year. A loan is considered not prime (subprime) if the contract rate is 300 or more basis points above the 30-Year Treasury note yield.

C. HOUSING AND MORTGAGE MARKET FORECAST

On average, industry forecasters project the economy to continue to grow during the 2015 through 2017 period, with real GDP growing at rates between 2.6 and 2.8 percent in each year. Residential Fixed Investment is expected to grow by 5.6 percent in 2015, 8.6 percent in 2016 and 8.9 percent in 2017 (see **Table 2**). The effects of interest rates, unemployment, inflation, refinancing, house prices, and the overall housing market are included inthe estimation equations for the housing goal market performance as explanatory variables.

Interest Rates. Mortgage interest rates are affected by many factors. Trends in interest rates on longer term financial instruments such as mortgages typically follow the fluctuations of the 10-Year Treasury note yield, with approximately a 167 to 179 basis point spread reflecting the differences in liquidity and credit risk expected for the 2015 through 2017 period. This expected rate spread is higher than what was experienced during the past five years. Overall, interest rates in the United States are heavily influenced by the monetary policies of the Federal Reserve Board's Federal Open Market Committee (FOMC). Since mid-2008, the FOMC has maintained an accommodative monetary policy in support of its dual mandate of fostering maximum employment and price stability. In its April 28-29, 2015 meeting, the FOMC stated that it is committed to a low federal funds rate policy (at 0 to 0.25 percent) for the time being. The FOMC will also continue to reinvest principal payments from its sizable portfolio of agency securities:

> "To support continued progress toward maximum employment and price stability, the Committee today reaffirmed its view that the current 0 to 1/4 percent target range for the federal funds rate remains appropriate. In determining how long to maintain this target range, the Committee will assess progress--both realized and expected--toward its objectives of maximum employment and 2 percent inflation. This assessment will take into account a wide range of information, including measures of labor market conditions, indicators of inflation pressures and inflation expectations, and readings on financial and international developments.

> The Committee anticipates that it will be appropriate to raise the target range for the federal funds rate when it has seen further improvement in the labor market and is reasonably confident that inflation will move back to its 2 percent objective over the medium term.
>
> The Committee is maintaining its existing policy of reinvesting principal payments from its holdings of agency debt and agency mortgage-backed securities in agency mortgage-backed securities and of rolling over maturing Treasury securities at auction. This policy, by keeping the Committee's holdings of longer-term securities at sizable levels, should help maintain accommodative financial conditions."[10]

Affordability in the mortgage market depends in part on the interest rate environment. The longer term 30-year fixed-rate mortgage interest rate, after falling to a low of 3.4 percent in the fourth quarter of 2012, gradually rose to 4.0 percent in the fourth quarter of 2014 before falling to 3.7 percent in the first quarter of 2015.[11] Shorter term fixed- and adjustable-rate mortgage interest rates remain at historical lows—Freddie Mac reported that the one-year adjustable-rate mortgage rate averaged 2.4 percent for most of 2014 and the first quarter of 2015. As a major contributor to the cost of mortgage financing, lower interest rates directly affect the affordability of buying a home or refinancing a mortgage. As the economic recovery continues, it is expected that interest rates, particularly longer term interest rates, will rise. For the 2015-2017 period, as shown in **Tables 2 and 3**, forecasts show that all interest rates are expected to increase, including the interest rate on a 30-year fixed-rate mortgage, which is expected to increase to 4.2 percent by the fourth quarter of 2015, 4.8 percent by the end of 2016 and

[10] Federal Reserve Board of Governors. Press Release of the Federal Open Market Committee Statement, April 28-29, 2015, April 29, 2015.
[11] Freddie Mac, Primary Mortgage Market Survey. (2012-2015).

Table 2

Economic and Mortgage Market Outlook

	2013				2014				2015				2016									
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	2012	2013	2014	2015	2016	2017
Low-Income Borrower HP Share [1]	25.5%	23.7%	23.5%	24.5%	23.0%	22.4%	20.9%	22.2%	22.5%	22.1%	22.2%	22.8%	22.6%	22.9%	22.8%	23.2%	26.6%	0.0%	22.0%	22.4%	22.9%	22.0%
Very Low-Income Borrower HP Share [2]	7.1%	6.2%	6.0%	6.4%	6.0%	5.8%	5.3%	5.9%	6.1%	5.9%	5.6%	6.1%	6.2%	6.1%	5.6%	6.0%	7.7%	0.0%	5.7%	5.9%	6.0%	5.7%
Low-Income Area HP Share [3]	14.3%	13.3%	13.7%	14.9%	15.9%	14.8%	14.5%	15.5%	16.1%	15.1%	14.9%	15.8%	16.4%	15.6%	15.4%	16.3%	13.6%	0.0%	14.0%	13.2%	13.6%	14.2%
Low-Income Borrower Refi. Share [4]	22.6%	24.0%	26.2%	28.0%	27.1%	26.7%	26.2%	24.8%	22.0%	21.1%	21.5%	22.9%	22.2%	22.6%	21.9%	23.1%	22.3%	0.0%	26.2%	21.8%	22.4%	22.8%
Real GDP [5]	2.7%	1.8%	4.4%	3.5%	-2.1%	4.5%	4.9%	2.2%	0.2%	2.6%	3.1%	3.1%	2.6%	2.7%	2.6%	2.6%	2.3%	2.2%	2.4%	2.4%	2.8%	2.9%
Nominal GDP [5]	4.2%	2.8%	6.1%	4.9%	-0.8%	6.7%	6.3%	2.4%	0.1%	4.6%	5.4%	5.3%	4.6%	4.9%	4.7%	4.7%	4.2%	3.7%	3.9%	3.6%	5.0%	4.8%
Real Personal Consumption [5]	3.5%	1.8%	2.0%	3.7%	1.2%	2.5%	3.2%	4.4%	1.9%	3.0%	3.1%	2.7%	10.6%	2.4%	2.3%	2.3%	1.8%	2.4%	2.5%	3.0%	4.7%	8.0%
Real Residential Construction [5]	7.6%	17.7%	10.8%	-8.8%	-5.4%	8.5%	3.2%	3.8%	1.3%	6.3%	9.2%	10.0%	8.0%	8.8%	9.1%	8.2%	13.5%	11.9%	1.6%	5.0%	8.9%	8.4%
Inflation Rate (CPI, Y/Y % Change) [5]	1.7%	1.4%	1.6%	1.2%	1.4%	2.1%	1.8%	1.2%	-0.1%	-0.6%	-0.2%	0.9%	2.0%	2.0%	2.1%	2.3%	1.9%	1.2%	1.2%	0.9%	2.3%	1.6%
Core Infl. Rate (CPI, Y/Y % Change) [5]	1.9%	1.7%	1.7%	1.7%	1.6%	1.9%	1.8%	1.7%	1.7%	1.5%	1.6%	1.8%	1.8%	1.8%	1.9%	2.0%	1.9%	1.7%	1.7%	1.8%	2.0%	2.2%
Core Infl. Rate (PCE, Y/Y % Change) [5]	1.5%	1.3%	1.3%	1.3%	1.2%	1.5%	1.5%	1.4%	1.3%	1.0%	0.9%	1.9%	1.8%	2.0%	2.0%	1.1%	1.9%	1.3%	1.4%	1.9%	1.1%	1.9%
Unemployment Rate	7.7%	7.5%	7.2%	7.0%	6.6%	6.2%	6.1%	5.7%	5.6%	5.4%	5.3%	5.2%	5.2%	5.1%	5.0%	5.0%	8.1%	7.4%	6.1%	5.3%	5.1%	5.0%
10-Year Treasury Yield	1.9%	2.0%	2.7%	2.7%	2.8%	2.6%	2.5%	2.3%	2.0%	2.1%	2.3%	2.4%	2.7%	2.8%	3.0%	3.0%	1.8%	2.4%	2.5%	2.2%	2.9%	3.4%
1-Year Treasury Yield	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.3%	0.5%	0.7%	1.1%	1.4%	1.6%	1.8%	0.2%	0.1%	0.1%	0.4%	1.5%	.....
Prime Rate	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.3%	3.4%	3.6%	4.0%	4.2%	4.4%	4.6%	3.3%	3.3%	3.3%	3.4%	4.3%	4.7%
Federal Funds Target Rate	0.14%	0.12%	0.08%	0.09%	0.07%	0.09%	0.09%	0.10%	0.11%	0.17%	0.30%	0.60%	0.90%	1.10%	1.40%	1.60%	0.14%	0.11%	0.09%	0.30%	1.25%	2.40%
Consumer Confidence	62.6	75.1	81.0	74.2	80.6	83.4	90.9	92.8	101.4	97.1	99.0	99.0	99.0	99.0	99.0	99.0	67.0	73.3	87.0	99.1	99.0	97.0

Note: Shaded area indicates historical values. Projected trends are an average forecast of Mortgage Bankers Association (MBA), Fannie Mae, Freddie Mac, National Association of Realtors, Wells Fargo, PNC Financial, Standard and Poor's, the National Association of Home Builders, the Conference Board, the Wall Street Journal Survey, the Federal Open Market Committee, Tading Economics,Raymond James Financial, and the Philadelphia Federal Reserve Bank Survey.

[1] Share of home purchase mortgage originations made to low-income borrowers in that quarter (year).

[2] Share of home purchase mortgage originations made to very low-income borrowers in that quarter (year).

[3] Share of home purchase mortgage originations on properties located in low-income areas, excluding those in designated disaster areas, in that quarter (year).

[4] Share of refinance mortgage originations made to low-income borrowers in that quarter (year).

[5] Quarter over quarter change, annual rate.

5.1 percent in 2017. The 10-Year Treasury note yield is expected to average 2.2 percent in 2015, then rise to 2.9 percent in 2016 and 3.4 percent in 2017.

Unemployment. In addition to being an indicator of the health of the economy in general, the employment situation affects the housing market more directly because buying a house is considered a large investment and a long-term commitment that requires stable employment. The unemployment rate has steadily fallen from 9.1 percent in August 2011 to 5.4 percent in April 2015. The labor force participation rate was 62.6 percent in June of 2015, remaining within the narrow band of 62.5 to 63.0 percent over the past year.[12]

One of the stated objectives of the FOMC's interest rate policy is fostering maximum employment. Given the foreseeable monetary policy and the continued growth in the economy, the unemployment rate is expected to fall to an average 5.3 percent in 2015, 5.1 percent in 2016 and 5.0 percent in 2017 (see **Table 2**). To the extent that lower-income jobs are affected more by the employment situation, the affordable home purchase market is affected.

Inflation. The second stated objective of the FOMC in determining its interest rate policy is for price stability. As shown in **Table 2**, industry observers expect core inflation (excluding food and energy) to remain near 2.0 percent through 2017.

House Prices. Trends in house prices influence the housing and mortgage markets. In periods of house price appreciation, home sales and mortgage originations may increase as the expected return on investment rises.[13] In periods of price depreciation or price uncertainty, home sales and mortgage originations tend to decrease as risk-averse homebuyers are reluctant to enter the market. House prices generally fell during 2009 through 2011, but turned around in 2012

[12] Bureau of Labor Statistics, News Release: The Employment Situation – April 2015, (May 8, 2015).
[13] House prices and home sales can have a circular relationship, as they had between 2000 and 2006. Rising prices and expectations of further growth caused demand to grow. As demand outpaced supply, house prices rose even more.

with an increase of 5.4 percent in FHFA's Purchase Only Home Price Index. House prices increased at a rate of 7.7 percent in 2013 and 5.1 percent in 2014. House prices are expected to continue to increase at rates of 4.3, 3.8, and 3.4 percent in 2015, 2016, and 2017, respectively (see **Table 3**).

The expected increase in interest rates and house prices leads to an expected decrease in housing affordability. Housing affordability, as measured in **Table 3** by NAR's Housing Affordability Index, is expected to drop from an index of 200 at the end of 2012 to 102 by 2017.

Housing Market. An active housing market is generally good for the affordable home market. When there are more homes for sale, potential home buyers have more options, prices tend to be more competitive and the search costs to find affordable housing decrease. Houses for sale volumes, as measured by months' supply (the ratio of houses for sale to houses sold), reached a seasonally adjusted high of 12.2 houses for sale to every house sold in January 2009, to a low of 3.9 houses for sale to every house sold in January 2013, and has steadily increased since, to 5.3 houses for sale to every house sold in March 2015 (which is just under the long-run average of 6.1).[14]

Refinance Rate. The size of the refinance mortgage market has an impact on the affordable share of refinance mortgages. Historically, refinance mortgage volume increases when the refinancing of mortgages is motivated by low interest rates ("rate-and-term refinances"), and higher-income borrowers tend to make up a greater share of this increased volume. As a result, in periods of low interest rates, the share of lower-income borrowers will decrease. Likewise,

[14] U.S. Census Bureau, "Houses for Sale by Regions and Months' Supply at Current Sales Rate," seasonally adjusted numbers.

Table 3

Housing and Mortgage Market Outlook

	2013				2014				2015				2016									
	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	Q 1	Q 2	Q 3	Q 4	2012	2013	2014	2015	2016	2017
Housing Starts [1]	952	867	883	1,011	933	984	1,029	1,056	977	1,094	1,128	1,178	1237	1269	1292	1303	784	928	1,001	1,095	1,275	1,247
Housing Starts, 1-Unit [1]	631	595	602	652	610	624	654	700	646	716	762	797	869	899	920	932	537	620	647	731	905	.....
Total Home Sales [2]	5,373	5,548	5,706	5,390	5,108	5,314	5,490	5,532	5,488	5,694	5,759	5,672	5,909	5,942	5,974	6,007	5,030	5,505	5,363	5,654	5,958	5,964
New Home Sales [1]	447	447	381	446	431	427	434	471	512	513	527	536	591	604	613	620	368	430	441	522	607	550
Existing Home Sales [1]	4,926	5,101	5,324	4,945	4,677	4,887	5,056	5,061	4,976	5,134	5,232	5,136	5,318	5,338	5,361	5,387	4,662	5,074	4,922	5,120	5,351	5,414
Single-Family Originations [3]	$477	$572	$469	$326	$247	$297	$300	$278	$334	$399	$339	$292	$248	$341	$340	$279	$2,044	$1,845	$1,122	$1,364	$1,208	$1,161
Refinance Mortgage Share [4]	74%	63%	51%	46%	50%	40%	38%	46%	54%	43%	37%	38%	35%	30%	30%	29%	69%	58%	43%	43%	31%	22%
FHA Home Purchase Market Share [5]	24%	21%	19%	19%	15%	18%	21%	18%	18%	20%	20%	20%	20%	20%	20%	20%	26%	21%	18%	19%	20%	20%
FHA Refinance Market Share [5]	10%	9%	8%	8%	5%	8%	8%	6%	4%	4%	4%	5%	4%	4%	4%	5%	6%	7%	7%	4%	4%	5%
ARM Market Share [5]	5%	6%	7%	8%	9%	10%	9%	9%	7%	8%	9%	9%	11%	12%	12%	13%	5%	7%	9%	8%	12%	12%
Investor Share [5]	13.7%	12.3%	11.7%	12.5%	12.7%	11.6%	11.6%	12.3%	12.6%	11.5%	11.5%	12.1%	12.6%	11.5%	11.5%	12.1%	13.2%	12.6%	12.1%	11.9%	11.9%	11.9%
30-Year Mortgage Fixed Rate [6]	3.5%	3.7%	4.4%	4.3%	4.4%	4.2%	4.1%	4.0%	3.7%	3.8%	4.0%	4.2%	4.4%	4.6%	4.7%	4.8%	3.7%	4.0%	4.2%	3.9%	4.6%	5.1%
5/1 ARM Rate [6]	2.6%	2.7%	3.2%	3.0%	3.1%	3.0%	3.0%	3.0%	2.9%	2.9%	3.1%	3.3%	3.5%	3.7%	3.9%	4.1%	2.8%	2.9%	3.0%	3.1%	3.8%	.....
1-Year ARM Rate [6]	2.6%	2.6%	2.7%	2.6%	2.5%	2.4%	2.4%	2.4%	2.4%	2.5%	2.6%	2.7%	3.1%	3.2%	3.3%	3.4%	2.7%	2.6%	2.4%	2.6%	3.3%	.....
Change in Housing Prices (FHFA ALL) [7]	2.3%	4.3%	4.7%	5.0%	5.4%	6.0%	5.8%	5.5%	4.3%	4.7%	4.7%	4.8%	4.6%	4.6%	4.6%	4.5%	0.7%	5.0%	5.5%	4.8%	4.5%	.....
Change in Housing Prices (FHFA PO) [8]	7.0%	7.5%	8.3%	7.7%	7.0%	5.7%	4.8%	5.1%	4.5%	3.8%	4.1%	4.3%	3.8%	3.9%	3.9%	3.8%	5.4%	7.7%	5.1%	4.3%	3.8%	3.4%
Change in Housing Prices (CS HPI) [9]	8.6%	11.6%	12.7%	13.7%	13.1%	9.4%	5.7%	4.3%	4.2%	3.7%	3.2%	3.1%	2.6%	2.7%	2.7%	2.8%	4.6%	13.7%	4.3%	3.1%	2.8%	3.4%
Housing Affordability Index [10]	195	184	171	168	165	167	168	165	167	159	149	144	139	115	105	105	200	168	165	144	105	102
Median Sales Price - New Homes [11]	$258	$268	$262	$272	$274	$282	$278	$301	$284	$293	$291	$299	$296	$301	$299	$305	$242	$265	$284	$292	$300	.....
Median Sales Price - Existing Homes [11]	$176	$203	$207	$197	$191	$212	$216	$208	$203	$218	$222	$216	$217	$227	$229	$225	$175	$196	$207	$215	$224	$229
Average LTV [12]	77.2%	78.6%	78.8%	80.0%	79.1%	79.2%	79.0%	80.0%	79.3%	79.7%	79.9%	80.2%	79.7%	80.2%	80.3%	80.6%	77.0%	78.7%	79.3%	79.8%	80.2%	80.4%
Percent LTVs at least 95% [12]	16.1%	17.8%	16.9%	18.4%	18.2%	18.6%	13.7%	17.4%	16.0%	16.8%	16.1%	16.5%	16.3%	16.8%	15.9%	16.2%	13.9%	17.3%	17.0%	16.3%	16.3%	15.9%
Percent LTVs at least 90% [12]	26.5%	29.8%	29.3%	32.8%	30.8%	32.0%	28.9%	31.7%	30.8%	32.6%	32.8%	33.3%	32.5%	33.6%	33.2%	33.6%	24.0%	29.6%	30.8%	32.4%	33.2%	33.2%

Note: Shaded area indicates historical values. Forecasts are an average forecast of Mortgage Bankers Association (MBA), Fannie Mae, Freddie Mac, National Association of Realtors, Wells Fargo, PNC Financial, the National Association of Home Builders, Standard and Poor's, the Wall Street Journal Survey, the Conference Board, Raymond James Financial, the Federal Reserve Bank of Philadelphia and the Federal Open Market Committee.

[1] Thousands of units

[2] Thousands of units, forecasted amount does not equal the sum of the existing plus new home sales because of differences in forecasts.

[3] FHFA and MBA, Billions of dollars

[4] The refinance shares for 2012-2013 are calculated from Home Mortgage Disclosure Act (HMDA) data. Preliminary estimates in 2014 are as reported by MBA.

[5] HMDA data.

[6] Freddie Mac, Primary Mortgage Market Survey

[7] FHFA House Price Index, all transactions (Y/Y % Change)

[8] FHFA House Price Index, purchase transactions only (Y/Y % Change, Seasonally Adjusted)

[9] Standard & Poor's Case-Shiller 10 City Index (Y/Y % Change, Seasonally Adjusted)

[*] Freddie Mac's Conventional Mortgage Home Price Index (Y/Y % Change, Annual Rate)

[10] National Association of Realtors

[11] Thousands of dollars

[12] FHFA Monthly Interest Rate Survey

refinancings that occurred when interest rates were high tended to have a higher proportion of lower-income homeowners who were consolidating their debts or who were drawing equity out of their homes for other uses.

In 2014, for the first time in more than five years, less than half of mortgage originations are expected to be for the purpose of refinancing an existing mortgage. As interest rates continue to rise, the share of originations from refinancing is expected to fall to 38 percent of mortgage originations in the fourth quarter of 2015, 29 percent by the end of 2016, and 22 percent in 2017 (see **Table 3)**.

Market Performance of Housing Goal-Eligible Mortgages. The estimates of the market performance for the two single-family, owner-occupied home purchase housing goals and one subgoal, and the refinancing mortgage housing goal, are provided at the top of **Table 2**. The estimates for the low-income borrower shares of the home purchase mortgage market are 22.4 percent in 2015, 22.9 percent in 2016 and 22.0 percent in 2017. The estimates for the very low-income borrower shares of the home purchase mortgage market are 5.9, 6.0 and 5.7 percent, respectively, in 2015, 2016 and 2017. The estimates for the share of goal-qualifying mortgages in low-income areas in the home purchase mortgage market, excluding designated disaster areas, are 13.2 percent of home purchase mortgages in 2015, 13.6 percent in 2016 and 14.2 percent in 2017. The estimates for the low-income refinancing goal are 21.8 percent in 2015, 22.4 percent in 2016 and 22.8 percent in 2017.

To arrive at these market projections, forecasts were compiled from thirteen industry and government sources (industry observers). The list of forecasters, along with each forecaster's annualized projections for 2015 through 2017 of the market indicators, is provided in **Table 4**

Table 4

Forecasts of Economic Indicators by Source

Forecast[1]	Real GDP Growth Rate			Residential Constr. Growth Rate			Inflation Rate (CPI)[2]			Inflation Rate (Core CPI)[2]			Inflation Rate (Core PCE)[2]			Unemployment Rate			10-Year Const. Mat. Treas. Yield			1-Year Const. Mat. Treas. Yield			Prime Rate			Federal Funds Rate		
	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017
Mortgage Bankers Association[3]	2.4%	2.7%		4.1%	10.1%		1.6%	2.4%								5.4%	5.1%		2.2%	3.0%								0.4%	1.7%	
Fannie Mae[4]	2.4%	2.8%		4.2%	8.5%		1.5%	2.2%		1.6%	2.0%					5.4%	5.0%		2.1%	2.4%		0.4%	1.1%					0.2%	0.7%	
Freddie Mac[5]	2.5%	2.8%					1.2%	2.3%								5.4%	5.1%		2.1%	3.0%		0.5%	1.9%							
National Association of Realtors[6]	2.5%	3.0%					1.2%	3.2%								5.4%	5.3%		2.2%	3.3%					3.5%	4.6%		0.4%	1.6%	
Wells Fargo[7]	2.3%	3.0%		4.8%	9.0%		1.0%	2.3%		1.8%	2.0%					5.4%	5.0%		2.2%	2.7%					3.4%	4.6%		0.4%	1.6%	
PNC Financial[8]	2.8%	2.9%	2.4%	6.5%	6.7%	5.8%	1.5%	2.2%	2.3%				1.3%	1.7%	1.8%	5.3%	4.9%	4.7%	2.1%	2.4%	2.7%				3.3%	4.0%	4.8%	0.2%	1.0%	1.8%
Standard and Poor's[9]	2.4%	3.0%	2.8%	4.6%	11.6%	9.4%		2.2%	2.2%	1.7%	1.9%	1.9%				5.3%	5.0%	4.9%	2.2%	2.9%	3.7%							0.3%	1.4%	2.7%
National Association of Home Builders[10]																			2.1%	2.7%		0.5%	1.5%		3.3%	4.3%		0.3%	1.3%	
The Conference Board[11]	2.2%	2.5%																												
Wall Street Journal Survey[12]	2.5%	2.9%	2.6%				0.1%	2.2%	2.3%							5.3%	4.9%	4.8%	2.3%	3.2%	3.6%							0.4%	1.5%	2.7%
Federal Open Market Committee[13]	2.9%	2.5%	2.3%										1.4%	1.7%	1.8%	5.1%	5.0%	5.0%												
Trading Economics[14]	2.6%	3.2%	2.7%				0.3%	1.7%	1.7%	1.8%	2.3%	2.3%	5.6%	-1.3%	1.9%	5.4%	6.0%	6.1%	2.4%	3.2%	3.4%				3.4%	4.1%	4.5%			
Raymond James Financial[15]	2.1%	2.5%		5.7%	7.5%		0.9%	1.9%		1.8%	1.8%		1.4%	1.7%		5.3%	4.8%		2.3%	3.1%								0.2%	0.8%	
Philadelphia FRB Survey[16]	2.4%	2.8%	2.9%	5.2%	8.8%		0.9%	2.1%	2.2%	1.8%	2.0%	2.1%	1.4%	1.7%	1.8%	5.4%	5.0%	4.8%	2.2%	2.9%	3.5%									
Average[17]	2.4%	2.8%	2.9%	5.0%	8.9%	8.4%	1.4%	2.1%	-0.1%	1.6%	1.9%	1.7%	1.2%	1.5%	1.3%	5.3%	5.1%	5.0%	2.2%	2.9%	3.4%	0.4%	1.5%		3.4%	4.3%	4.7%	0.3%	1.3%	2.4%
Minimum	*2.1%*	*2.5%*	*2.3%*	*4.1%*	*6.7%*	*5.8%*	*0.1%*	*1.7%*	*1.7%*	*1.6%*	*1.8%*	*1.9%*	*1.3%*	*-1.3%*	*1.8%*	*5.1%*	*4.8%*	*4.7%*	*2.1%*	*2.4%*	*2.7%*	*0.4%*	*1.1%*		*3.3%*	*4.0%*	*4.5%*	*0.2%*	*0.7%*	*1.8%*
Maximum	*2.9%*	*3.2%*	*2.9%*	*6.5%*	*11.6%*	*9.4%*	*1.6%*	*3.2%*	*2.3%*	*1.8%*	*2.3%*	*2.3%*	*5.6%*	*1.7%*	*1.9%*	*5.4%*	*6.0%*	*6.1%*	*2.4%*	*3.3%*	*3.7%*	*0.5%*	*1.9%*		*3.5%*	*4.6%*	*4.8%*	*0.4%*	*1.7%*	*2.7%*

[1] Forecasts are annual averages of quarterly forecasts, where applicable.

[2] Fourth Quarter over Fourth Quarter Percent Change.

[3] Last Updated 5/18/2015

[4] Last Updated 5/11/2015

[5] Last Updated 5/15/2015

[6] Last Updated 5/1/2015

[7] Last Updated 5/13/2015 , U.S. Economic Forecast and 4/30/2015 , U.S. Housing Market Forecast.

[8] Last Updated 5/15/2015

[9] Last Updated 5/21/2015

[10] Last Updated 4/30/2015

[11] Last Updated 5/13/2015

[12] Last Updated 5/1/2015 , survey of 57 forecasters.

[13] Last Updated 3/18/2015 , midpoint of the central tendency projection.

[14] Last Updated 5/18/2015

[15] Last Updated 5/13/2015

[16] Last Updated 5/15/2015 , survey of 45 forecasters.

[17] Averages include actual values for months when available. Therefore the average line may not equal the average of the above numbers.

and Table 5. The forecasts are all provided on either a quarterly or annual basis for each market indicator. An econometric state space methodology was used to extend the trends of the market performance for each goal, based on the monthly time series database provided by the FFIEC and the Federal Reserve Board. For the low-income areas goal, this model produced only the market estimates for the subgoal. The remainder of the market estimates for this goal relates to the designated disaster areas. The 2015 through 2017 estimates of the share of home purchase mortgages that will qualify for the designated disaster areas portion of the low-income areas goal will be provided separately, based on data provided by the Federal Emergency Management Agency (FEMA).[15]

[15] http://www.fema.gov/disasters.

Table 5

Forecasts of Housing and Mortgage Market Indicators by Source

Forecast[1]	Housing Starts[2]			Housing Starts (1-Unit)[2]			Total Home Sales[2]			New Home Sales[2]			Existing Home Sales[2]			Single-Family Originations[3]			Refinance Mortgage Rate			FHA Market Share			ARM Market Share		
	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017
Mortgage Bankers Association	1,075	1,228		709	843		5,641	5,980		512	562		5,129	5,418		$1,281	$293		42.7%	32.8%							
Fannie Mae	1,106	1,319		740	921		5,646	5,890		529	621		5,116	5,269		$1,460	$295		48.0%	32.8%					7.8%	9.0%	
Freddie Mac	1,144	1,400					5,607	5,800								$1,350	$319		42.8%	29.5%		20.4%	20.0%		8.1%	14.5%	
National Association of Realtors	1,134	1,390		761	990		5,840	6,210		576	720		5,264	5,490													
Wells Fargo	1,139	1,225		741	793		5,622	5,990		518	590		5,104	5,400													
PNC Financial	1,016	1,081	1,139				5,698	5,918	6,158	520	543	580	5,177	5,376	5,578												
Standard and Poor's	1,119	1,400	1,500																								
National Association of Home Builders	1,054	1,342		704	977					529	718																
The Conference Board	1,090	1,320																									
Wall Street Journal Survey	1,079	1,276																									
Trading Economics	1,037	1,072	1,102				5,505	5,649	5,769	468	496	520	5,038	5,153	5,249												
Federal Open Market Committee																											
Philadelphia FRB Survey																											
Average [4]	1,095	1,275	1,247	731	905		5,654	5,958	5,964	522	607	550	5,120	5,351	5,414	$1,364	$1,208		42.9%	30.9%		19.5%	20.0%		7.9%	11.8%	
Minimum	*1,016*	*1,072*	*1,102*	*704*	*793*		*5,505*	*5,649*	*5,769*	*468*	*496*	*520*	*5,038*	*5,153*	*5,249*	*$1,281*	*$293*		*42.7%*	*29.5%*		*20.4%*	*20.0%*		*7.8%*	*9.0%*	
Maximum	*1,144*	*1,400*	*1,500*	*761*	*990*		*5,840*	*6,210*	*6,158*	*576*	*720*	*580*	*5,264*	*5,490*	*5,578*	*$1,460*	*$319*		*48.0%*	*32.8%*		*20.4%*	*20.0%*		*8.1%*	*14.5%*	

Forecast[1]	30-Year Mortgage Fixed Rate			5/1 ARM Rate			1-Year ARM Rate			Change in Home Prices (FHFA ALL)[5]			Change in Home Prices (FHFA PO)[5]			Change in Home Prices (Case-Shiller)[6]			Housing Affordability Index[7]			Median Sales Price - New Homes[8]			Median Sales Price - Existing Homes[8]		
	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017	2015	2016	2017
Mortgage Bankers Association	4.1%	4.9%								5.0%	4.6%											$289	$289		$210	$216	
Fannie Mae	3.8%	4.1%		3.0%	3.4%		2.6%	3.0%					4.3%	3.7%	3.8%							$294	$307		$216	$225	
Freddie Mac	4.0%	4.9%		3.0%	4.2%		2.5%	2.9%								1.1%	0.9%										
National Association of Realtors	4.0%	5.2%					2.7%	4.1%											144	105		$293	$301		$219	$230	
Wells Fargo	4.0%	4.5%					2.6%	3.0%					4.8%	4.8%	4.8%	4.0%	3.8%					$291	$304		$214	$227	
PNC Financial	3.9%	4.2%	4.4%													3.1%	2.9%	3.4%									
Standard and Poor's	3.9%	4.7%	5.8%																								
National Association of Home Builders	3.9%	4.4%					2.5%	3.3%																			
The Conference Board																											
Wall Street Journal Survey										4.4%	4.2%																
Trading Economics	4.2%	4.8%	5.1%										6.9%	5.1%	5.5%	4.5%	4.3%	3.7%									
Philadelphia FRB Survey																											
Average [4]	3.9%	4.6%	5.1%	3.1%	3.8%		2.6%	3.3%		4.8%	4.5%		4.3%	3.8%	3.4%	3.1%	2.8%	3.4%	144	105		$292	300		$215	$224	
Minimum	*3.8%*	*4.1%*	*4.4%*	*3.0%*	*3.4%*		*2.5%*	*2.9%*		*4.4%*	*4.2%*		*4.3%*	*3.7%*	*3.8%*	*1.1%*	*0.9%*	*3.4%*	*144*	*105*		*$289*	*$289*		*$210*	*$216*	
Maximum	*4.2%*	*5.2%*	*5.8%*	*3.0%*	*4.2%*		*2.7%*	*4.1%*		*5.0%*	*4.6%*		*6.9%*	*5.1%*	*5.5%*	*4.5%*	*4.3%*	*3.7%*	*144*	*105*		*$294*	*$307*		*$219*	*$230*	

[1] Forecasts are annual averages of quarterly forecasts, where applicable. See Table 2 for update information. The FOMC and Raymond James & Associates only provide forecasts on basic macroeconomic series and therefore are omitted from the mortgage/housing forecast table (see Table 2).

[2] Thousands of units

[3] Billions of dollars

[4] Averages include actual values for months when available. Therefore the average line may not equal the average of the above numbers.

[5] Federal Housing Finance Agency: All transactions and home Purchase only home price indicies (Q4/Q4 % Change).

[6] Standard & Poor's / Case-Shiller Home Price Index, 10-City Composite (Q4/Q4 % Change).

[7] Housing Affordability Index (4th Quarter), National Association of Realtors. Forecasts are scaled to NAR's quarterly HAI series.

[8] Thousands of dollars

D. STATISTICAL MODELS OF THE SINGLE-FAMILY HOUSING GOALS

To estimate the 2015 through 2017 market shares for the four single-family housing goals, a state space form (SSF) is incorporated with the associated algorithms of the Kalman filter and smoother.[16] This SSF approach is a method by which the time series gap left by the HMDA data can be statistically extended with a similar time series which is highly correlated with it. For the home purchase goals, an estimate of monthly market affordability levels for the home purchase goals from FHFA's MIRS data is used.[17] The market size for the refinance goal is estimated using the SSF approach with the combined Fannie Mae and Freddie Mac 3-month moving average goal shares for January 2004 – April 2015 as the second signal.

The forecast models are estimated using HMDA data for the years 2004 through 2013, as there were several significant changes in HMDA reporting beginning in 2004. A discussion on why this time series is used, as well as a comparison of results from this time series and an alternative longer time series, is provided in **Appendix E**.

Several specifications of the auto-regressive (AR) model were tested for each housing goal. All of the time series, both the dependent (goal-qualifying share) and independent (explanatory), were found to be stationary when integrated at the first level.[18] While several exogenous variables had the expected sign, many were found to be insignificant at a 10 percent level of confidence. The equations were fitted with monthly binary variables to capture seasonality effects, as opposed to moving average terms which have no forecasting value.

[16] The methodology followed is an adaptation of a state space model developed by Freddie Mac, Housing Analysis and Research. For a thorough discussion of the state space approach, see Harvey, Andrew, "Forecasting with Unobserved Components Time Series Models," in Handbook of Economic Forecasting, G. Elliott, C.W.J. Granger and A. Timmermann eds., North Holland, 2006, pp. 327-412.

[17] This is an estimated time series of 3-month moving average goal-qualifying shares based on MIRS data from January 2004 through April 2015.

[18] In simple terms, a stationary time series has no trend, has a constant variance over time, has a constant autocorrelation structure, and has no periodic fluctuations (seasonality).

For each housing goal, four alternative specifications are presented, in addition to a re-estimated (with 2013 HMDA data) model specification used in the proposed rule.[19] The **Full Model** includes all possible explanatory variables, whether they have a significant impact or not. For explanatory variable categories where there are several variables to choose from (e.g., the category of volume includes home sales, housing starts and mortgage originations), at least one variable will be included in the model specification and all variables with a significant impact will be included. In addition to all possible explanatory variables, the **Full Model w/2004-07** includes a set of monthly binary variables for the years 2004 through 2007 to capture time specific effects of the mortgage boom period. The **Best Fit Model** includes explanatory variables that provide the best fit specification, as determined by significance of the variable, low model variance, minimizing white noise, and model goodness of fit.[20] The **Best Fit Model w/2004-07** is the best fit specification when the 2004 through 2007 binary monthly variables are included.

All of the models are first-differenced and the hypothesis of non-stationarity for the first order integrated time series can be rejected.

Low-Income Borrower Home Purchase Goal. **Table 6** shows the four model specifications analyzed for the Low-Income Borrower Home Purchase Goal (LIP) plus the model used in the proposed rule, re-estimated using updated HMDA data. The **Best Fit Model** provides the best model for forecasting this goal. The Akaike Information Criterion (AIC) statistic for this specification is lowest, indicating it has the best goodness of fit. It also does the best of all the specifications in reducing white noise, as determined by the Chi Square statistic. Additional diagnostic information is provided in **Appendix A**.

[19] 79 Federal Register 176 (September 11, 2014), p. 54482.

[20] In the following tables, white noise is minimized when the probability of a larger Chi Square statistic (i.e., $P(>\chi^2)$) is highest. A better goodness of fit is determined by the lowest (most negative) Akaike Information Criterion statistic.

The best fitting equation was found to be a first differenced seasonal AR model with four autoregressive terms, with *AR(2)* and *AR(4)* being significant at the five percent level. In addition to the time series components, drivers of this housing goal include the unemployment rate lagged one month, log of the Core CPI year over year change, the 10-Year Treasury yield lagged one month, the 30-year fixed mortgage rate, log of median price of existing homes sold, log of FHFA's House Price Index (HPI) lagged one month, log of NAR's Home Affordability Index (HAI), log of total home sales, log of single-family housing starts, share of Adjustable Rate Mortgages (ARM) lagged three months, and share of mortgages on owner-occupied properties. The Chi-Square statistic indicates that the hypothesis that the residuals are white noise cannot be rejected.

The forecasts for the Low-Income Borrower Home Purchase Goal are shown in **Figure 1**. While the SSF provides the best forecast, the forecast based on HMDA data alone is also shown. The SSF forecast averages 22.4, 22.9 and 22.0 percent in 2015 through 2017, respectively. The 2017 confidence interval is plus or minus 5.0 percent, which is smaller than the same interval for the model used in the proposed rule. Also, for reference, the figure is annotated with the 2010-2011 goal benchmark (27 percent) and the 2012-2014 benchmark (23 percent).

Table 6

Low-Income Borrower Home Purchase Goal

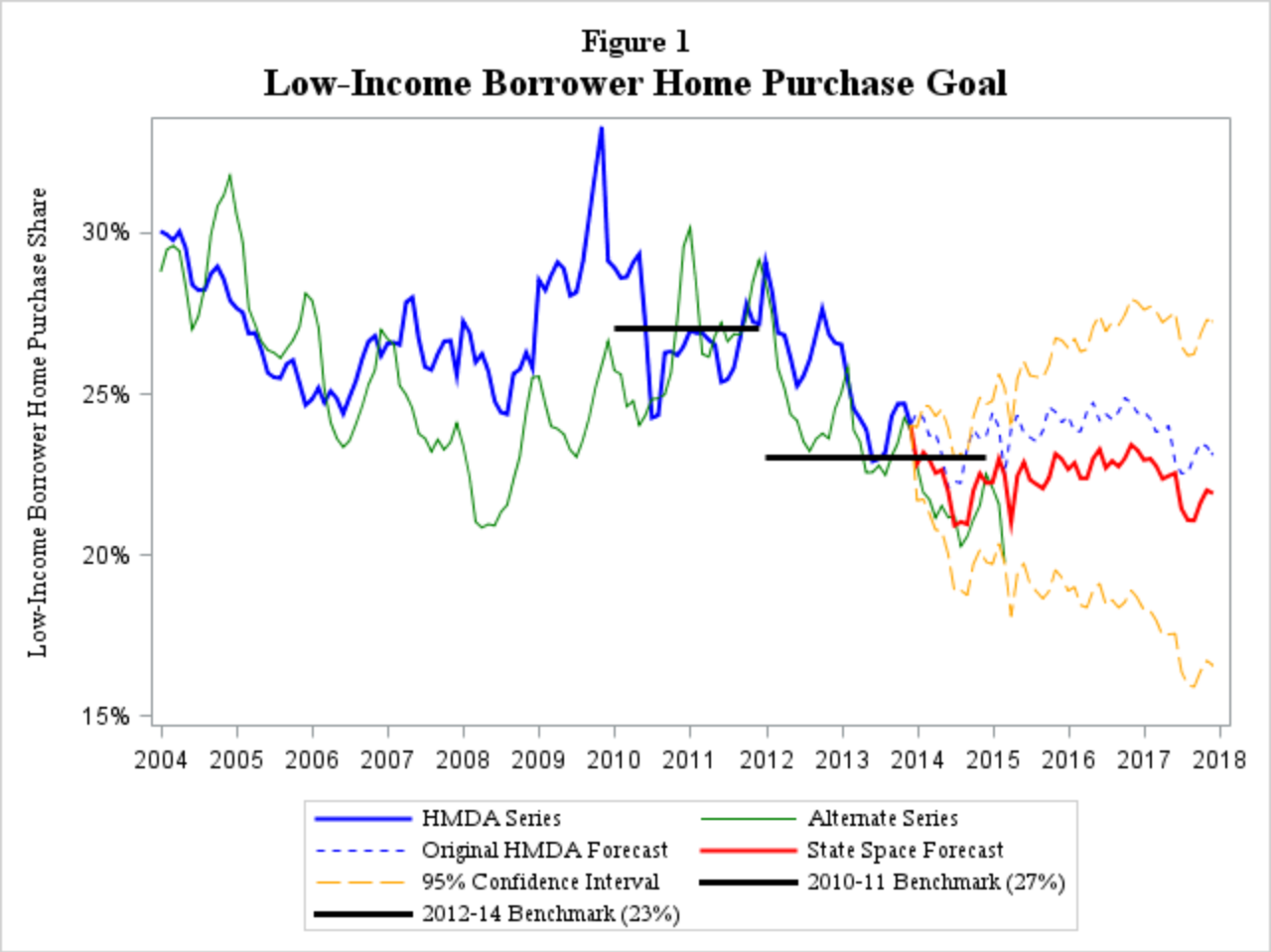
		Full Model w/ 2004-07	Best Fit w/ 2004-07	Full Model	Best Fit Model	Model Used in Prop. Rule
	AR(1)	-0.075	-0.227 **	-0.132	-0.169	-0.106
		(0.126)	(0.110)	(0.109)	(0.105)	(0.099)
	AR(2)	0.456 ***	0.259 **	0.345 ***	0.256 **	0.235 **
		(0.121)	(0.113)	(0.111)	(0.108)	(0.100)
	AR(3)	-0.026	0.060	-0.041	-0.021	
		(0.129)	(0.113)	(0.110)	(0.108)	
	AR(4)	-0.307 **	-0.211 *	-0.256 **	-0.231 **	
		(0.129)	(0.110)	(0.110)	(0.105)	
	AR(5)	0.089				
		(0.122)				
	AR(6)	0.229 *				
		(0.120)				
	Unemplment Rate$_{t-1}$	0.517		0.446	0.464 *	0.744 **
		(0.326)		(0.279)	(0.264)	(0.320)
	Ln(Core CPI$_{Y/Y}$)	-0.221 **	-0.137 *	-0.166 ***	-0.146 **	
		(0.100)	(0.081)	(0.064)	(0.060)	
	Consumer Confidence	0.000 *		0.000		
		(0.000)		(0.000)		
Interest Rates	10-Year Treas. Yield$_{t-1}$	-0.458 **	-0.582 ***	-0.653 ***	-0.628 **	-0.248
		(0.203)	(0.194)	(0.251)	(0.253)	(0.218)
	30-Year Fixed Mort. Rate	-0.266		-0.691 **	-0.646 **	
		(0.265)		(0.313)	(0.295)	
	Rate Spread					-0.365 ***
						(0.091)
House Prices	Ln(Med. Price, Exist. Homes)	-0.106 ***	-0.086 ***	-0.185 ***	-0.177 ***	-0.143 ***
		(0.035)	(0.031)	(0.048)	(0.047)	(0.032)
	Ln(HPI)$_{t-1}$	0.230 **		0.147 *	0.125 *	
		(0.097)		(0.076)	(0.071)	
	Ln(HAI)			0.073 *	0.068 *	
				(0.041)	(0.040)	
Volume	Ln(Home Sales)	0.049 ***	0.058 ***	0.041 ***	0.042 ***	0.090 ***
		(0.015)	(0.014)	(0.014)	(0.014)	(0.012)
	Ln(Housing Starts)			0.012 **	0.011 **	
				(0.006)	(0.006)	
	FHA Share	0.053		0.031		
		(0.046)		(0.044)		
	ARM Share$_{t-3}$	-0.068 **	-0.058 *	-0.092 ***	-0.095 ***	
		(0.032)	(0.033)	(0.031)	(0.032)	
	Owner-Occupied Share	0.355 ***	0.549 ***	0.517 ***	0.570 ***	
		(0.127)	(0.108)	(0.119)	(0.105)	
	Average LTV	0.105		0.079		
		(0.066)		(0.062)		
	Percent LTVs at least 90%	-0.036		-0.016		
		(0.025)		(0.023)		
		---------- Monthly Binary Variables ----------				
		[2004-2007 Monthly Binary Variables]				
	σ^2	0.000022	0.000023	0.000021	0.000021	0.000028
		(0.004667)	(0.004762)	(0.004591)	(0.004596)	(0.005313)
	χ^2	8.010	9.430	4.210	3.640	10.430
	P(>χ^2)	0.238	0.307	0.838	0.888	0.404
	AIC	-898.930	-907.146	-909.839	-920.310	-892.211
	95% Confidence Interval (2017)	+/- 8.4%	+/- 5.2%	+/- 5.3%	+/- 5.1%	+/- 8.0%

Standard Errors are reported in parantheses.

* indicates significance at the 90% level.

** indicates significance at the 95% level.

*** indicates significance at the 99% level.



Very Low-Income Borrower Home Purchase Goal. **Table 7** shows the four model specifications analyzed for the Very Low-Income Borrower Home Purchase Goal (VLIP) plus the model used in the proposed rule, re-estimated using updated HMDA data. The **Best Fit Model** is provides the best model for forecasting this goal. The AIC statistic for this specification is lowest, indicating it has the best goodness of fit. It also does the best of all the specifications in reducing white noise, as determined by the Chi Square statistic. Additional diagnostic information is provided in **Appendix A**.

The best fitting equation was found to be a first differenced seasonal AR model with two autoregressive terms, with *AR(2)* being significant at the one percent level. In addition to the time series components, drivers of this housing goal include the unemployment rate lagged one month, log of the Core CPI year over year change, the 10-Year Treasury yield lagged one month, log of median price of existing homes sold, log of total home sales, and log of mortgage originations lagged two months. The Chi-Square statistic indicates that the hypothesis that the residuals are white noise cannot be rejected.

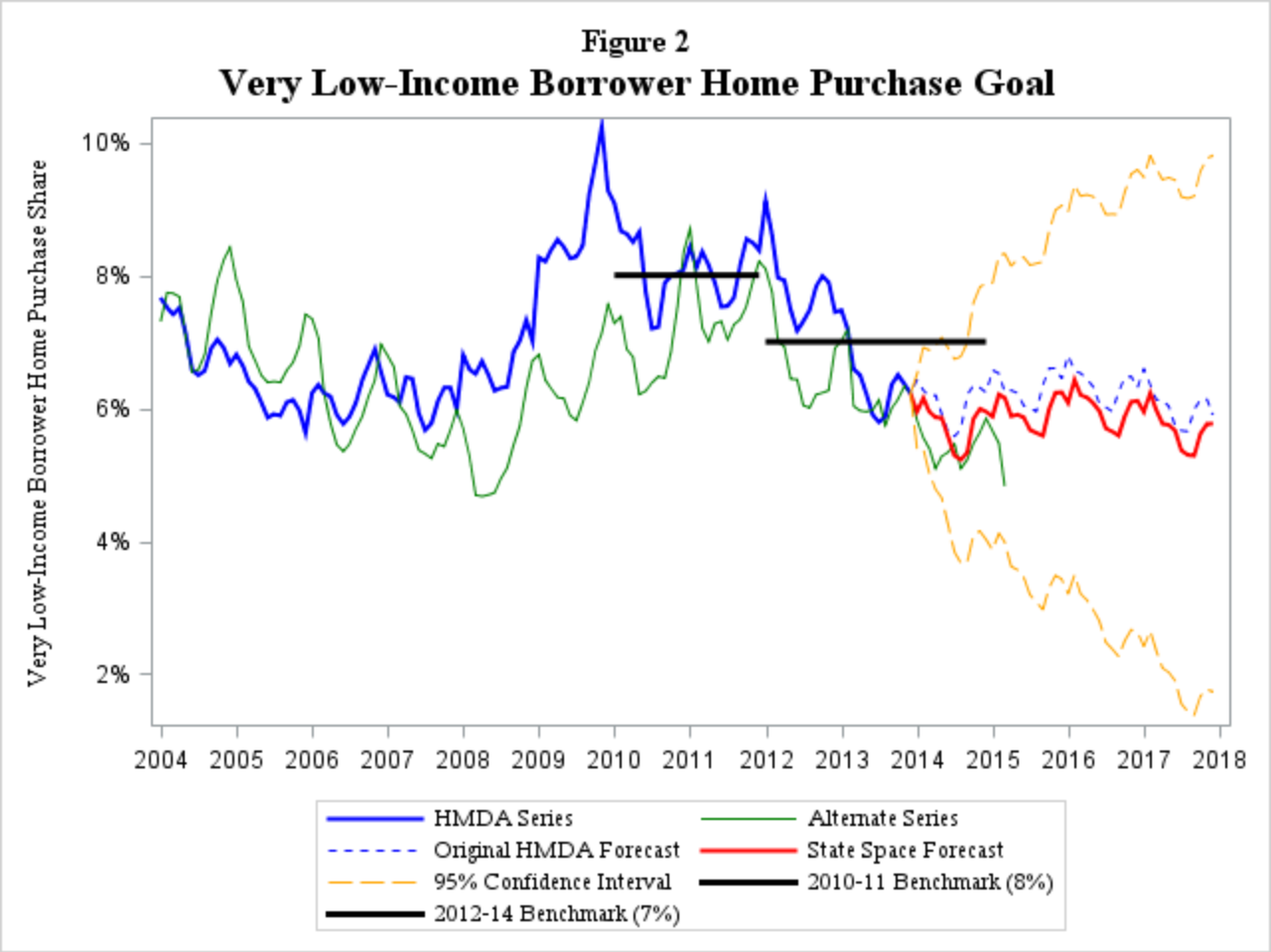
The forecasts for the Very Low-Income Borrower Home Purchase Goal are shown in **Figure 2**. While the SSF provides the best forecast, the forecast based on HMDA data alone is also shown. The SSF forecast averages 5.9, 6.0 and 5.7 percent in 2015 through 2017, respectively. The 2017 confidence interval is plus or minus 3.8 percent, which is slightly larger than the same interval for the model used in the proposed rule. Also, for reference, the figure is annotated with the 2010-2011 goal benchmark (8 percent) and the 2012-2014 benchmark (7 percent).

Table 7

Very Low-Income Borrower Home Purchase Goal

		Full Model w/ 2004-07	Best Fit w/ 2004-07	Full Model	Best Fit Model	Model Used in Prop. Rule
	AR(1)	0.013	0.004	0.003	-0.001	0.123
		(0.113)	(0.110)	(0.105)	(0.101)	(0.103)
	AR(2)	0.337 ***	0.244 **	0.353 ***	0.305 ***	-0.121
		(0.122)	(0.111)	(0.108)	(0.100)	(0.103)
	AR(3)					-0.315 ***
						(0.102)
	Unemplment Rate$_{t-1}$	0.316 **	0.290 **	0.350 **	0.283 **	0.545 ***
		(0.141)	(0.129)	(0.137)	(0.125)	(0.115)
Inflation	Ln(Core CPI$_{M/M}$)					0.587 **
						(0.229)
	Ln(Core CPI$_{Y/Y}$)	-0.138 ***	-0.081 **	-0.120 ***	-0.106 ***	
		(0.046)	(0.039)	(0.033)	(0.030)	
	Consumer Confidence	0.000		0.000		
		(0.000)		(0.000)		
Interest Rates	10-Year Treas. Yield$_{t-1}$	-0.265 ***	-0.239 ***	-0.362 ***	-0.238 ***	
		(0.092)	(0.087)	(0.108)	(0.083)	
	30-Year Fixed Mort. Rate	-0.004		-0.141		
		(0.120)		(0.133)		
House Prices	Ln(Med. Price, Exist. Homes)	-0.029 *	-0.030 **	-0.064 ***	-0.034 ***	
		(0.015)	(0.014)	(0.020)	(0.012)	
	Ln(HPI)					-0.042
						(0.042)
	Ln(HPI)$_{t-1}$					0.021
						(0.043)
	Ln(HAI)			0.032 *		
				(0.017)		
Volume	Ln(Home Sales)	0.027 ***	0.027 ***	0.027 ***	0.027 ***	
		(0.006)	(0.005)	(0.006)	(0.005)	
	Ln(Housing Starts)	0.000 ***		0.000 ***		
		(0.000)		(0.000)		
	Ln(Mortgage Originations)$_{t-2}$	-0.003 *	-0.004 **	-0.003 *	-0.003 *	
		(0.002)	(0.002)	(0.002)	(0.002)	
	FHA Share	0.033		0.016		
		(0.023)		(0.021)		
	ARM Share	-0.025 *		-0.013		
		(0.015)		(0.014)		
	Owner-Occupied Share	-0.076		-0.041		
		(0.055)		(0.052)		
	Average LTV	0.058 *		0.025		
		(0.031)		(0.028)		
	Percent LTVs at least 95%	-0.022 *		-0.014		
		(0.012)		(0.011)		
		---------- Monthly Binary Variables ----------				
		[2004-2007 Monthly Binary Variables]				
	σ^2	0.000004	0.000004	0.000004	0.000004	0.000005
		(0.002018)	(0.002035)	(0.002022)	(0.002016)	(0.002325)
	χ^2	2.290	2.360	2.650	1.990	8.910
	P(>χ^2)	0.683	0.670	0.618	0.737	0.031
	AIC	-1099.230	-1110.980	-1105.580	-1122.010	-1088.620
	95% Confidence Interval (2017)	+/- 3.8%	+/- 3.3%	+/- 3.8%	+/- 3.8%	+/- 2.2%

Standard Errors are reported in parantheses.
* indicates significance at the 90% level.
** indicates significance at the 95% level.
*** indicates significance at the 99% level.



Low-Income Areas Home Purchase Subgoal. **Table 8** shows the four model specifications analyzed for the Low-Income Areas Home Purchase Subgoal (LAP) plus the model used in the proposed rule, re-estimated using updated HMDA data. The **Best Fit Model with 2004-2007 Monthly Binary Variables** provides the best model for forecasting this goal. The AIC statistic for this specification is lowest, indicating it has the best goodness of fit. While this model specification does not do as well as the other model when it comes to reducing white noise, as determined by the Chi Square statistic, the difference is not great. Additional diagnostic information is provided in **Appendix C**.

The best fitting equation was found to be a first differenced seasonal AR model with three autoregressive terms, with *AR(2)* and *AR(3)* being significant at the level of at least ten percent. In addition to the time series components, drivers of this housing goal include the unemployment rate, log of the Core CPI year over year change lagged three months, the consumer confidence level lagged one month (although the magnitude of its impact is minimal), the 30-year fixed mortgage rate lagged one month, and the log of single-family housing starts lagged two months. The Chi-Square statistic indicates that the hypothesis that the residuals are white noise cannot be rejected.

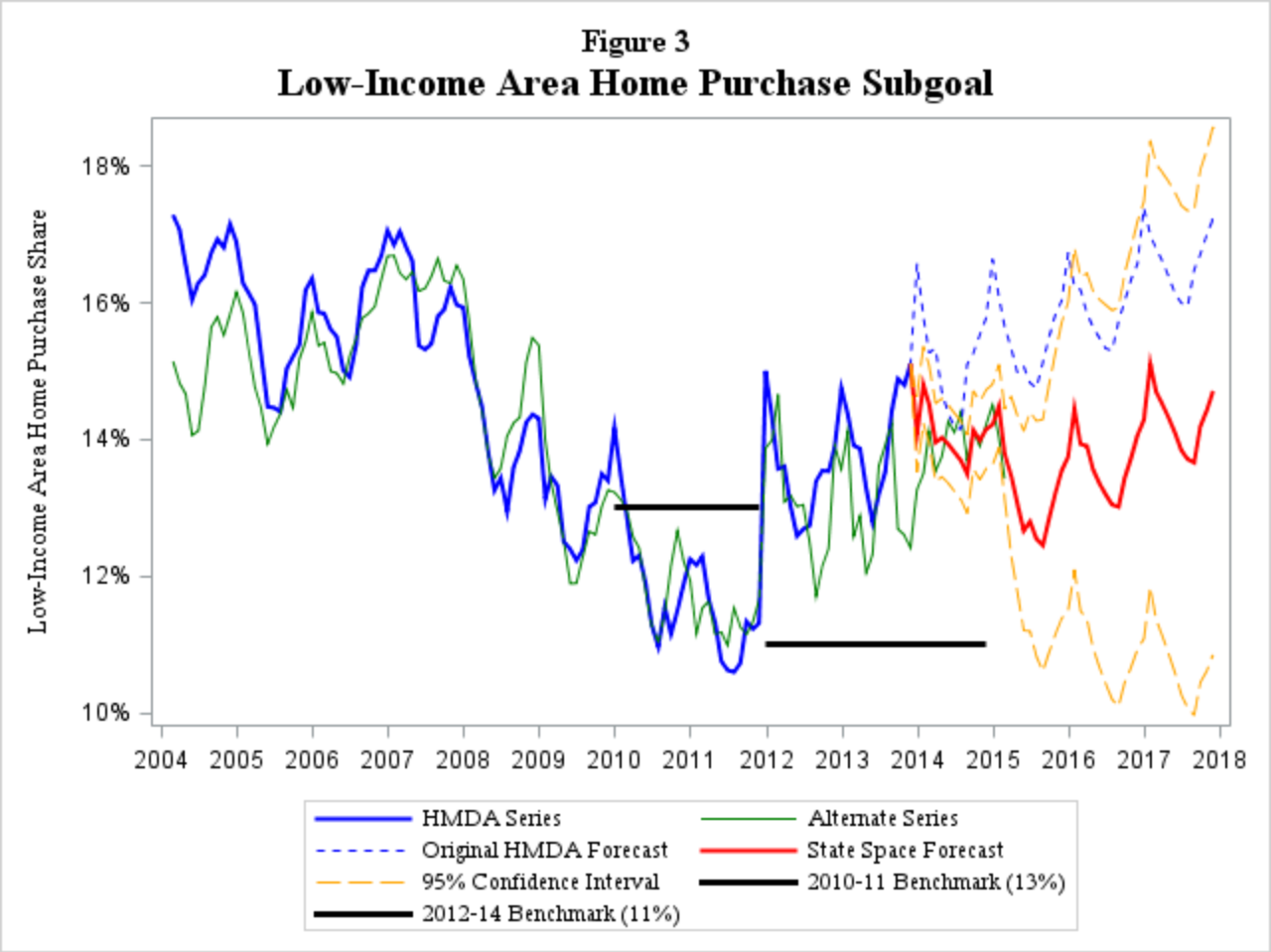
The forecasts for the Low-Income Areas Home Purchase Subgoal are shown in **Figure 3**. While the SSF provides the best forecast, the forecast based on HMDA data alone is also shown. The SSF forecast averages 13.2, 13.6 and 14.2 percent in 2015 through 2017, respectively. The 2017 confidence interval is plus or minus 3.6 percent, which is smaller than the same interval for the model used in the proposed rule. Also, for reference, the figure is annotated with the 2010-2011 goal benchmark (13 percent) and the 2012-2014 benchmark (11 percent).

Table 8

Low-Income Areas Home Purchase Subgoal

		Full Model w/ 2004-07	Best Fit w/ 2004-07	Full Model	Best Fit Model	Model Used in Prop. Rule
	AR(1)	-0.228 **	-0.087	-0.223 **	-0.219 **	-0.070
		(0.109)	(0.106)	(0.106)	(0.106)	(0.101)
	AR(2)	-0.306 ***	-0.226 **	-0.129	-0.149	-0.170 *
		(0.110)	(0.108)	(0.110)	(0.109)	(0.102)
	AR(3)		0.191 *	0.033	0.023	0.161
			(0.116)	(0.115)	(0.113)	(0.103)
	AR(4)			-0.186 *	-0.179	-0.096
				(0.111)	(0.111)	(0.104)
	AR(5)			-0.241 **	-0.220 *	0.097
				(0.113)	(0.113)	(0.102)
	AR(6)					0.049
						(0.103)
	Unemplment Rate	-0.675 ***	-0.491 **	-0.702 ***	-0.646 ***	-0.523 **
		(0.199)	(0.200)	(0.193)	(0.186)	(0.216)
Inflation	$Ln(Core\ CPI_{M/M})_{t-1}$	0.696 *		0.646 *	0.571 *	
		(0.417)		(0.342)	(0.339)	
	$Ln(Core\ CPI_{Y/Y})_{t-3}$	0.147 ***	0.100 *	0.156 ***	0.156 ***	
		(0.050)	(0.054)	(0.041)	(0.040)	
	$Consumer\ Confidence_{t-1}$	0.000 ***	0.000 *	0.000 **	0.000 **	
		(0.000)	(0.000)	(0.000)	(0.000)	
Interest Rates	30-Year Fixed Mort. Rate			-0.117		
				(0.195)		
	$30\text{-Year Fixed Mort. Rate}_{t-1}$	0.363 *	0.445 **			
		(0.212)	(0.210)			
House Prices	Ln(Med. Price, Exist. Homes)	-0.056 **	-0.058 **	-0.042	-0.046 *	
		(0.025)	(0.025)	(0.028)	(0.028)	
	Ln(HPI)			-0.136 ***	-0.125 **	
				(0.053)	(0.052)	
	$Ln(HAI)_{t-1}$					0.026
						(0.017)
Volume	Ln(Housing Starts)	-0.004				
		(0.005)				
	$Ln(Housing\ Starts)_{t-2}$		0.008 **	0.008 *	0.009 **	
			(0.004)	(0.004)	(0.004)	
	FHA Share	-0.075 **		-0.150 ***	-0.137 ***	
		(0.033)		(0.034)	(0.033)	
	ARM Share	0.042		0.064 **	0.062 **	
		(0.028)		(0.025)	(0.025)	
	Owner-Occupied Share	0.145 *		0.329 ***	0.299 ***	
		(0.075)		(0.082)	(0.078)	
	$Average\ LTV_{t-1}$	-0.029		-0.039		
		(0.044)		(0.037)		
	$Percent\ LTVs\ at\ least\ 90\%_{t-2}$	-0.035 **		-0.038 ***	-0.036 **	
		(0.016)		(0.014)	(0.015)	
		----------	Monthly Binary Variables	----------		
		[2004-2007 Monthly Binary Variables]				
	σ^2	0.000013	0.000013	0.000013	0.000013	0.000016
		(0.003645)	(0.003652)	(0.003606)	(0.003591)	(0.004035)
	χ^2	10.120	11.070	4.590	3.890	1.800
	$P(>\chi^2)$	0.430	0.271	0.710	0.793	0.937
	AIC	-952.015	-971.104	-959.100	-961.464	-956.764
	95% Confidence Interval (2017)	+/- 2.9%	+/- 3.8%	+/- 2.6%	+/- 2.6%	+/- 4.7%

Standard Errors are reported in parantheses.
* indicates significance at the 90% level.
** indicates significance at the 95% level.
*** indicates significance at the 99% level.



Low-Income Borrower Refinance Goal. **Table 9** shows the four model specifications analyzed for the Low-Income Borrower Refinance Goal (LIR) plus the model used in the proposed rule, re-estimated using updated HMDA data. The **Best Fit Model** provides the best model for forecasting this goal. The AIC statistic for this specification is lowest, indicating it has the best goodness of fit. It is also among the best of the specifications in reducing white noise, as determined by the Chi Square statistic. Additional diagnostic information is provided in **Appendix D**.

The best fitting equation was found to be a first differenced seasonal AR model with five autoregressive terms, with *AR(1)* and *AR(5)* being significant at the level of at least ten percent. In addition to the time series components, drivers of this housing goal include the log of the Core CPI month over month change lagged one month, the consumer confidence level (although the magnitude of its impact is minimal), the 10-Year Treasury yield lagged one month, log of median price of existing homes sold, log of FHFA's HPI, log of total home sales, log of mortgage originations, FHA market share of refinance mortgages, share of ARMs lagged two months, the share of mortgages on owner-occupied properties and the refinance rate. The Chi-Square statistic indicates that the hypothesis that the residuals are white noise cannot be rejected.

The forecasts for the Low-Income Borrower Refinance Goal are shown in **Figure 4**. While the SSF provides the best forecast, the forecast based on HMDA data alone is also shown. The SSF forecast averages 21.8, 22.4 and 22.8 percent in 2015 through 2017, respectively. The 2017 confidence interval is plus or minus 6.2 percent, which is smaller than the same interval for the model used in the proposed rule. Also, for reference, the figure is annotated with the 2010-2011 goal benchmark (21 percent) and the 2012-2014 benchmark (20 percent).

Table 9

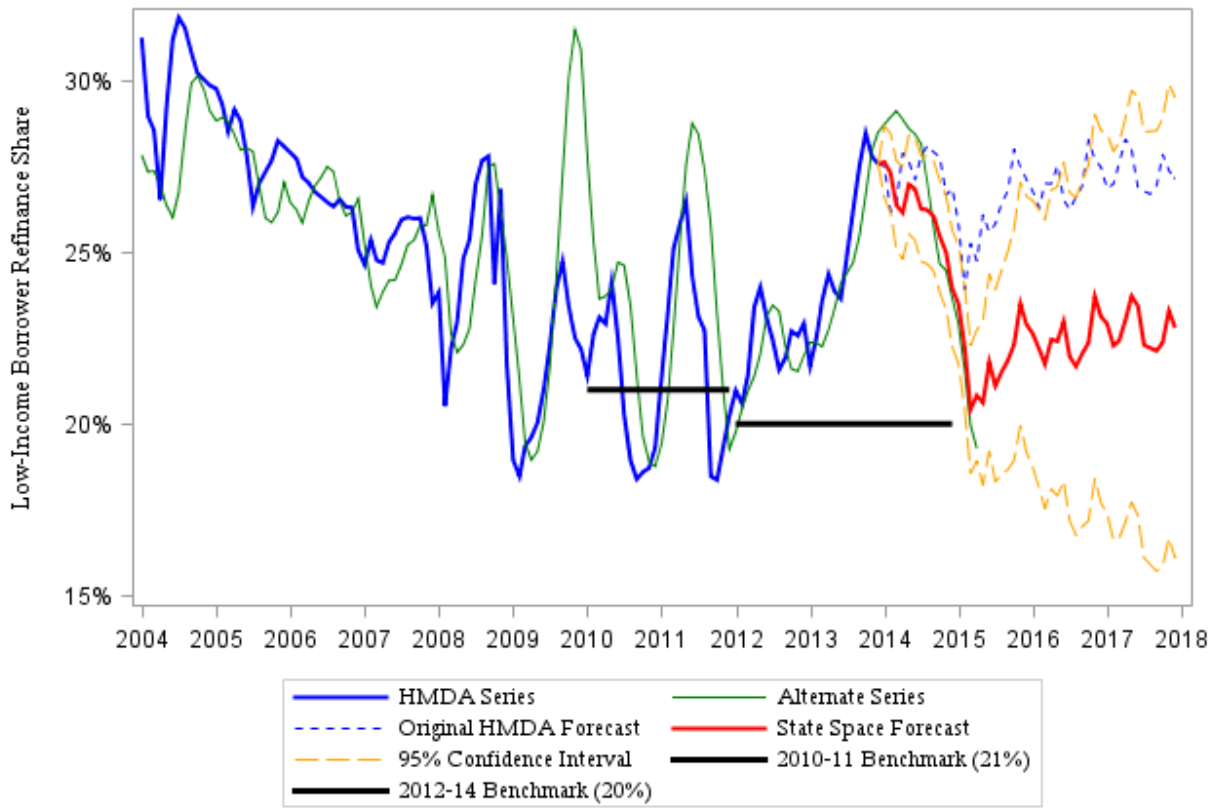
Low-Income Borrower Refinance Goal

		Full Model w/ 2004-07	Best Fit w/ 2004-07	Full Model	Best Fit Model	Model Used in Prop. Rule
	AR(1)	-0.612 ***	-0.528 ***	-0.320 ***	-0.335 ***	-0.312 ***
		(0.115)	(0.111)	(0.119)	(0.114)	(0.095)
	AR(2)	-0.258 **	-0.260 **	-0.030	-0.052	
		(0.114)	(0.127)	(0.126)	(0.125)	
	AR(3)		-0.014	0.199 *	0.185	
			(0.126)	(0.117)	(0.117)	
	AR(4)		-0.220 **	-0.023	-0.032	
			(0.112)	(0.119)	(0.118)	
	AR(5)			0.233 **	0.200 *	
				(0.111)	(0.110)	
	Unemplment Rate	0.442	0.703 ***	0.245		
		(0.288)	(0.240)	(0.355)		
Inflation	Ln(Core $CPI_{M/M}$)	0.994 *	1.229 **			
		(0.550)	(0.544)			
Inflation	Ln(Core $CPI_{M/M})_{t-1}$			-1.265 **	-1.289 **	
				(0.551)	(0.542)	
	Consumer Confidence	0.000 **	0.000 ***	0.000 **	0.000 **	
		(0.000)	(0.000)	(0.000)	(0.000)	
Interest Rates	10-Year Treas. $Yield_{t-1}$	0.941 **		1.186 ***	1.203 ***	1.642 ***
		(0.434)		(0.378)	(0.369)	(0.413)
Interest Rates	30-Year Fixed Mort. Rate	-0.564				
		(0.364)				
Interest Rates	Rate Spread			-0.260		-0.956 *
				(0.481)		(0.552)
House Prices	Ln(Med. Price, Exist. Homes)	0.045				
		(0.036)				
House Prices	Ln(HPI)			-0.391 ***	-0.404 ***	
				(0.122)	(0.120)	
House Prices	$Ln(HPI_{Y/Y})$			-0.037 ***	-0.041 ***	
				(0.014)	(0.012)	
Volume	Ln(Home Sales)			-0.054 ***	-0.052 ***	
				(0.015)	(0.015)	
Volume	Ln(Mortgage Originations)	-0.018 ***	-0.021 ***	-0.016 ***	-0.015 ***	
		(0.006)	(0.006)	(0.006)	(0.006)	
	FHA Share	0.085 *		0.155 ***	0.159 ***	
		(0.050)		(0.054)	(0.052)	
	ARM $Share_{t-2}$	0.071 *	0.070 *	0.107 ***	0.108 ***	
		(0.038)	(0.038)	(0.038)	(0.038)	
	Owner-Occupied Share	-0.878 ***	-0.873 ***	-0.726 ***	-0.748 ***	
		(0.151)	(0.133)	(0.152)	(0.140)	
	Refinance Rate	-0.072 ***	-0.099 ***	-0.087 ***	-0.082 ***	-0.183 ***
		(0.023)	(0.020)	(0.025)	(0.024)	(0.022)
	---------- Monthly Binary Variables ----------					
	[2004-2007 Monthly Binary Variables]					
	σ^2	0.000035	0.000036	0.000033	0.000032	0.000056
		(0.005951)	(0.005964)	(0.005727)	(0.005692)	(0.007460)
	χ^2	4.010	1.500	0.270	0.430	2.720
	$P(>\chi^2)$	0.404	0.472	0.602	0.511	0.744
	AIC	-852.326	-852.763	-865.559	-868.513	-813.985
	95% Confidence Interval (2017)	+/- 4.3%	+/- 4.1%	+/- 7.2%	+/- 7.3%	+/- 7.0%

Standard Errors are reported in parantheses.
* indicates significance at the 90% level.
** indicates significance at the 95% level.
*** indicates significance at the 99% level.

Figure 4

Low-Income Borrower Refinance Goal



E. CONCLUSIONS

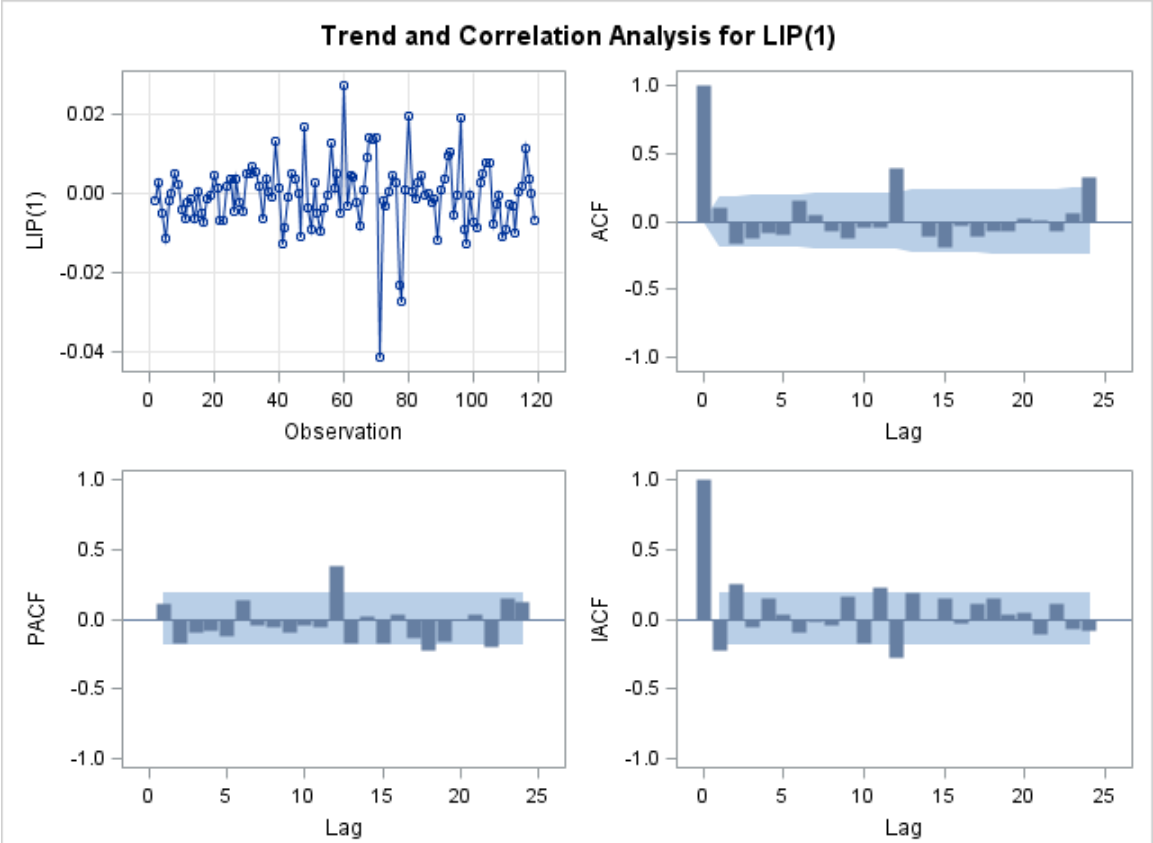
FHFA is required to consider market size when establishing housing goals. This paper describes the methodologies used to estimate the affordable market size for the four single-family housing goals for 2015 through 2017. The 2015-2017 midpoint ranges, with overall ranges in brackets, of the affordable share of the prime, conforming conventional mortgage market for the four housing goals are:

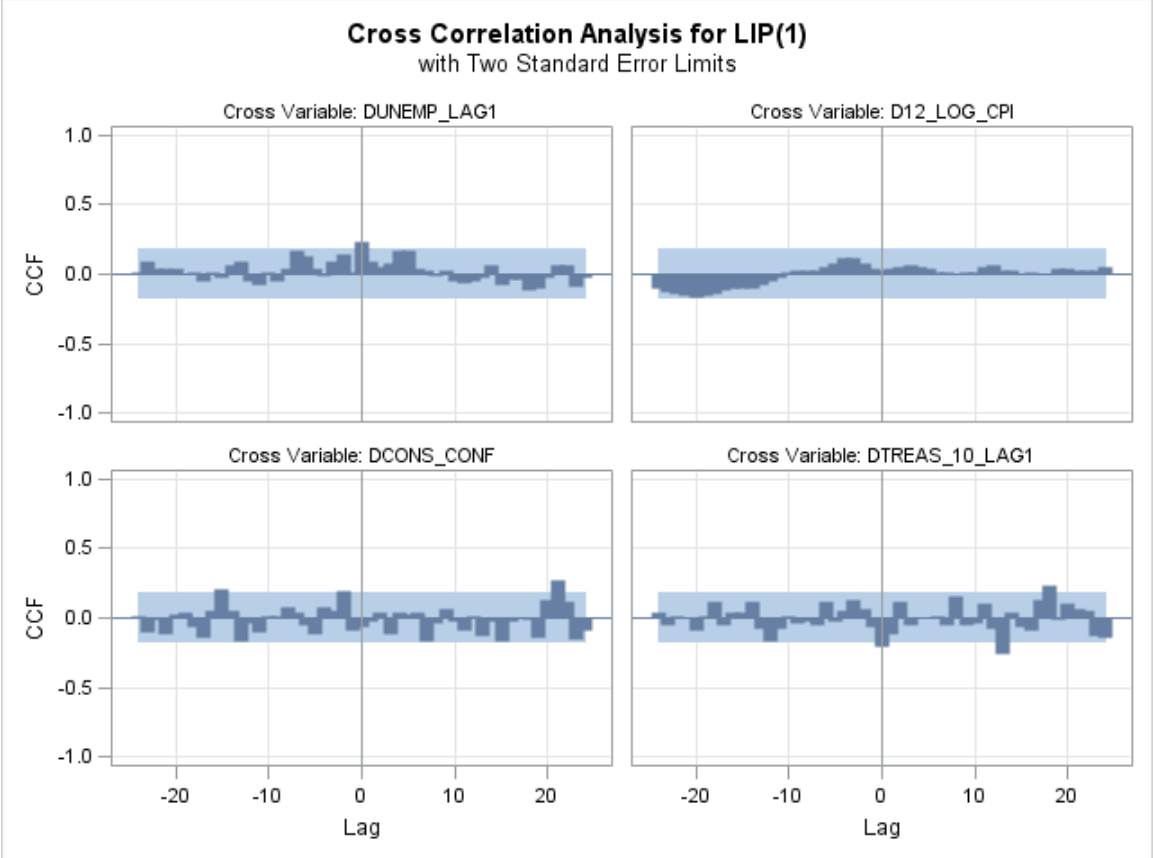
- Low-Income Borrower Home Purchase Goal 22 - 23 % [17 – 27 %]
- Very Low-Income Borrower Home Purchase Goal 6 % [2 – 10 %]
- Low-Income Areas Home Purchase Subgoal 13 - 14 % [11 – 18 %]
- Low-Income Borrower Refinance Goal 22 - 23 % [17 – 29 %]

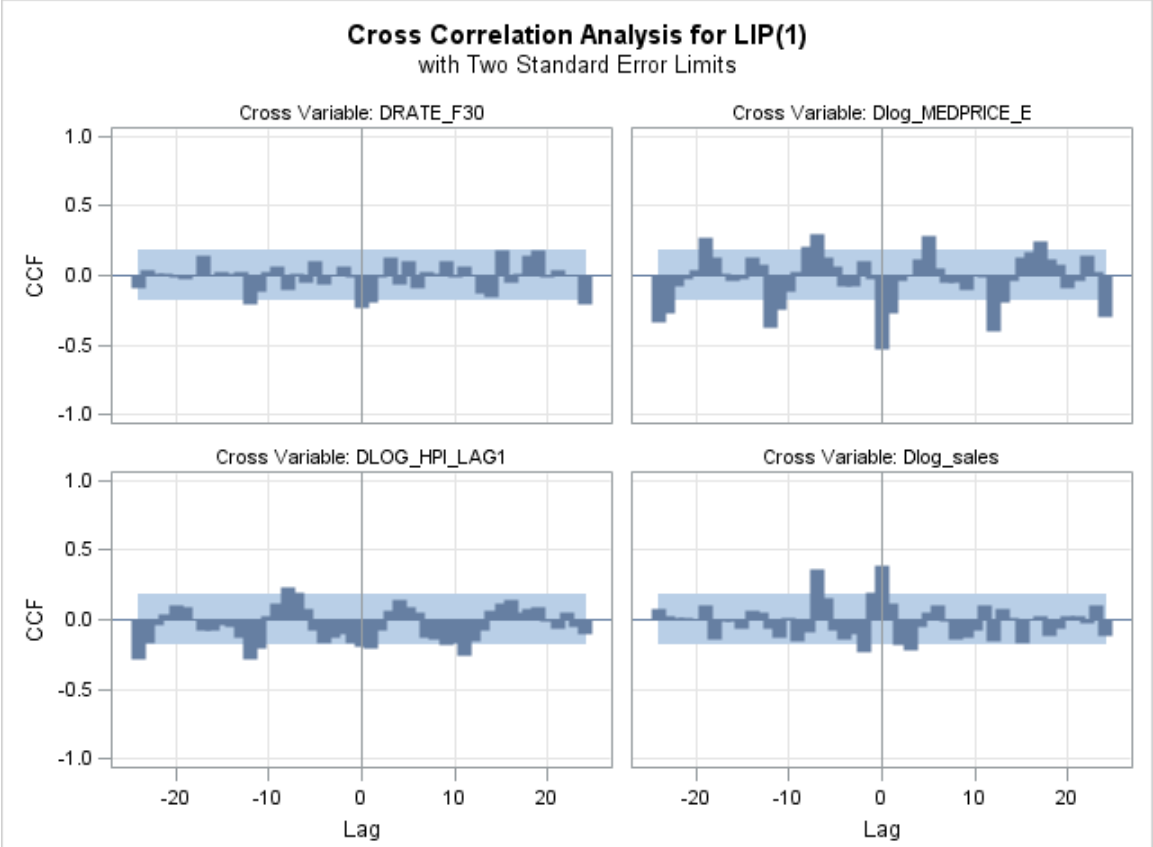
The market projections are based on econometric SSF time series models, incorporating industry and government economic, housing and mortgage market forecasts.

Appendix A

Low-Income Borrower Home Purchase Goal


Trend and Correlation Analysis for LIP(1)
LIP(1)
Observation
ACF
Lag
PACF
Lag
IACF
Lag


Cross Correlation Analysis for LIP(1)
with Two Standard Error Limits
Cross Variable: DUNEMP_LAG1
Cross Variable: D12_LOG_CPI
Cross Variable: DCONS_CONF
Cross Variable: DTREAS_10_LAG1
CCF
Lag


Cross Correlation Analysis for LIP(1)
with Two Standard Error Limits
Cross Variable: DRATE_F30
Cross Variable: Dlog_MEDPRICE_E
Cross Variable: DLOG_HPI_LAG1
Cross Variable: Dlog_sales
CCF
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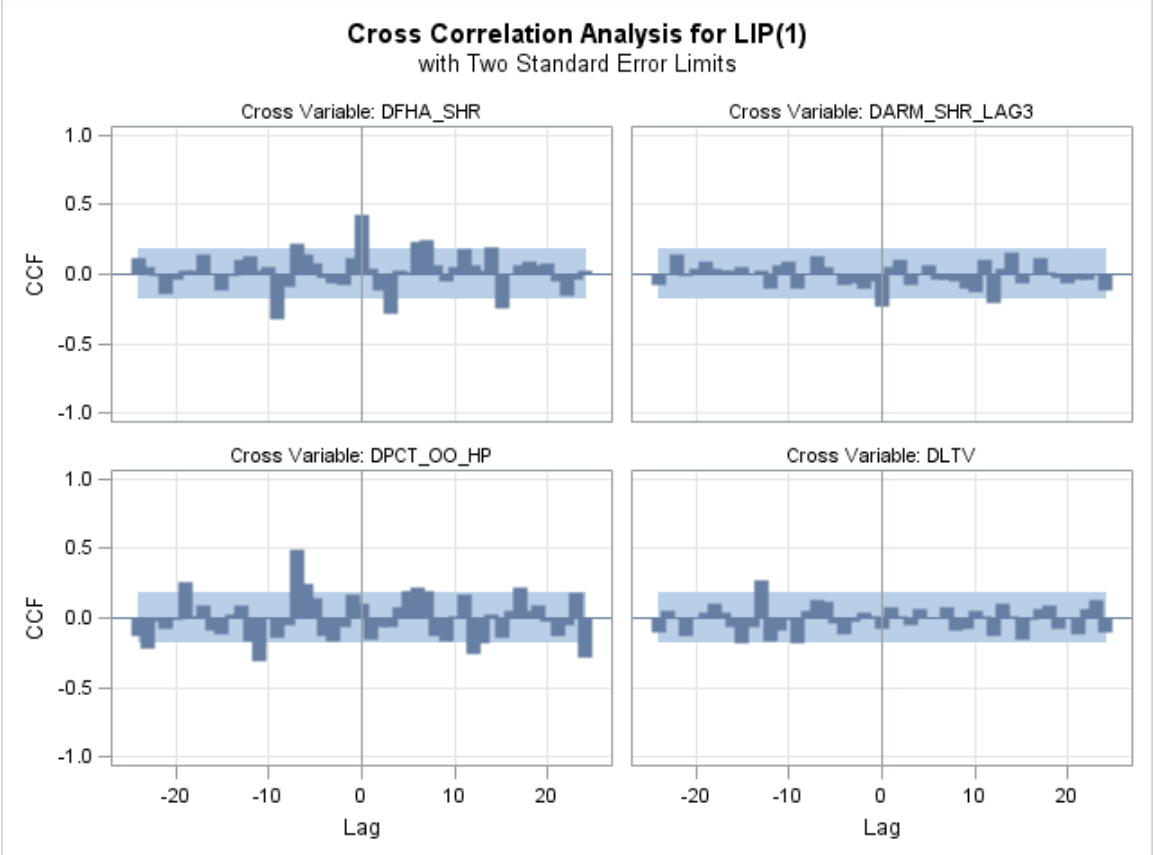
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag


Cross Correlation Analysis for LIP(1)
with Two Standard Error Limits
Cross Variable: DFHA_SHR
Cross Variable: DARM_SHR_LAG3
Cross Variable: DPCT_OO_HP
Cross Variable: DLTV
CCF
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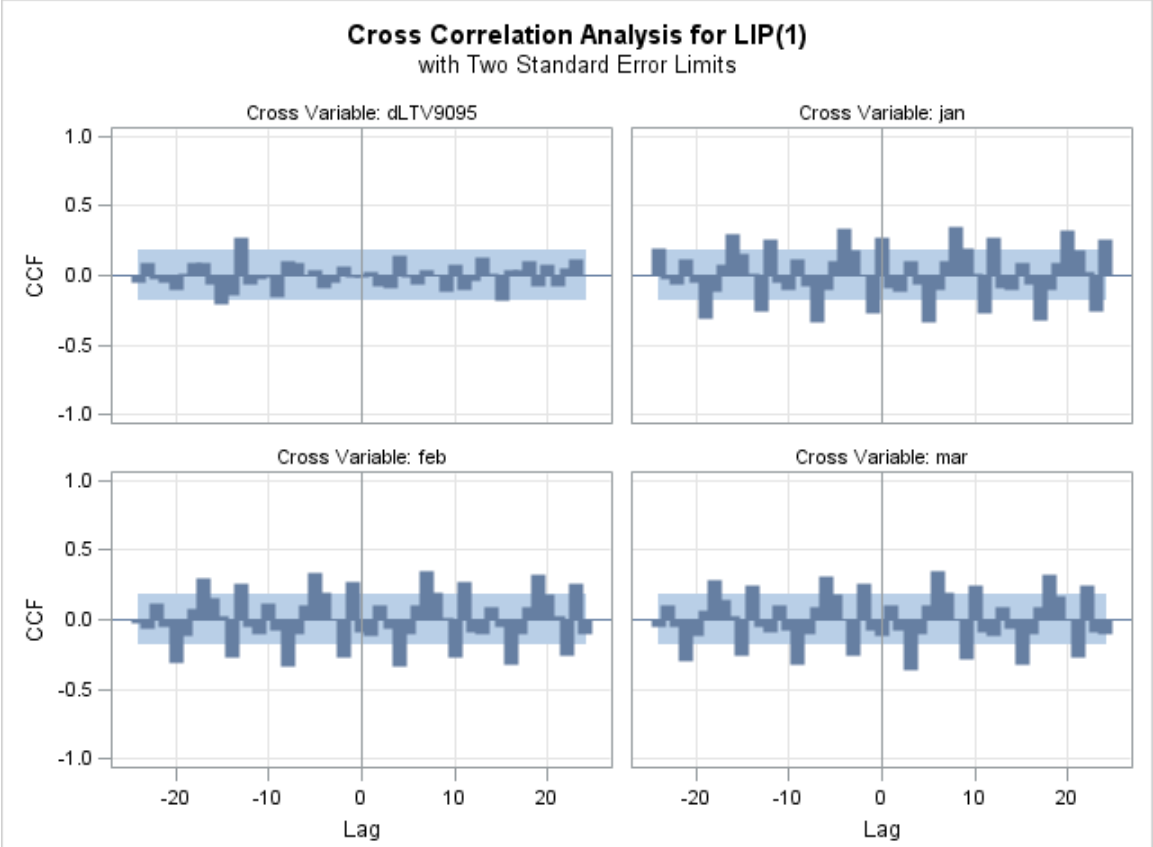
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag


Cross Correlation Analysis for LIP(1)
with Two Standard Error Limits
Cross Variable: dLTV9095
Cross Variable: jan
Cross Variable: feb
Cross Variable: mar
CCF
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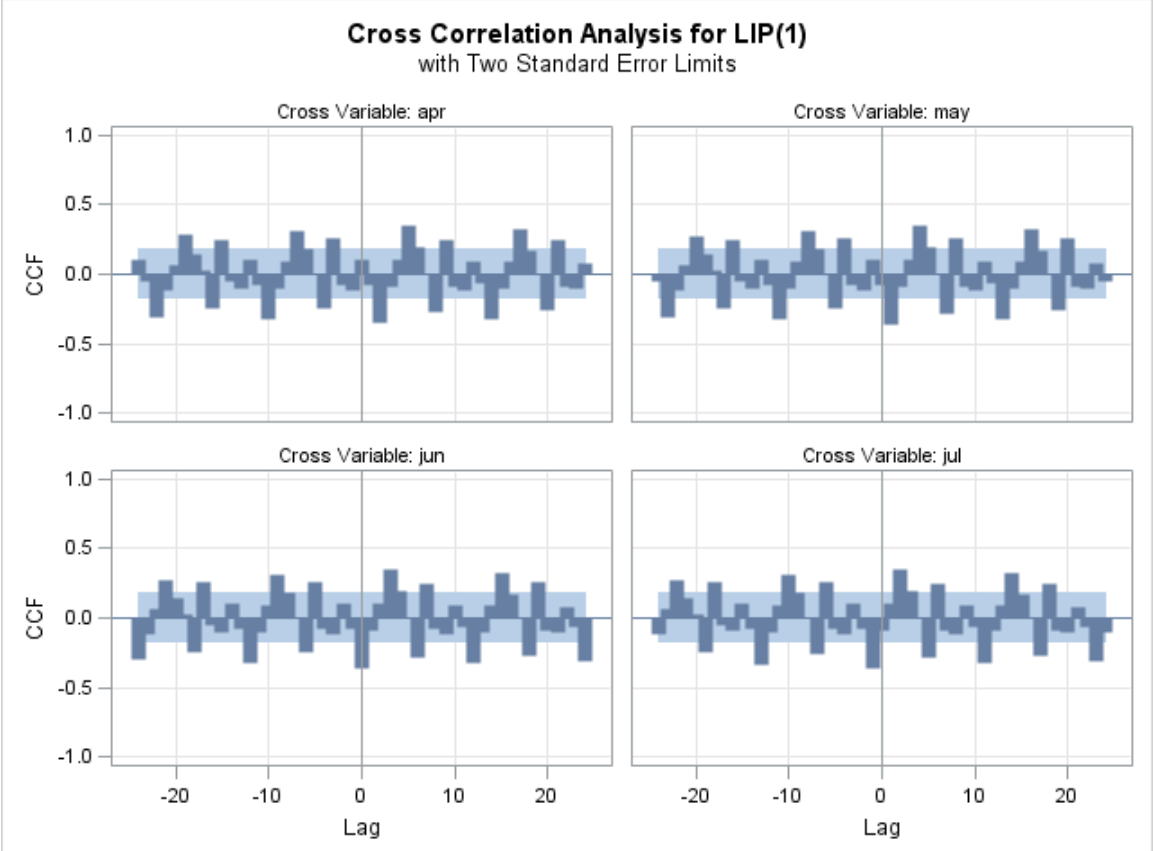
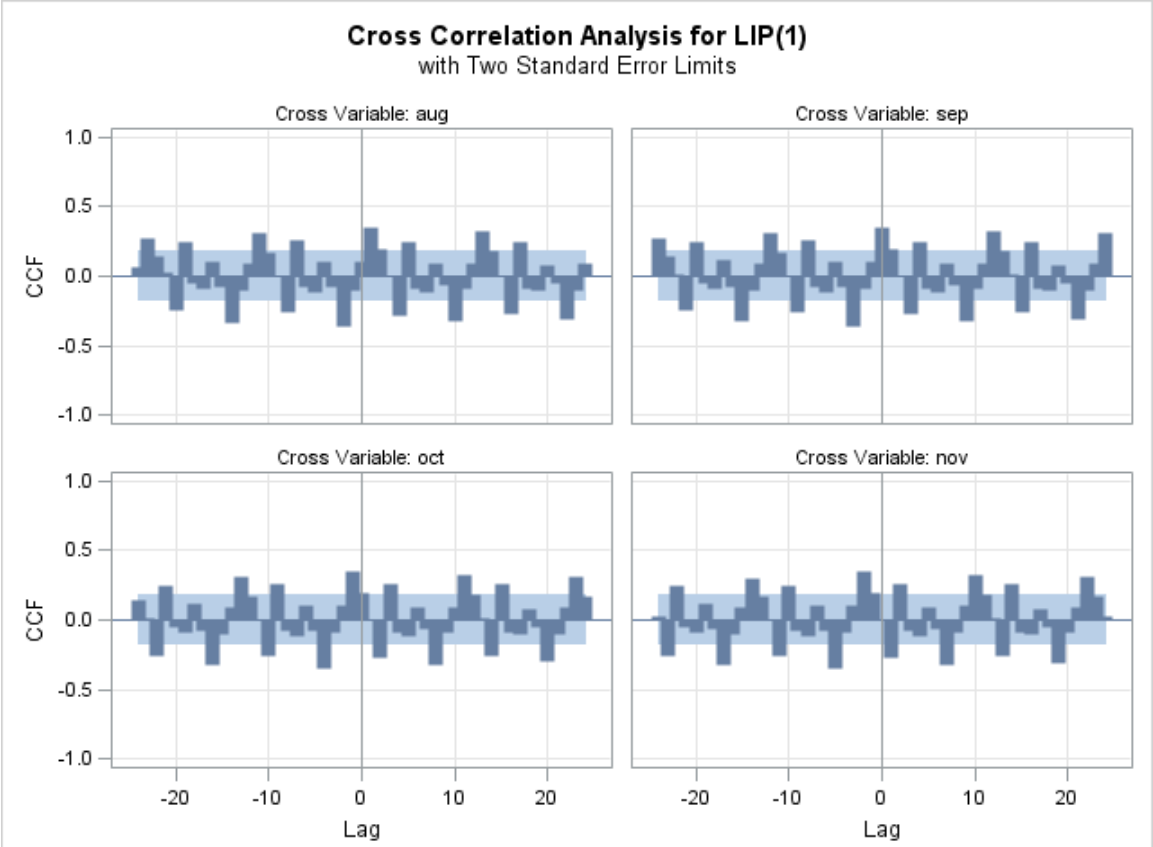
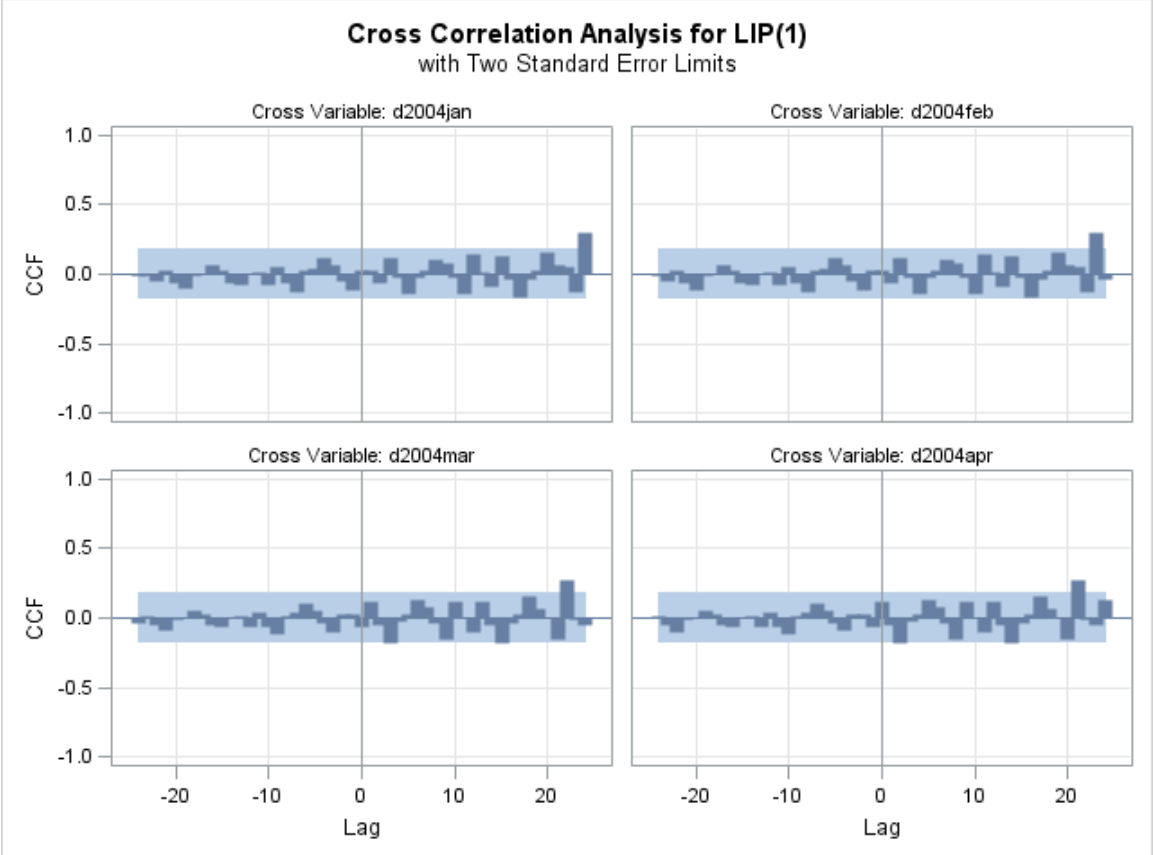
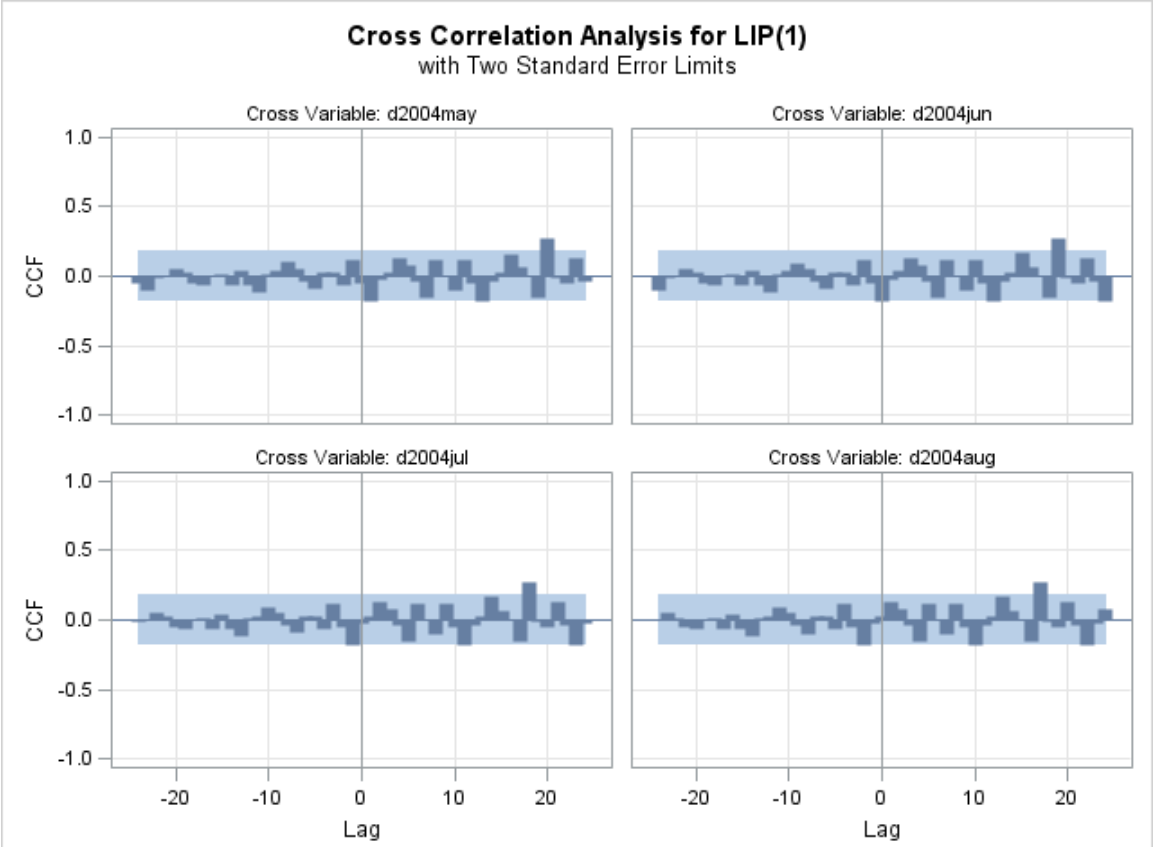
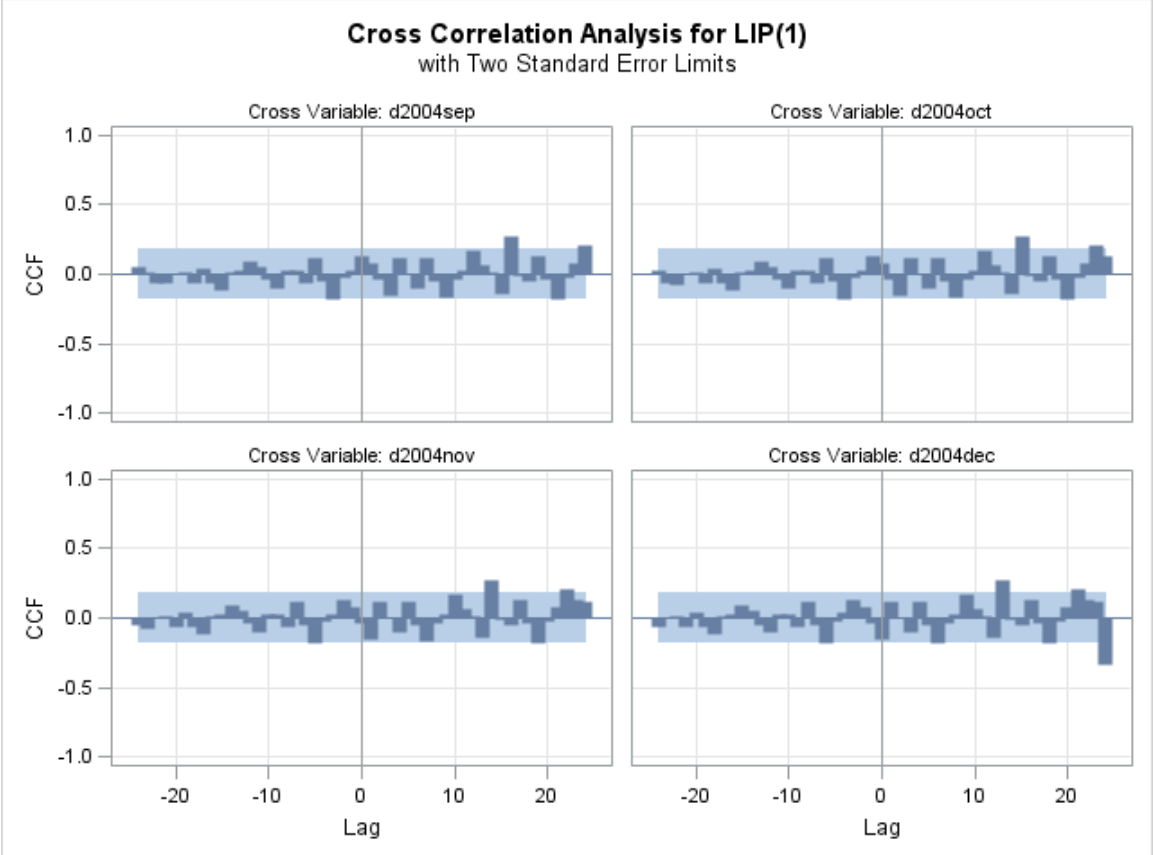
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag


Cross Correlation Analysis for LIP(1)
with Two Standard Error Limits
Cross Variable: apr
Cross Variable: may
Cross Variable: jun
Cross Variable: jul
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

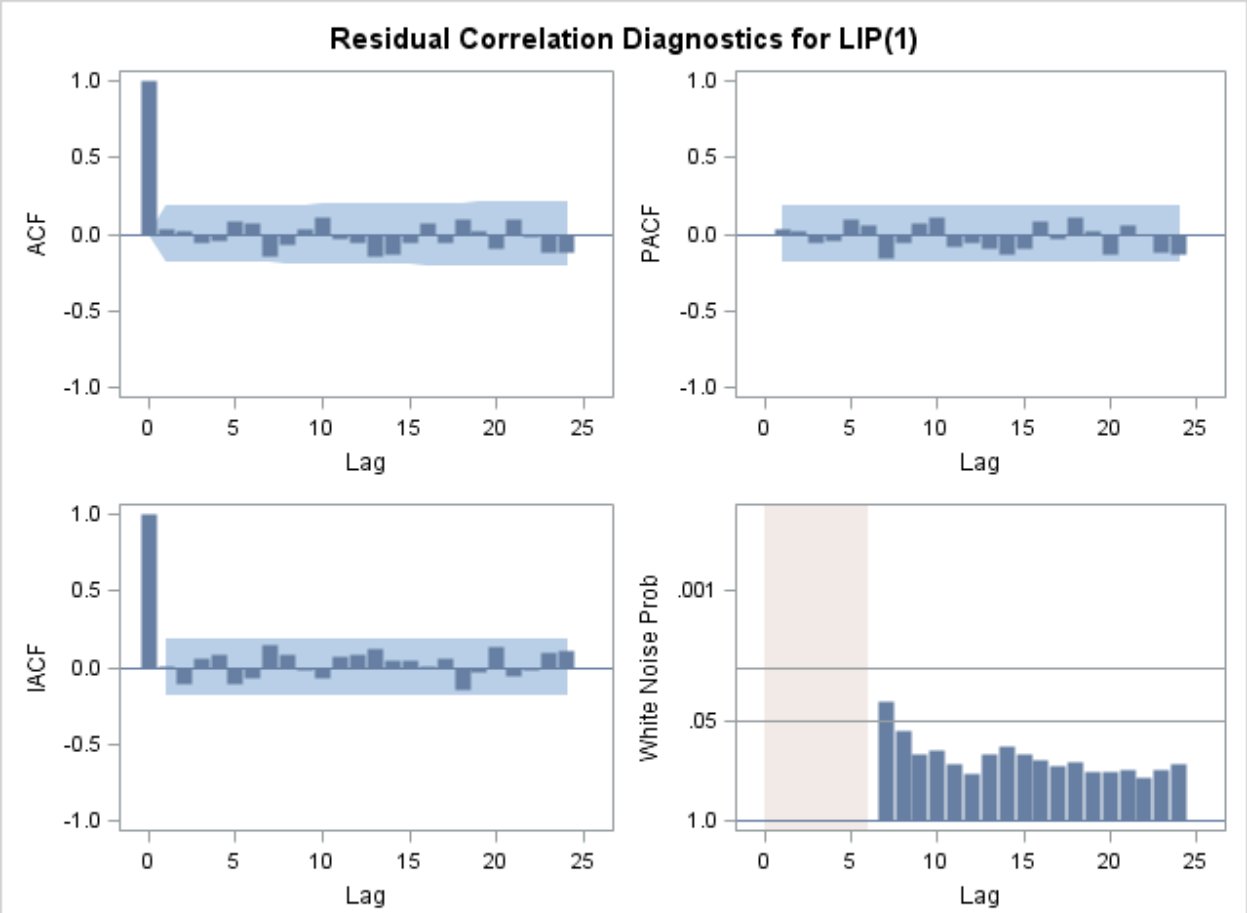

Cross Correlation Analysis for LIP(1)
with Two Standard Error Limits
Cross Variable: aug
Cross Variable: sep
Cross Variable: oct
Cross Variable: nov
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

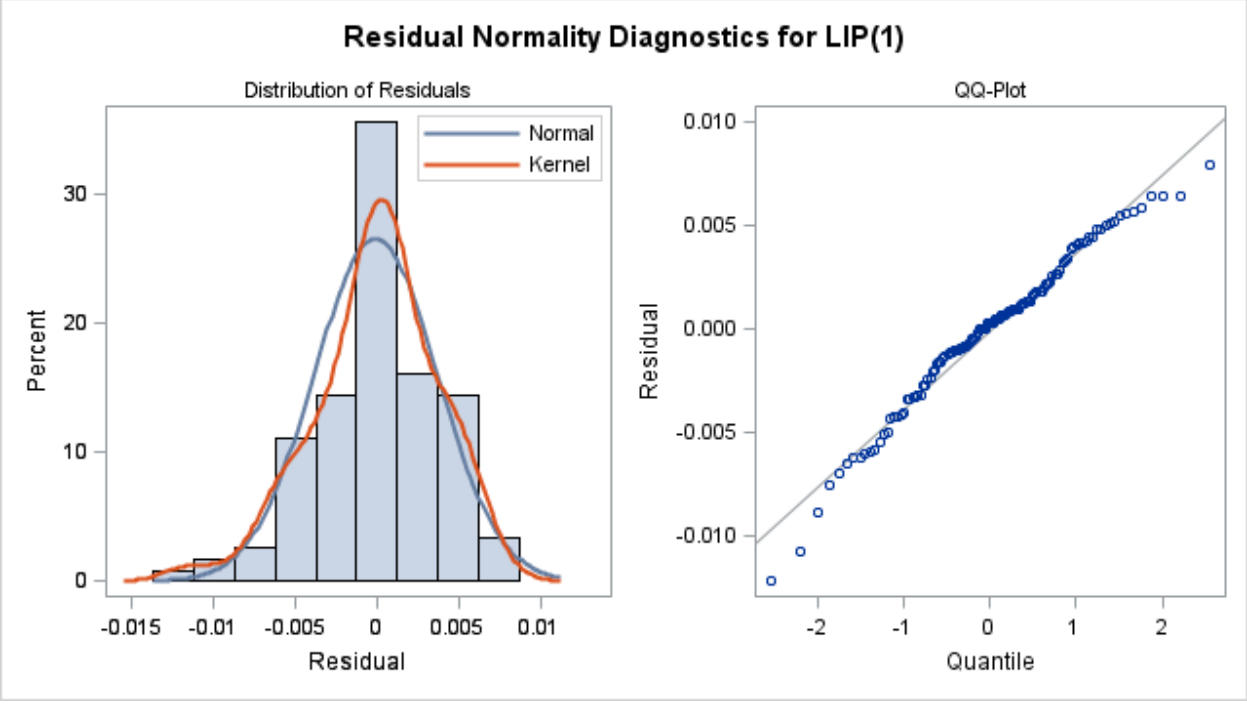

Cross Correlation Analysis for LIP(1)
with Two Standard Error Limits
Cross Variable: d2004jan
Cross Variable: d2004feb
Cross Variable: d2004mar
Cross Variable: d2004apr
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag


Cross Correlation Analysis for LIP(1)
with Two Standard Error Limits
Cross Variable: d2004may
Cross Variable: d2004jun
Cross Variable: d2004jul
Cross Variable: d2004aug
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

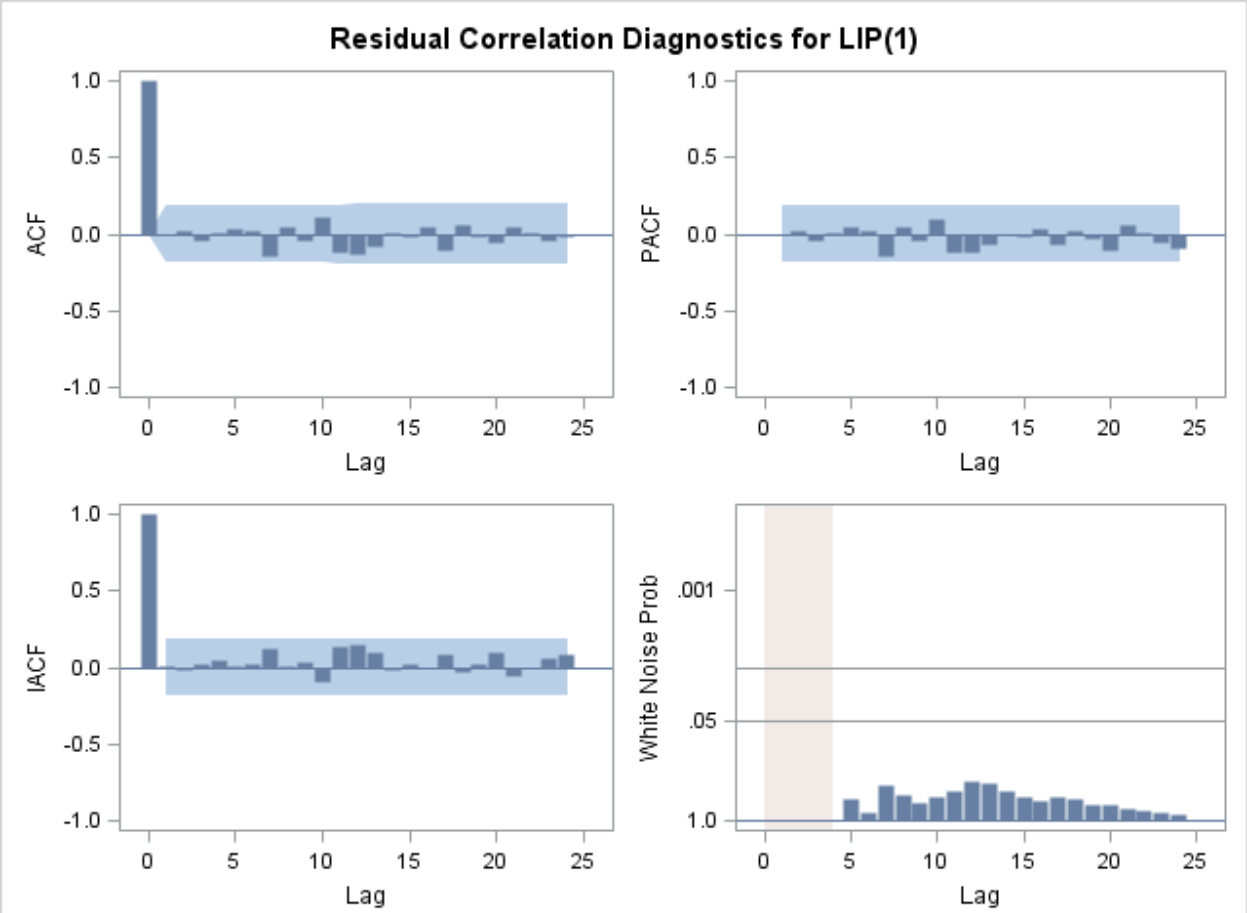

Cross Correlation Analysis for LIP(1)
with Two Standard Error Limits
Cross Variable: d2004sep
Cross Variable: d2004oct
Cross Variable: d2004nov
Cross Variable: d2004dec
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

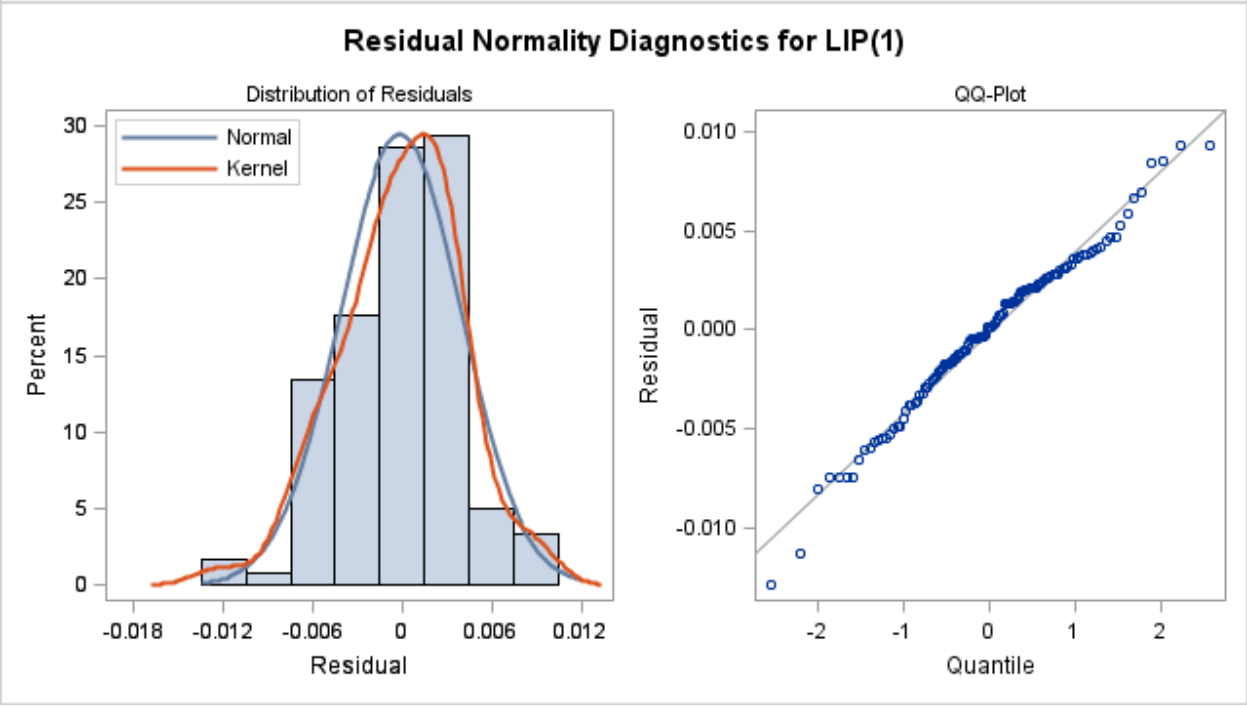
Full Model w/ 2004-07



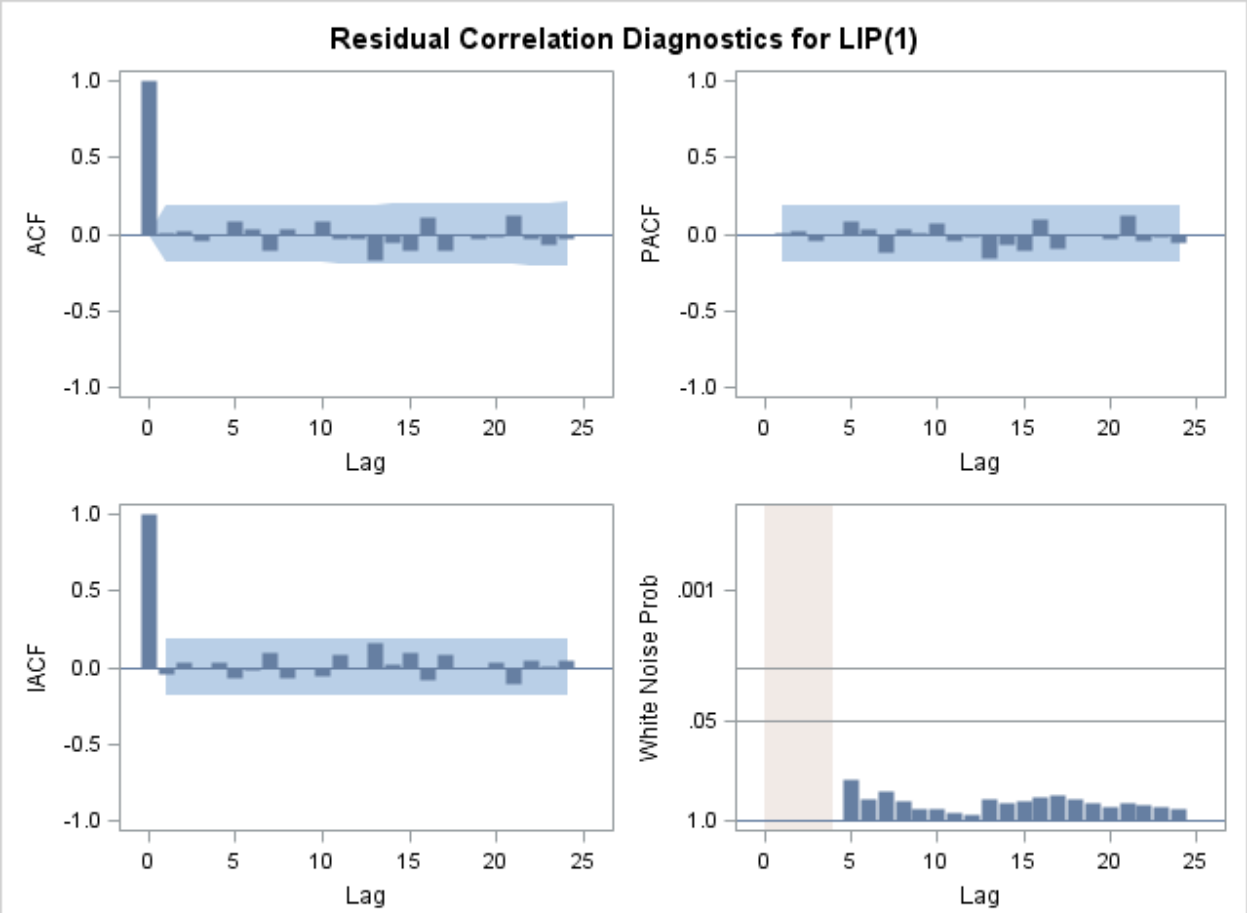


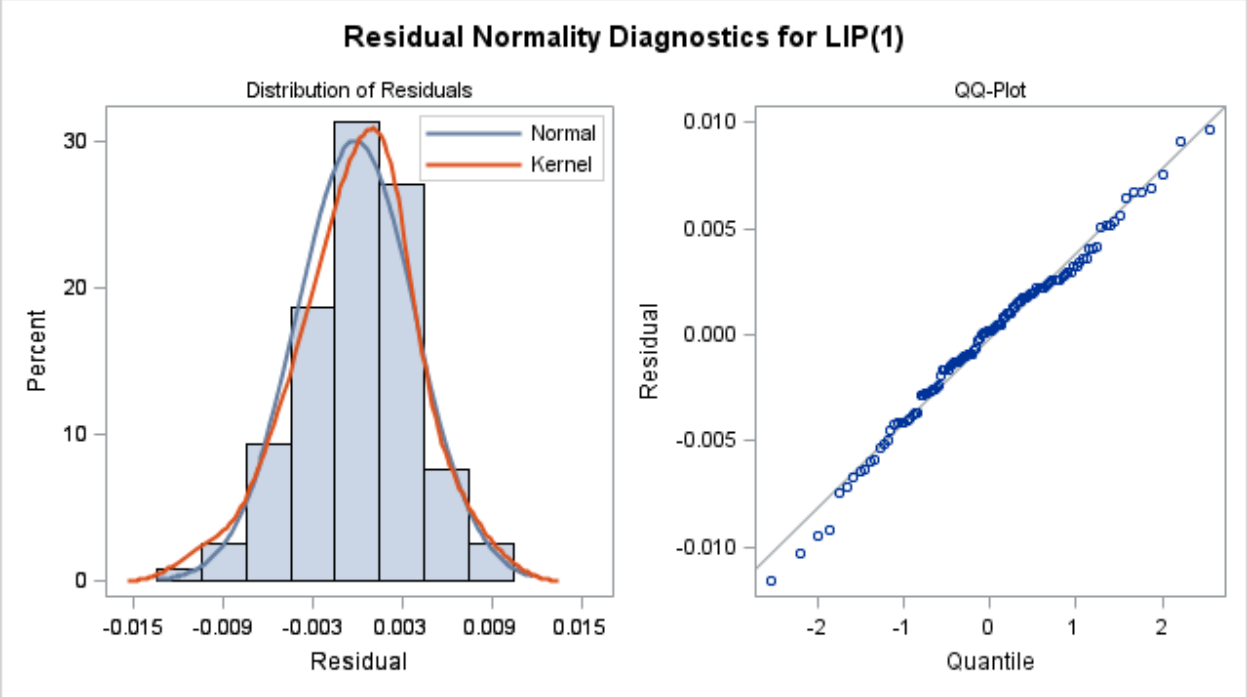
Best Fit w/ 2004-07



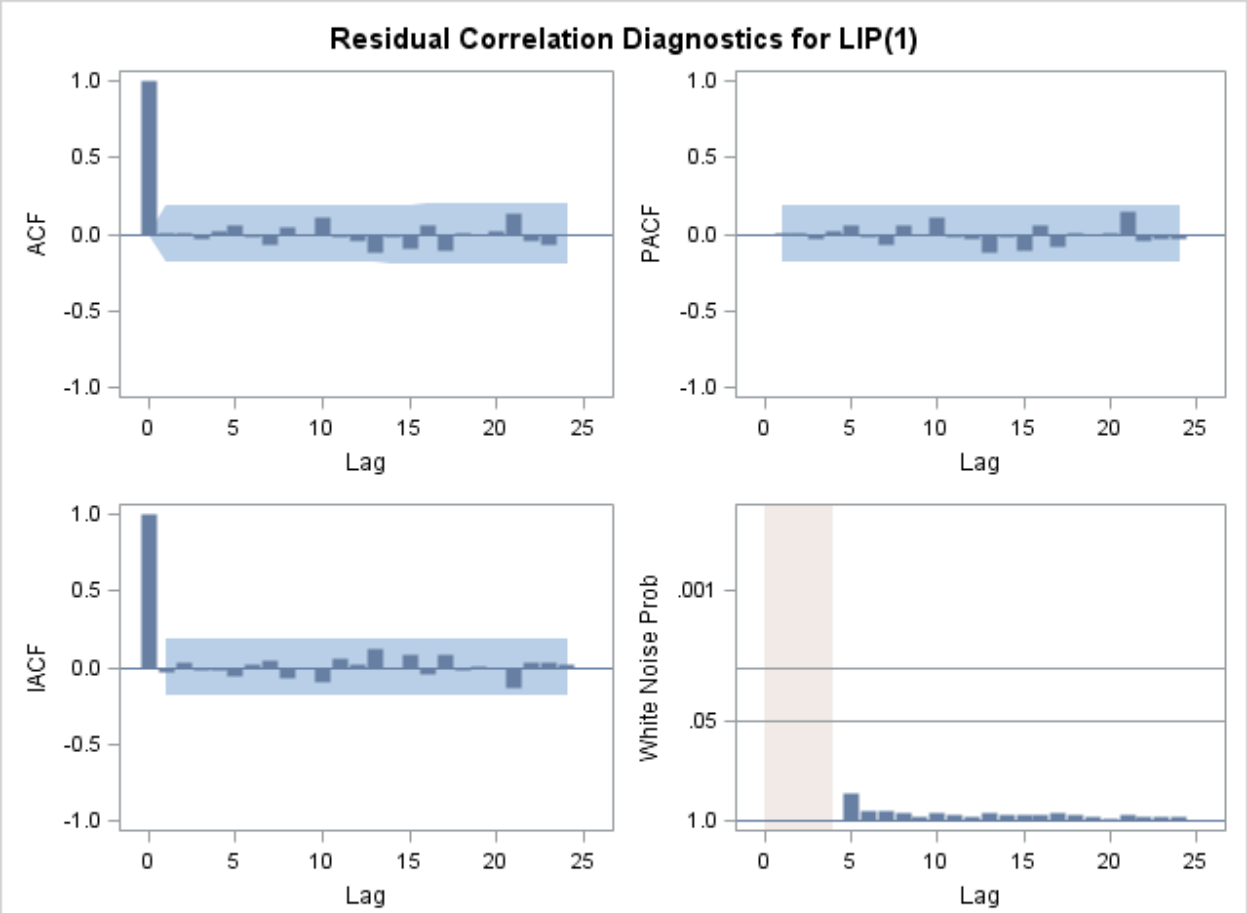


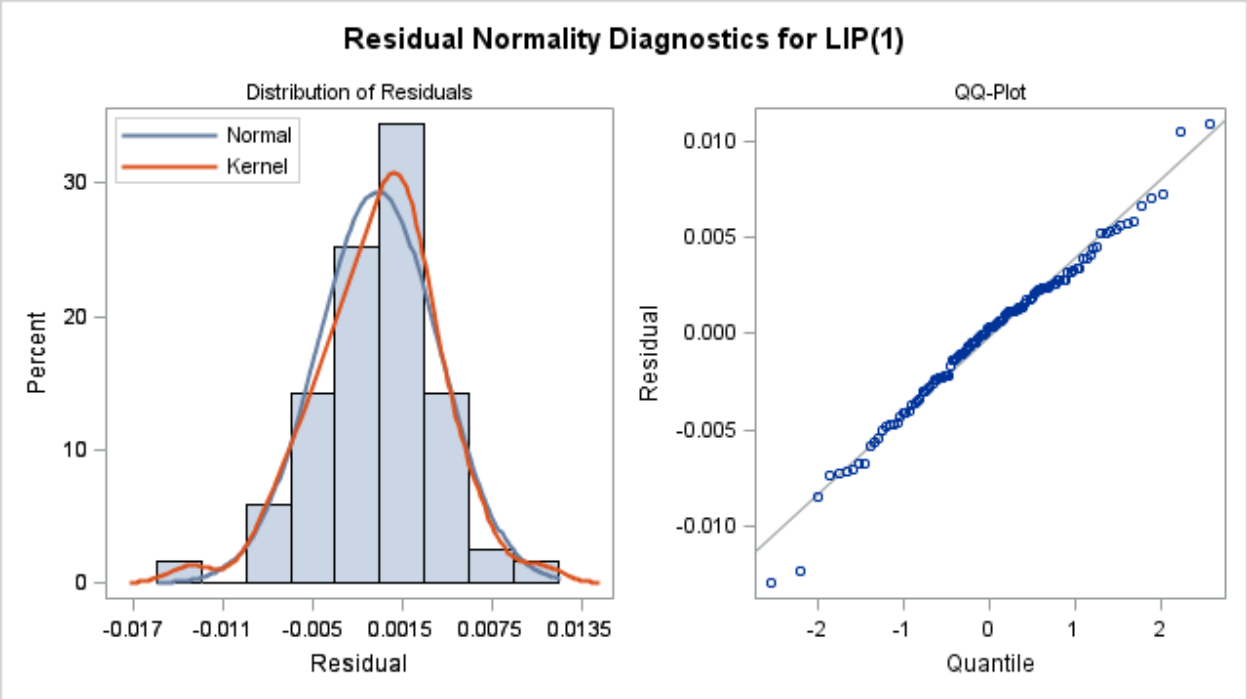
Full Model


Residual Correlation Diagnostics for LIP(1)
ACF
PACF
IACF
White Noise Prob
Lag
1.0
0.5
0.0
-0.5
-1.0
0
5
10
15
20
25
.001
.05
1.0


Residual Normality Diagnostics for LIP(1)
Distribution of Residuals
Normal
Kernel
Percent
Residual
30
20
10
0
-0.015
-0.009
-0.003
0.003
0.009
0.015
QQ-Plot
Residual
Quantile
0.010
0.005
0.000
-0.005
-0.010
-2
-1
0
1
2

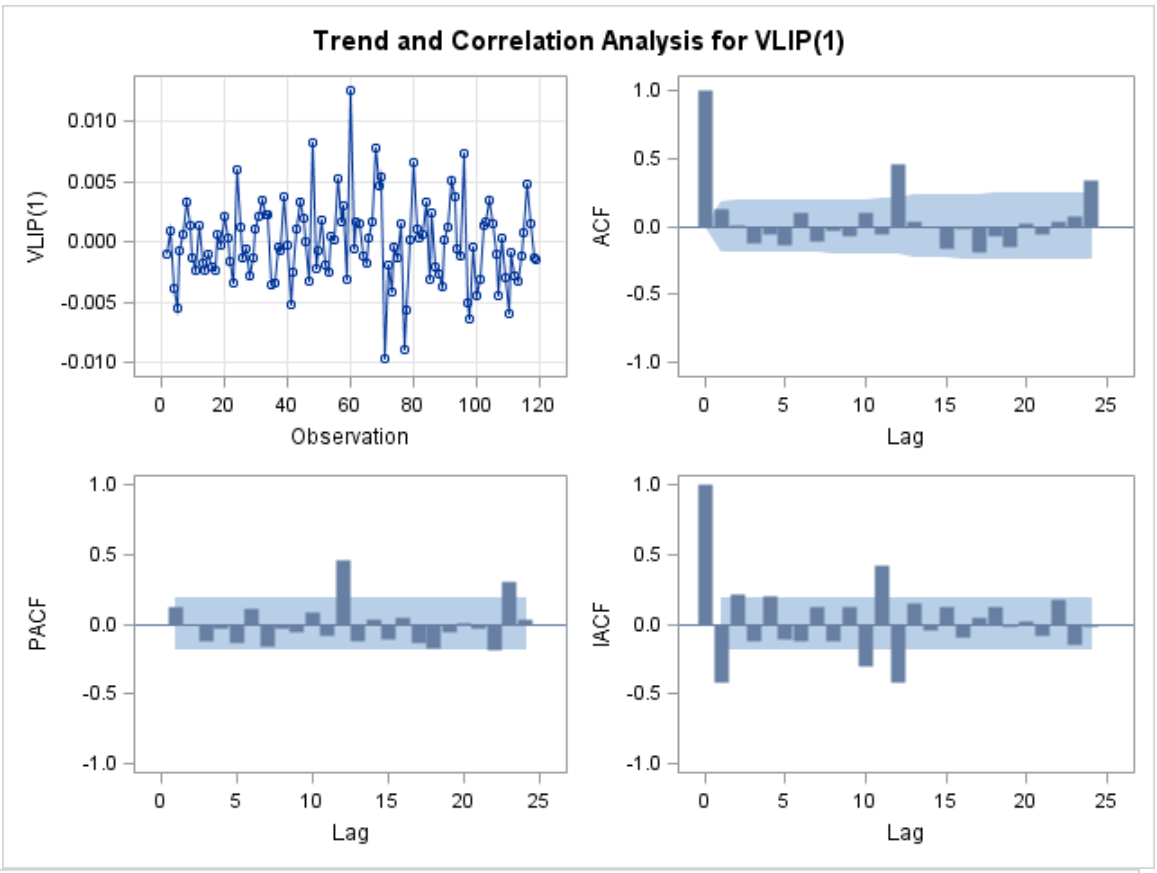
Best Fit Model

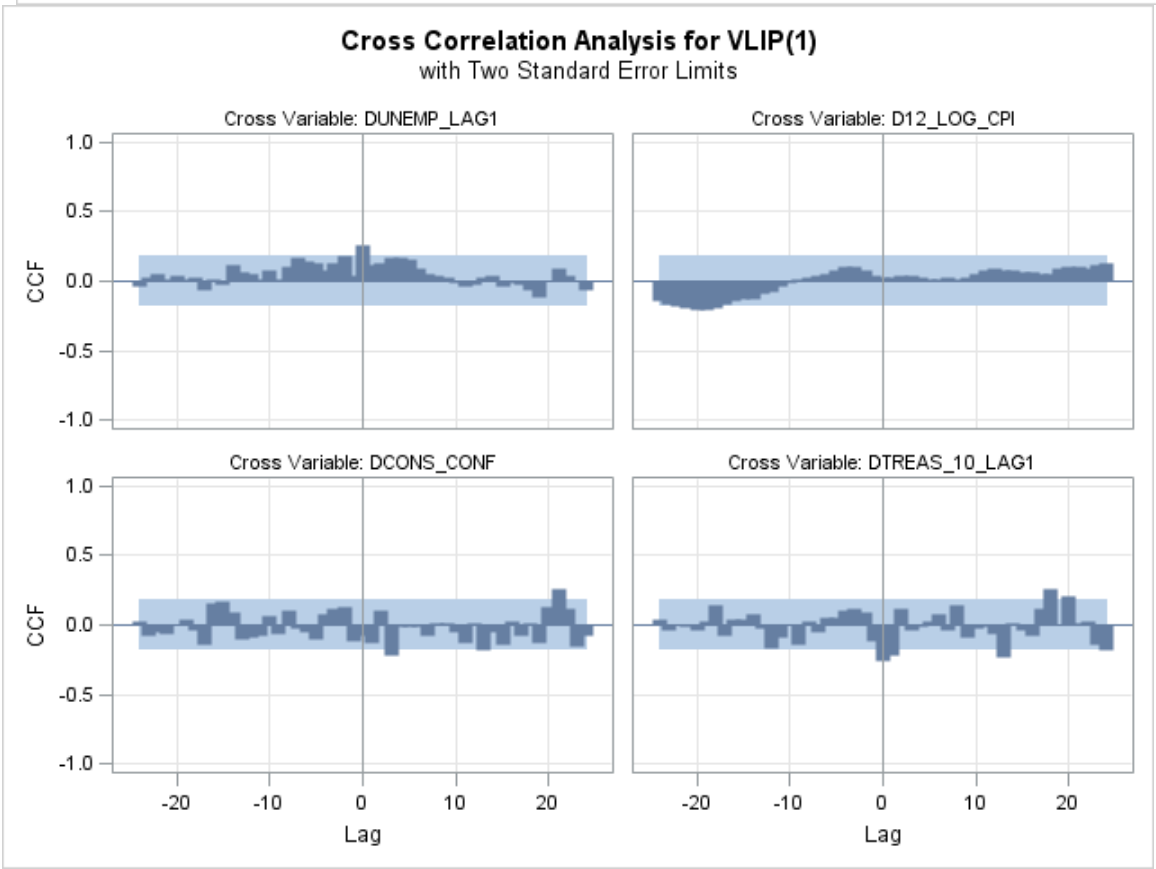


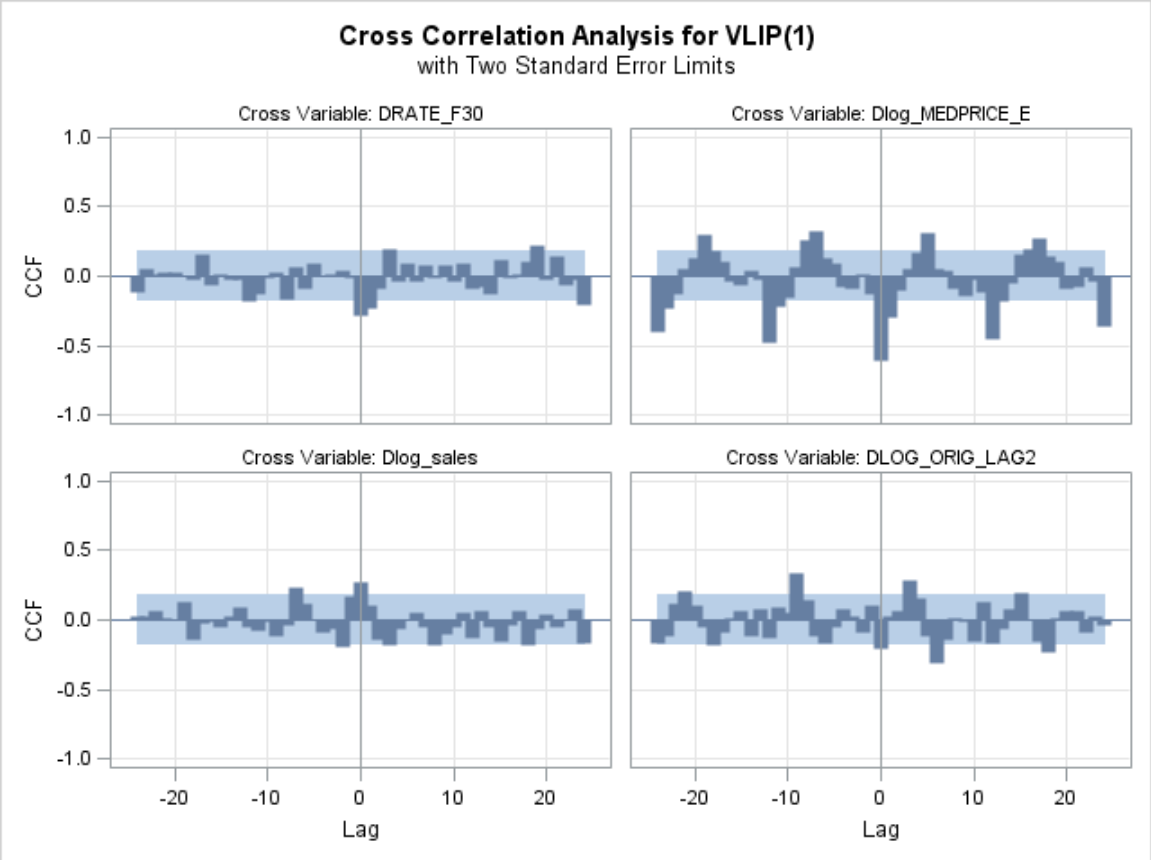


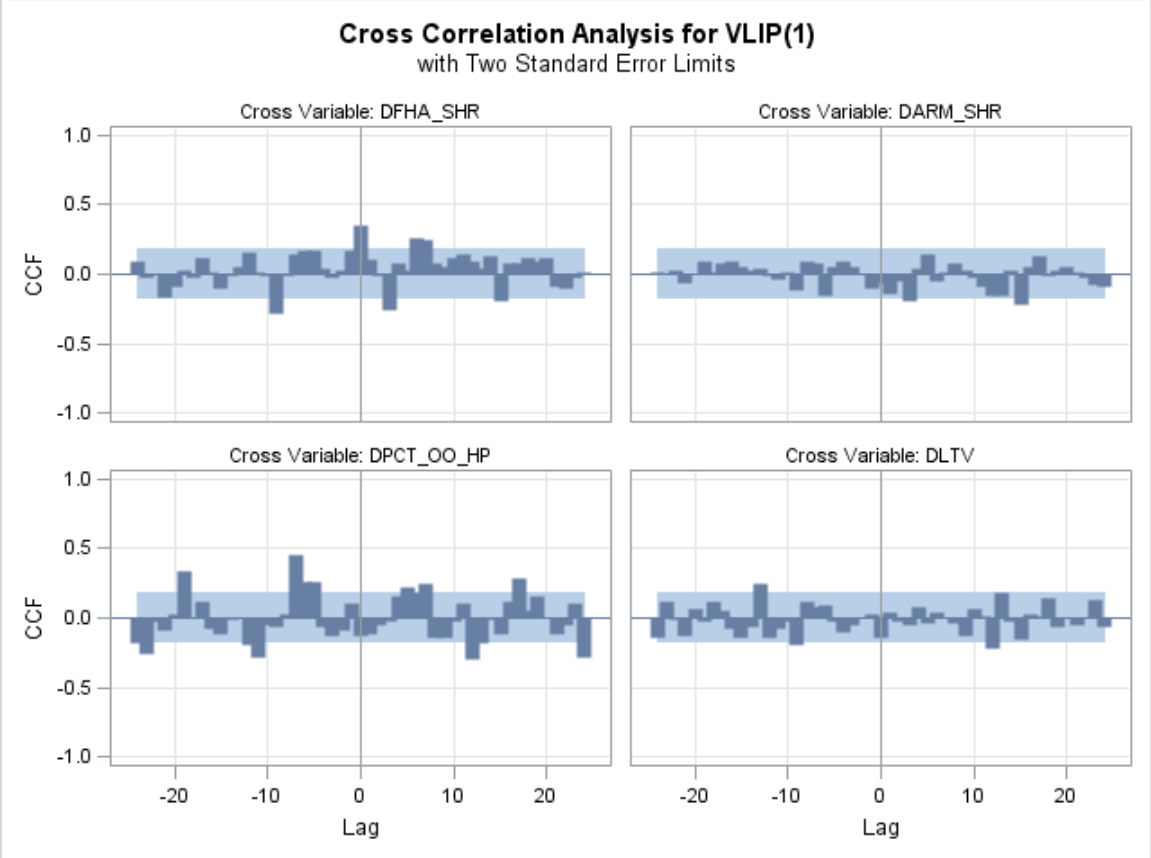
Appendix B

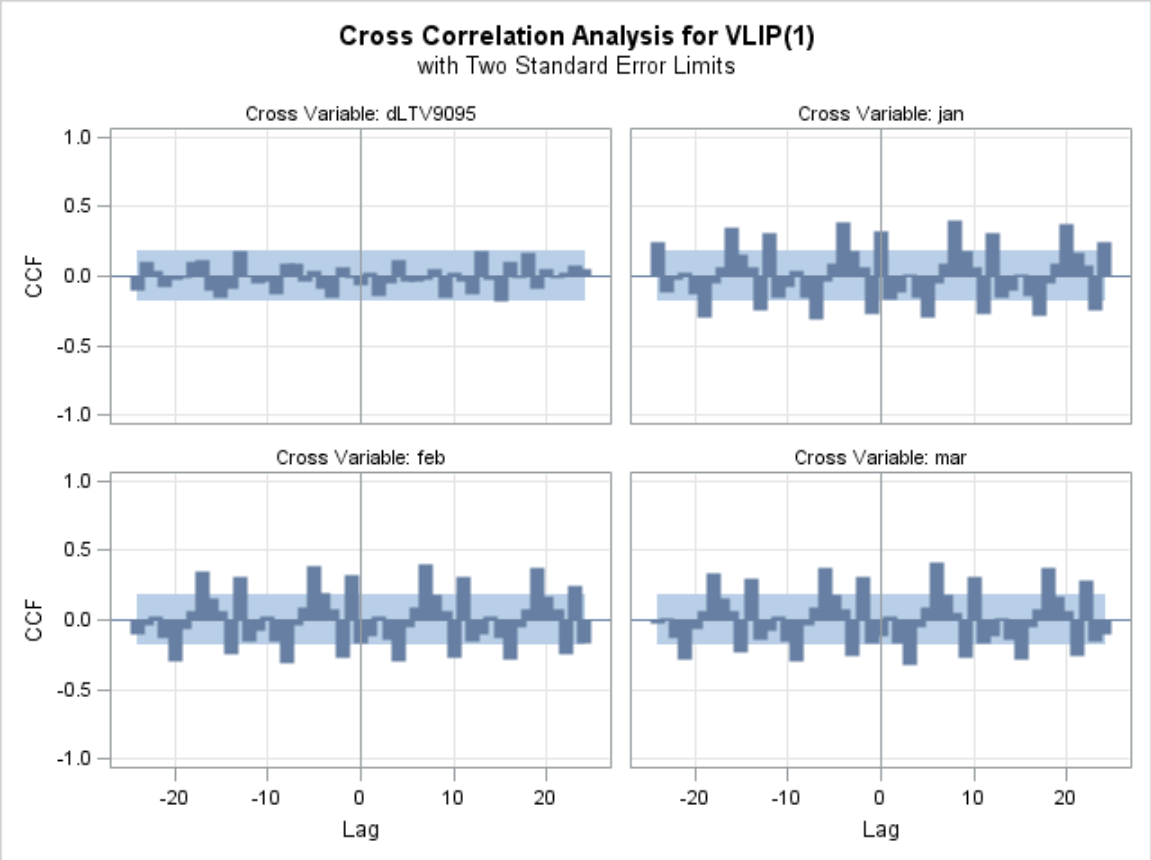
Very Low-Income Borrower Home Purchase Goal

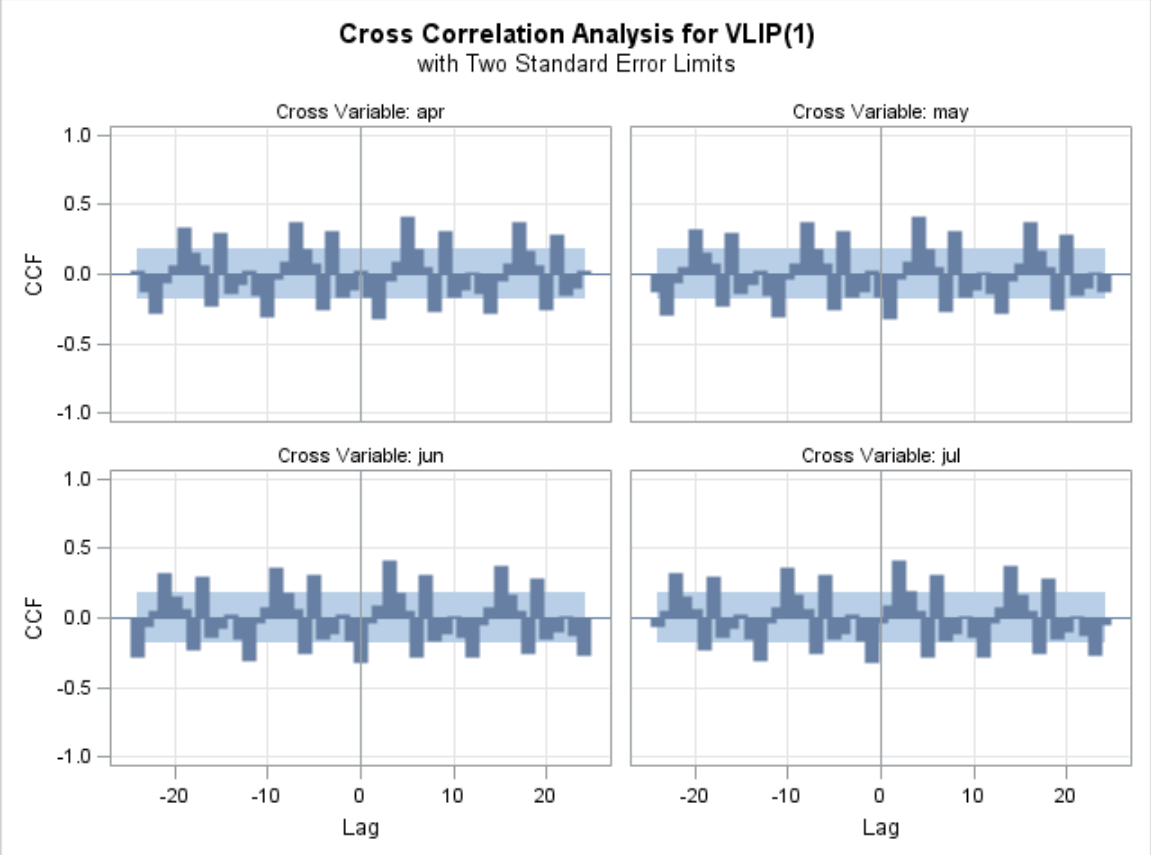

Trend and Correlation Analysis for VLIP(1)
VLIP(1)
Observation
ACF
Lag
PACF
Lag
IACF
Lag

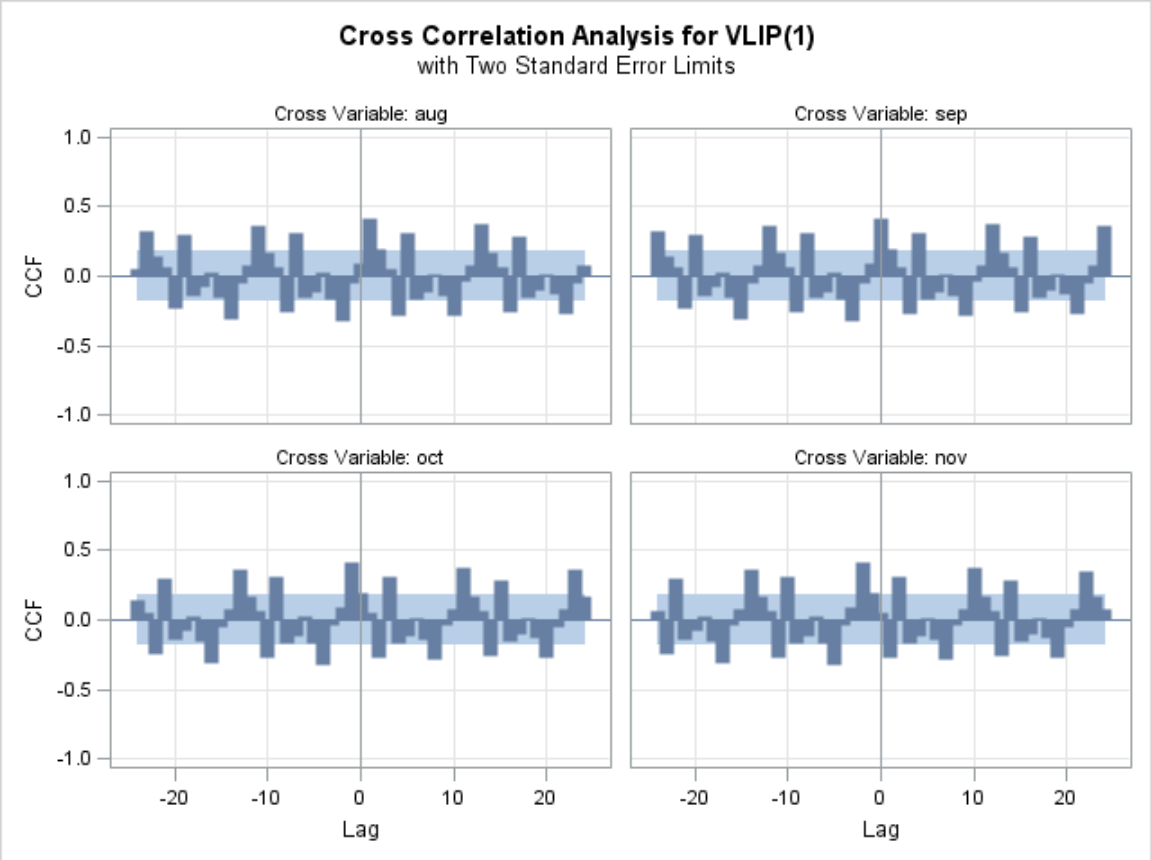

Cross Correlation Analysis for VLIP(1)
with Two Standard Error Limits
Cross Variable: DUNEMP_LAG1
Cross Variable: D12_LOG_CPI
Cross Variable: DCONS_CONF
Cross Variable: DTREAS_10_LAG1
CCF
Lag

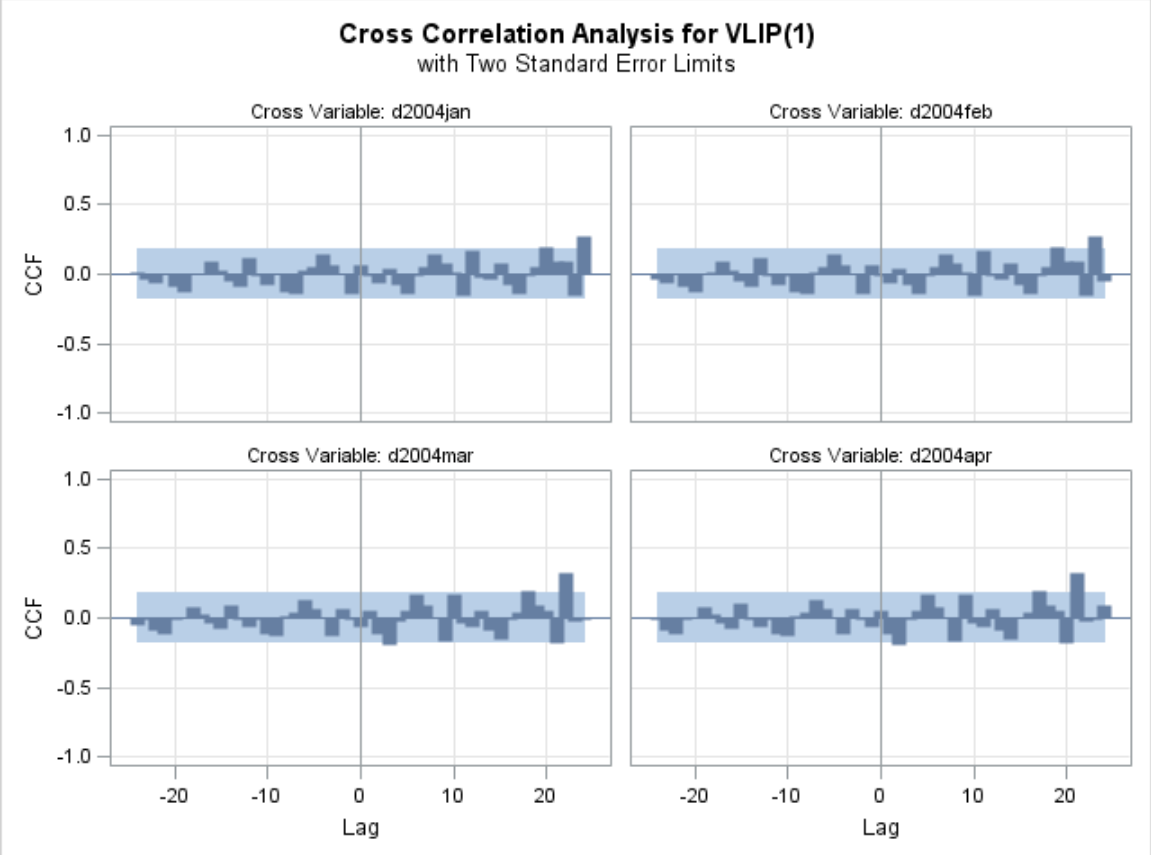

Cross Correlation Analysis for VLIP(1)
with Two Standard Error Limits
Cross Variable: DRATE_F30
Cross Variable: Dlog_MEDPRICE_E
Cross Variable: Dlog_sales
Cross Variable: DLOG_ORIG_LAG2
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

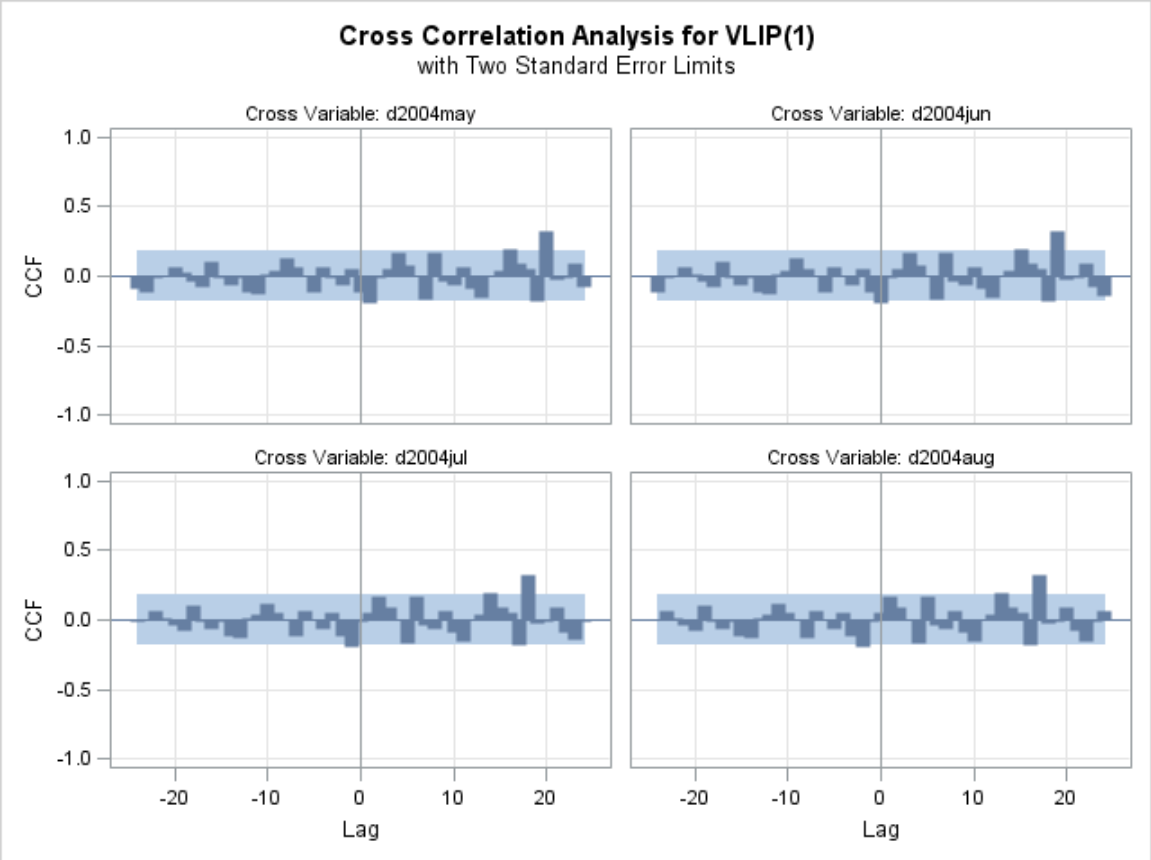

Cross Correlation Analysis for VLIP(1)
with Two Standard Error Limits
Cross Variable: DFHA_SHR
Cross Variable: DARM_SHR
Cross Variable: DPCT_OO_HP
Cross Variable: DLTV
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

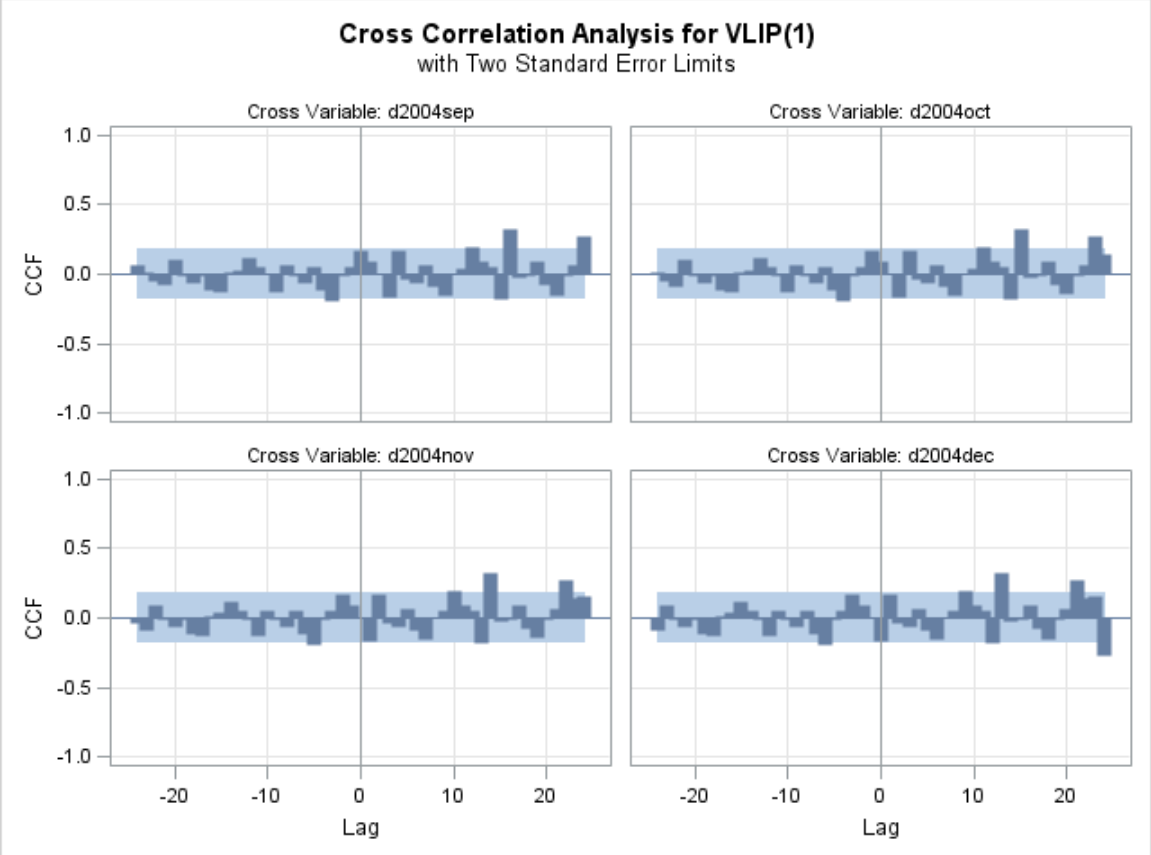

Cross Correlation Analysis for VLIP(1)
with Two Standard Error Limits
Cross Variable: dLTV9095
Cross Variable: jan
Cross Variable: feb
Cross Variable: mar
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag


Cross Correlation Analysis for VLIP(1)
with Two Standard Error Limits
Cross Variable: apr
Cross Variable: may
Cross Variable: jun
Cross Variable: jul
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

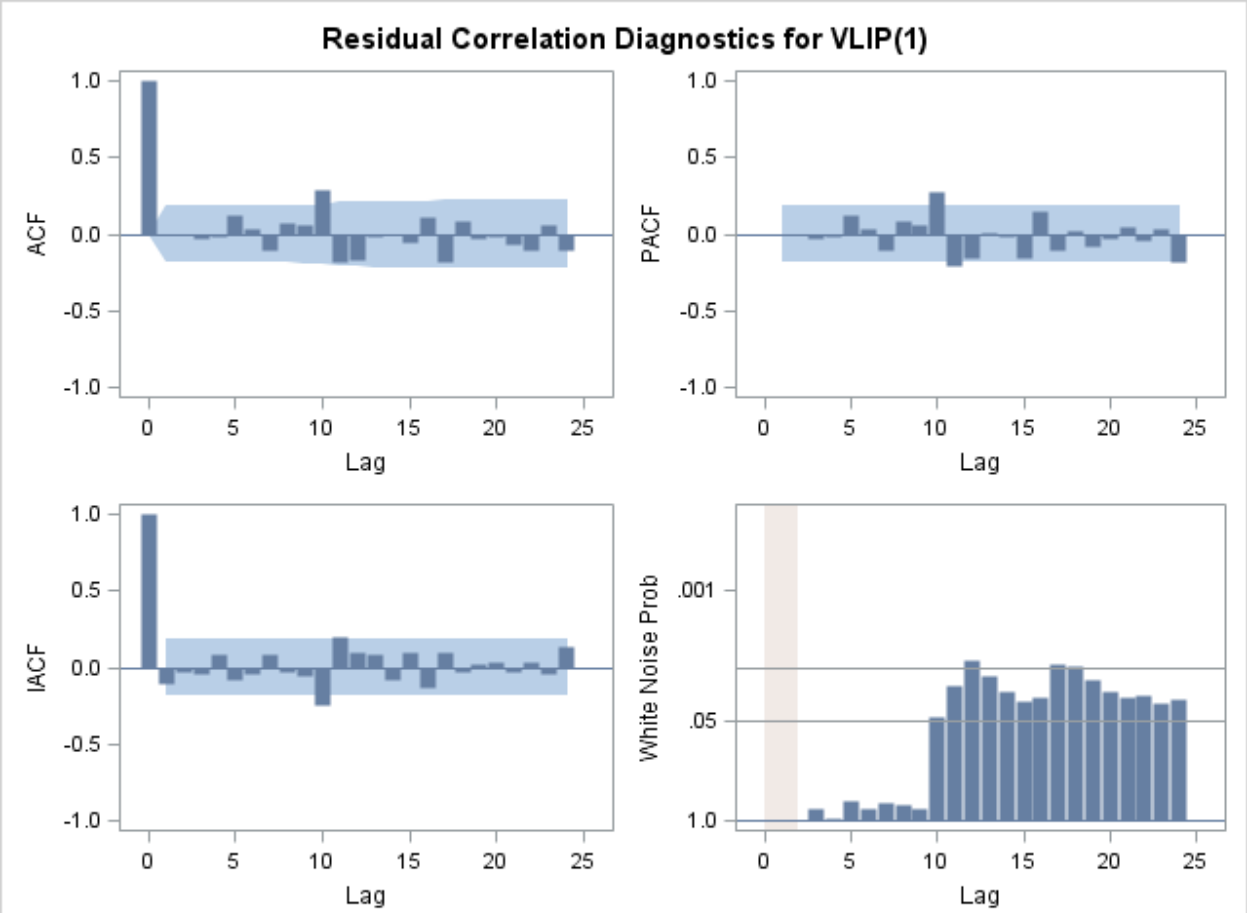

Cross Correlation Analysis for VLIP(1)
with Two Standard Error Limits
Cross Variable: aug
Cross Variable: sep
Cross Variable: oct
Cross Variable: nov
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

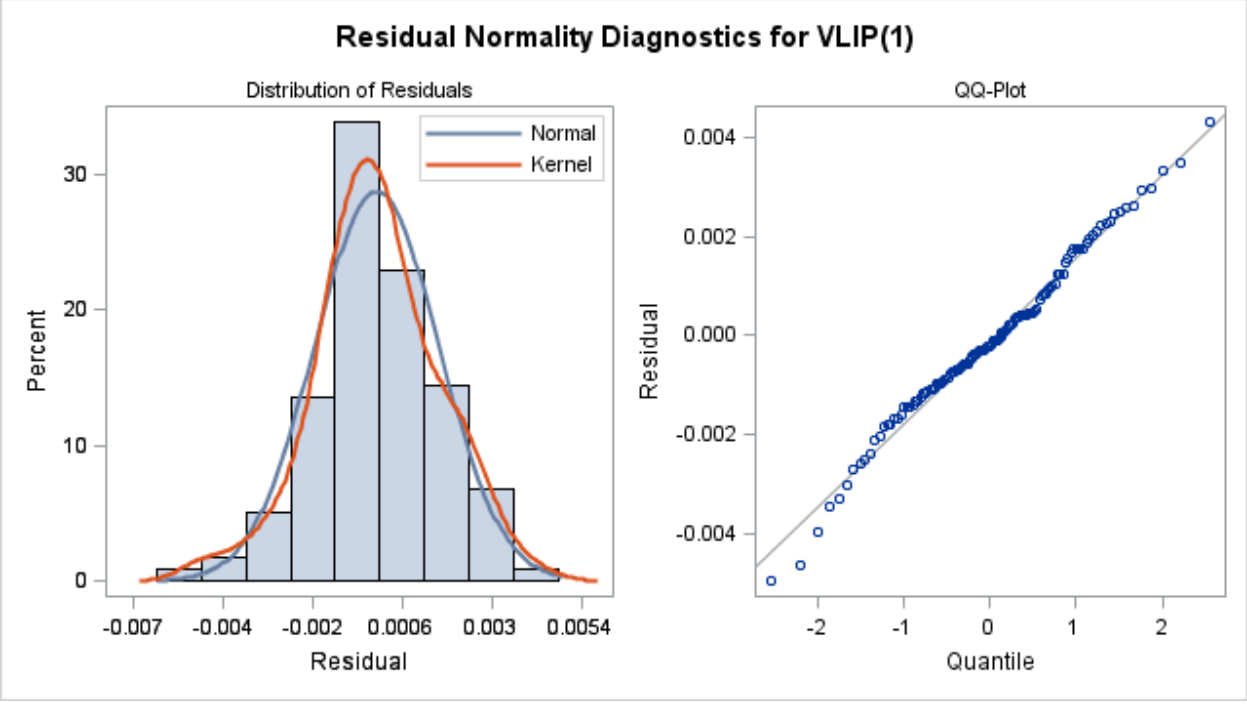

Cross Correlation Analysis for VLIP(1)
with Two Standard Error Limits
Cross Variable: d2004jan
Cross Variable: d2004feb
Cross Variable: d2004mar
Cross Variable: d2004apr
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag


Cross Correlation Analysis for VLIP(1)
with Two Standard Error Limits
Cross Variable: d2004may
Cross Variable: d2004jun
Cross Variable: d2004jul
Cross Variable: d2004aug
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

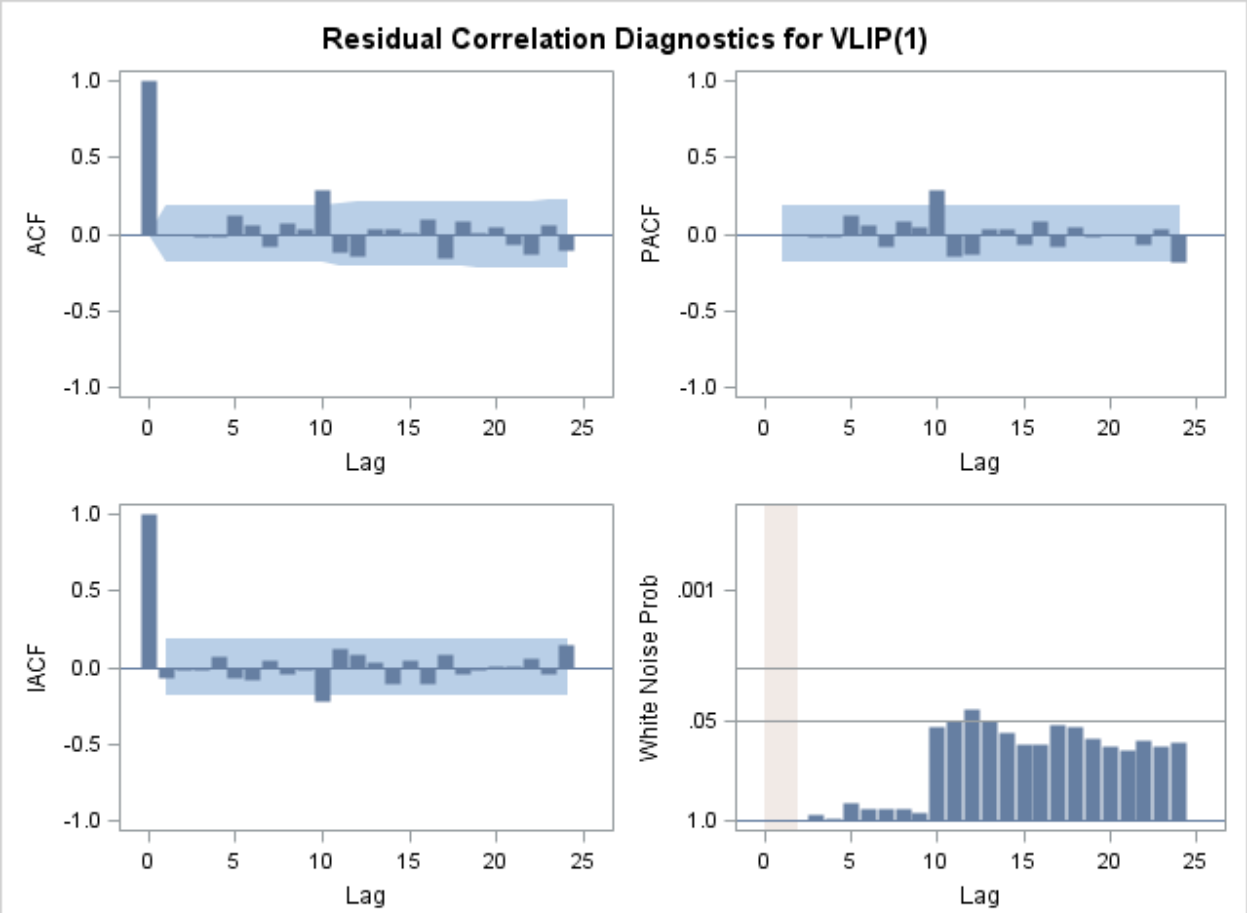

Cross Correlation Analysis for VLIP(1)
with Two Standard Error Limits
Cross Variable: d2004sep
Cross Variable: d2004oct
Cross Variable: d2004nov
Cross Variable: d2004dec
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

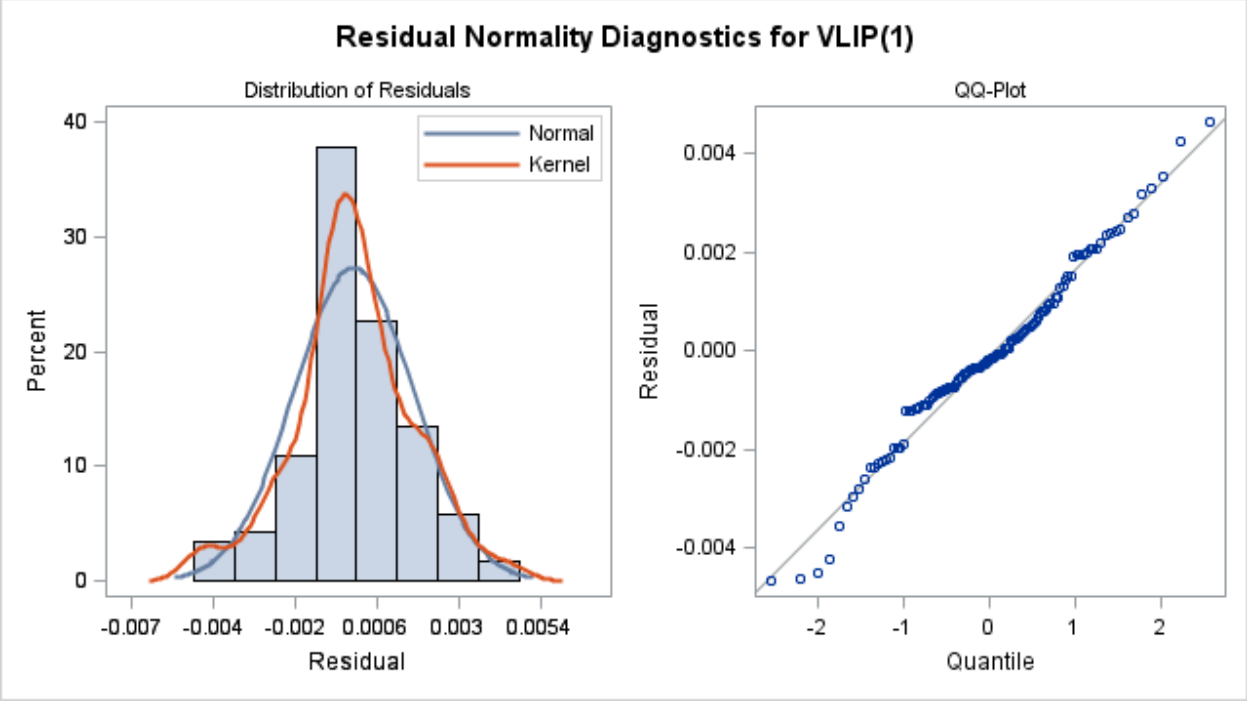
Full Model w/ 2004-07



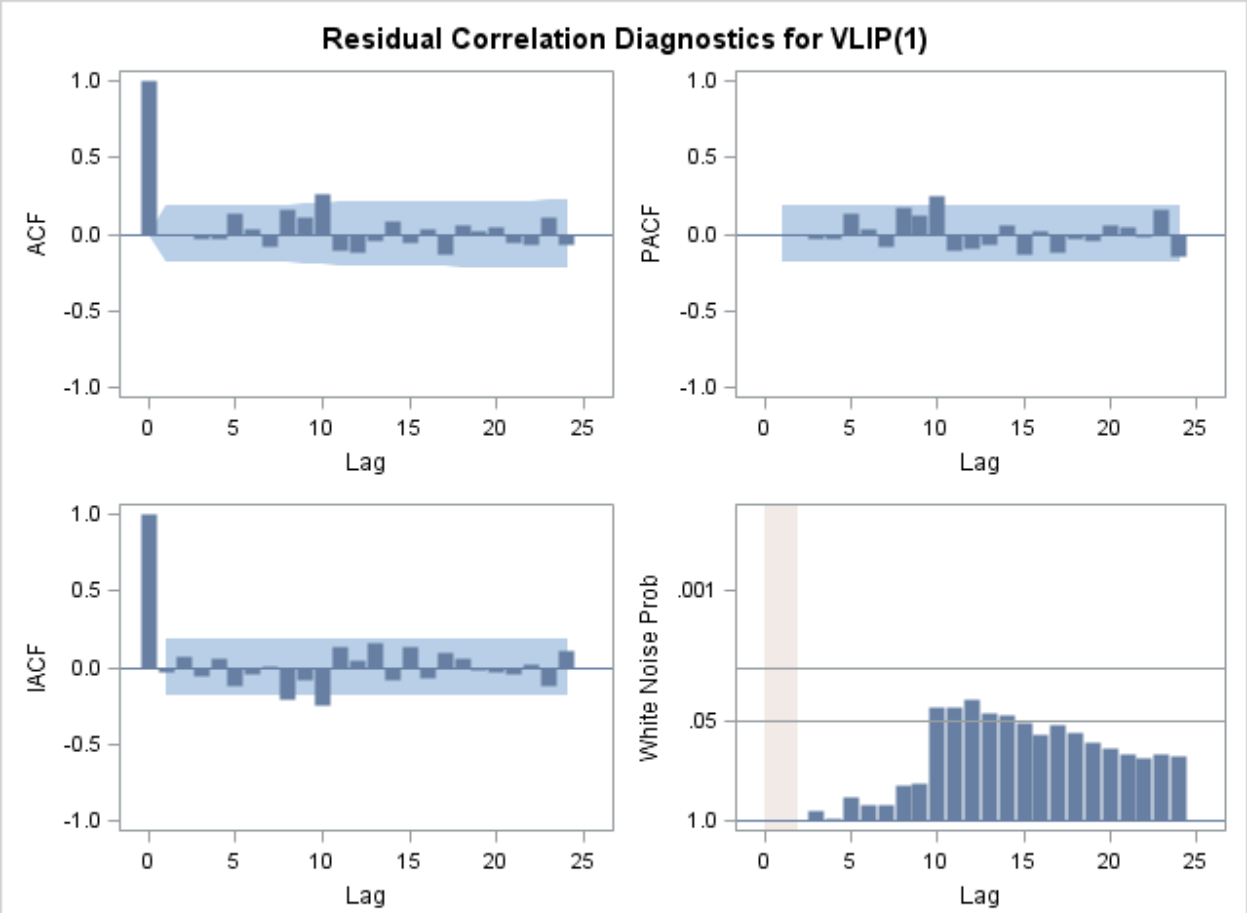


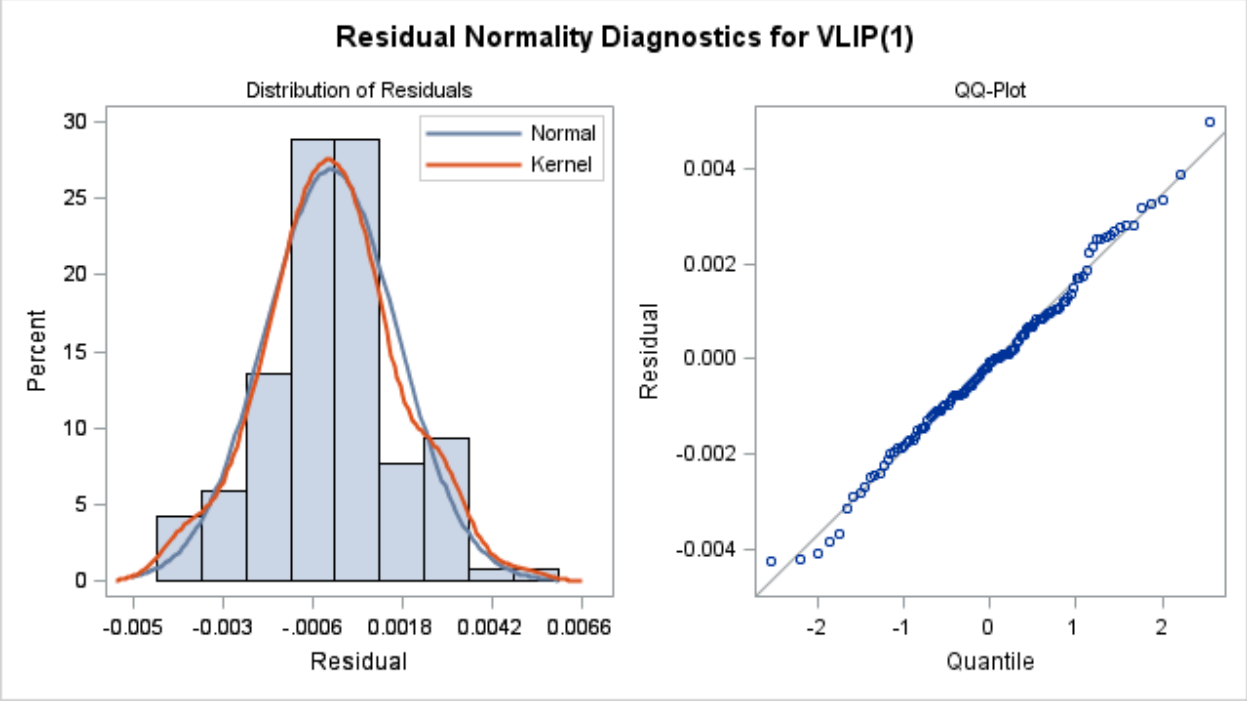
Best Fit w/ 2004-07



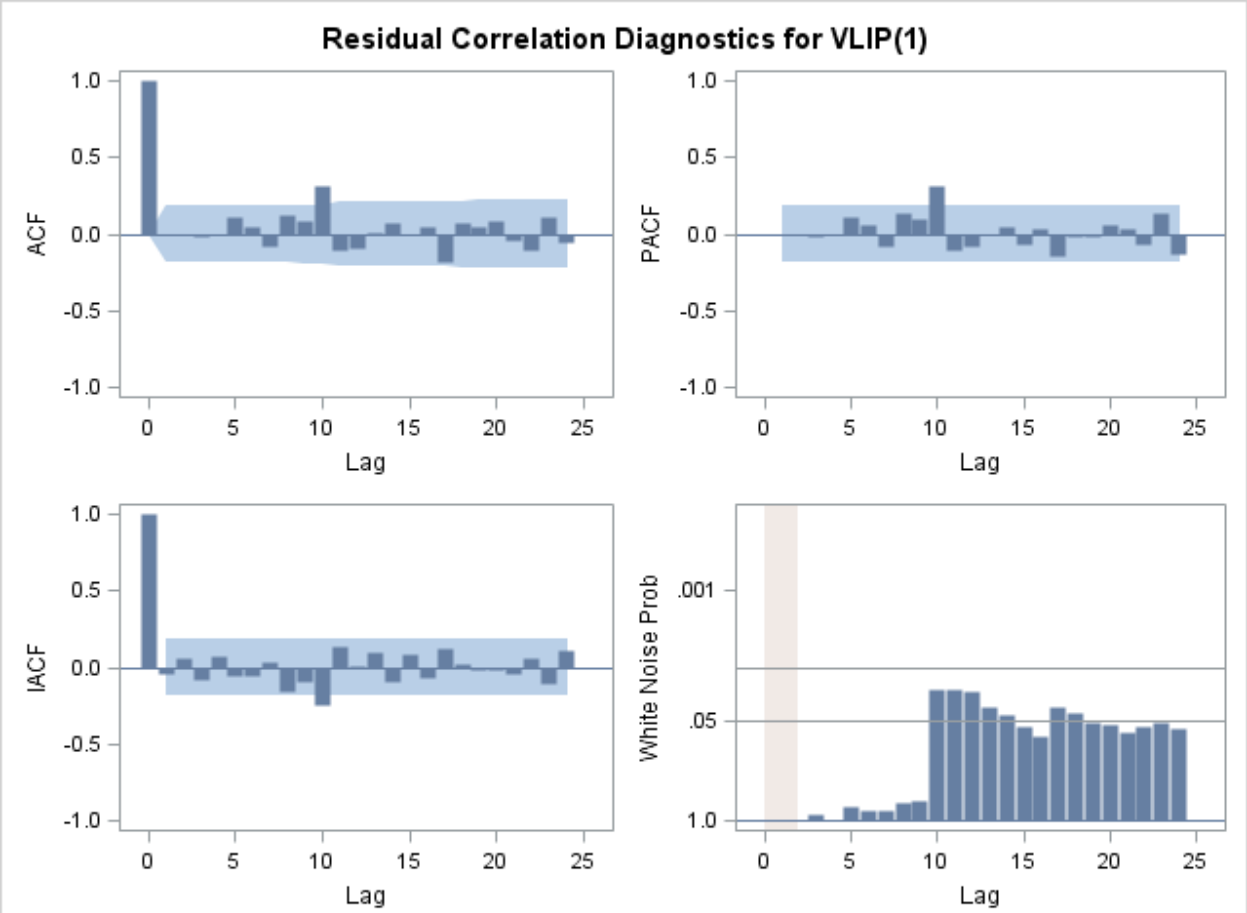


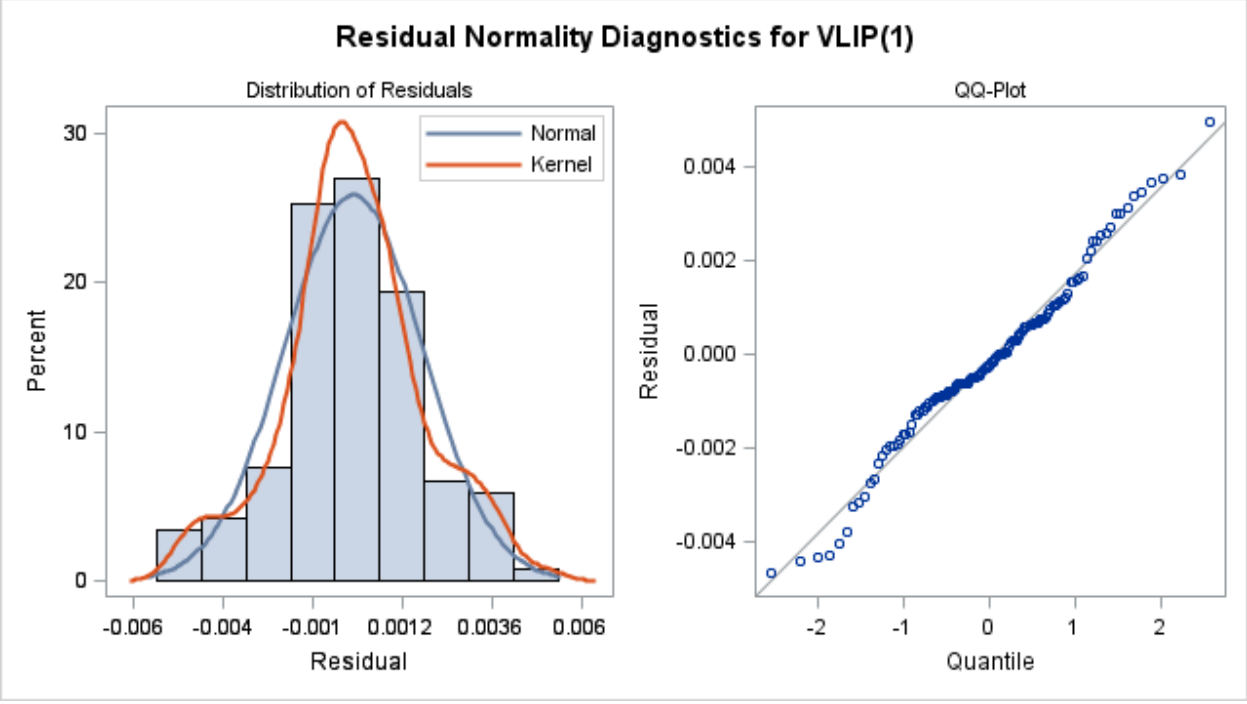
Full Model


Residual Correlation Diagnostics for VLIP(1)
ACF
PACF
IACF
White Noise Prob
Lag
1.0
0.5
0.0
-0.5
-1.0
0
5
10
15
20
25
.001
.05
1.0


Residual Normality Diagnostics for VLIP(1)
Distribution of Residuals
Normal
Kernel
Percent
Residual
30
25
20
15
10
5
0
-0.005
-0.003
-.0006
0.0018
0.0042
0.0066
QQ-Plot
Residual
Quantile
0.004
0.002
0.000
-0.002
-0.004
-2
-1
0
1
2

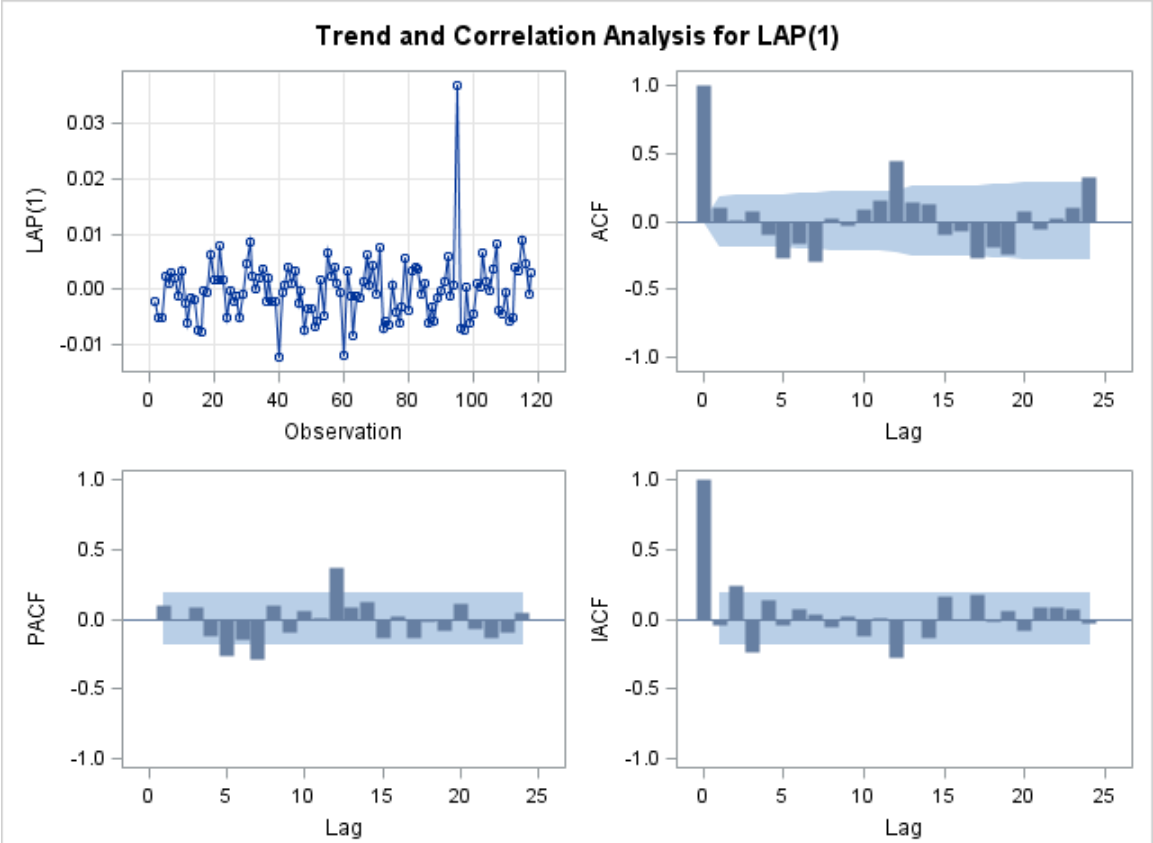
Best Fit Model

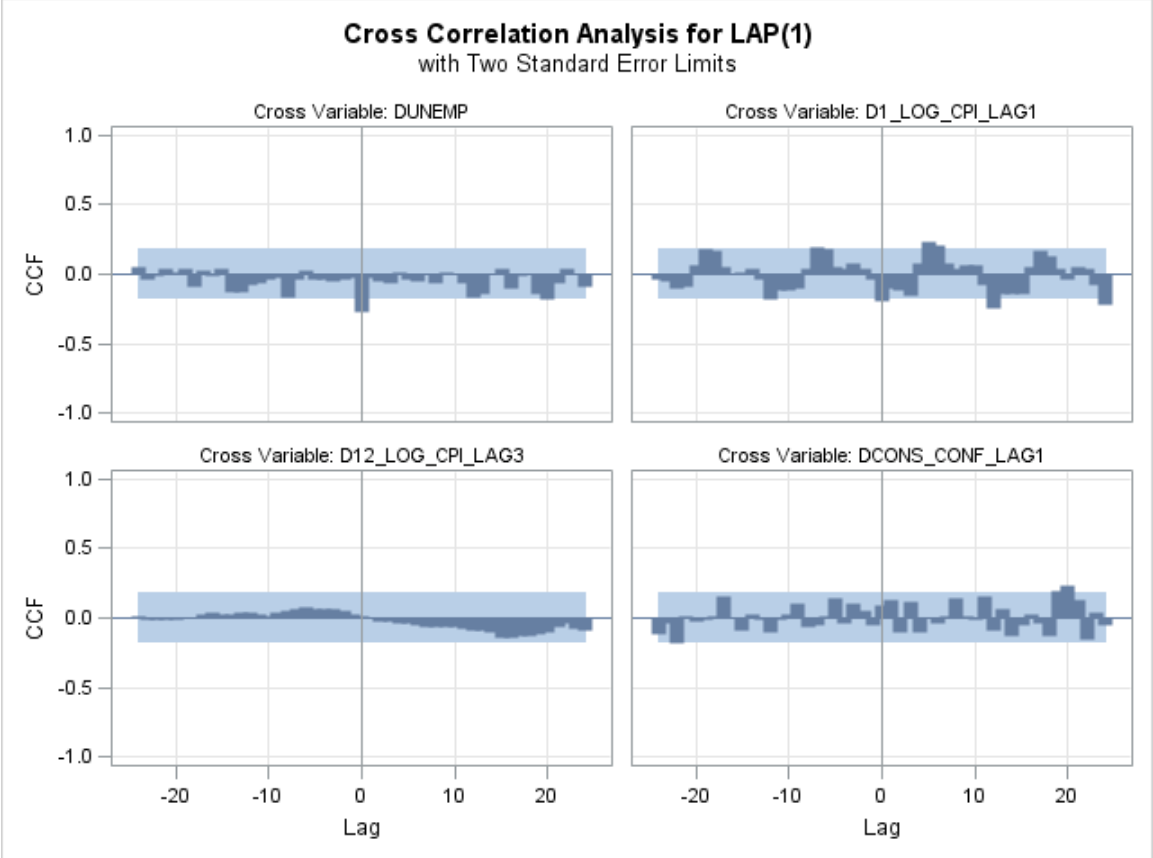


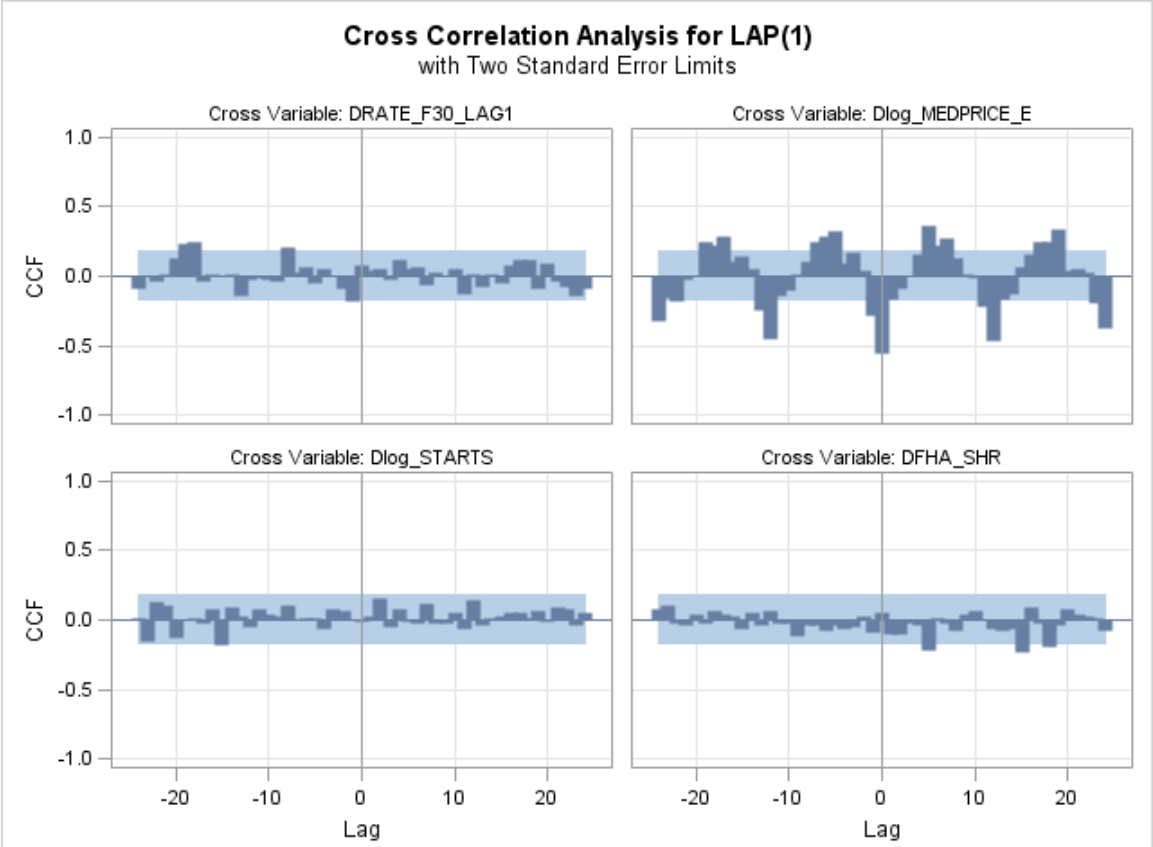


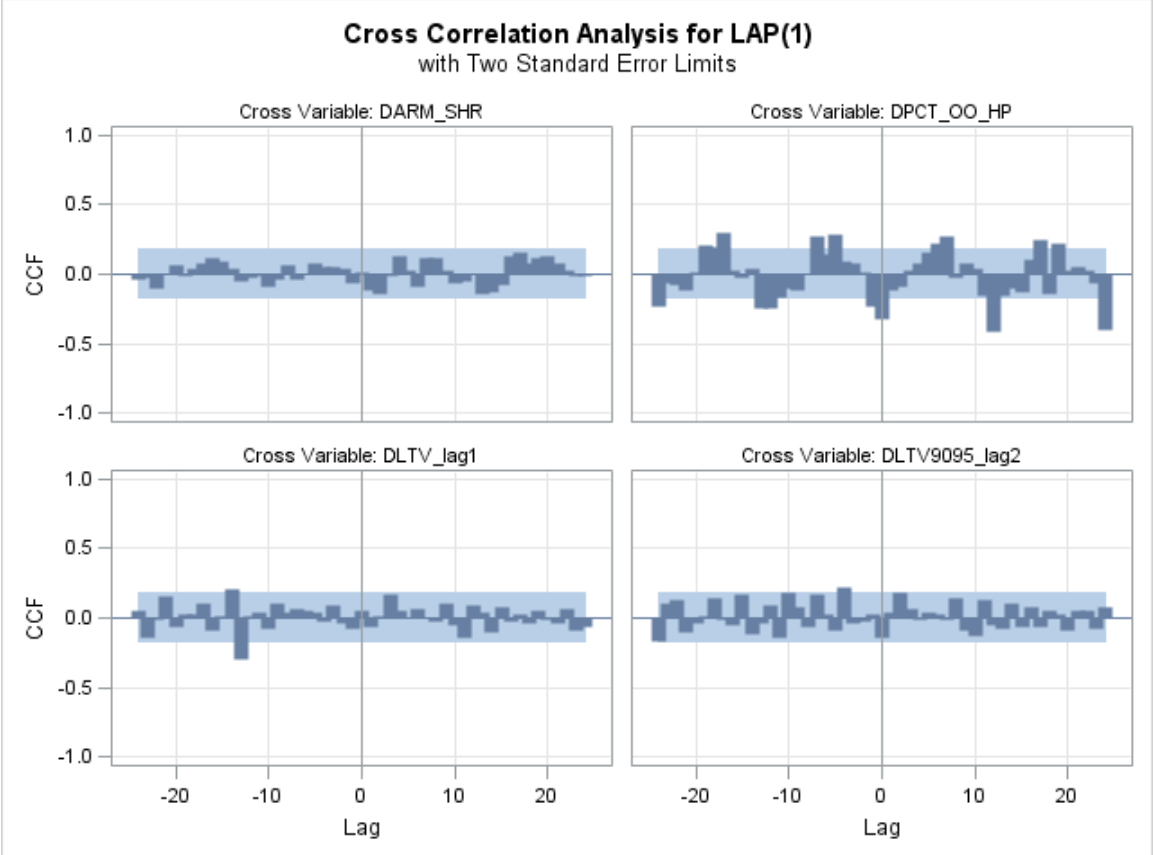
Appendix C

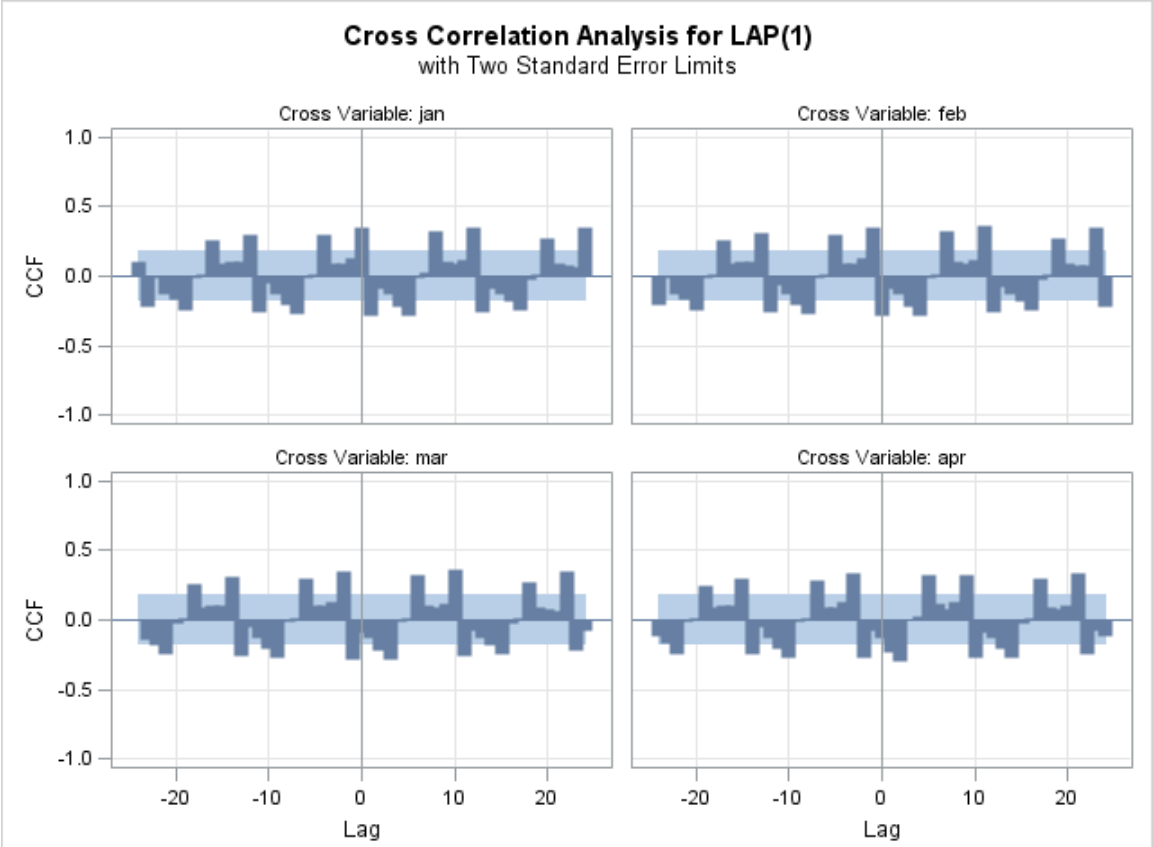
Low-Income Areas Home Purchase Subgoal

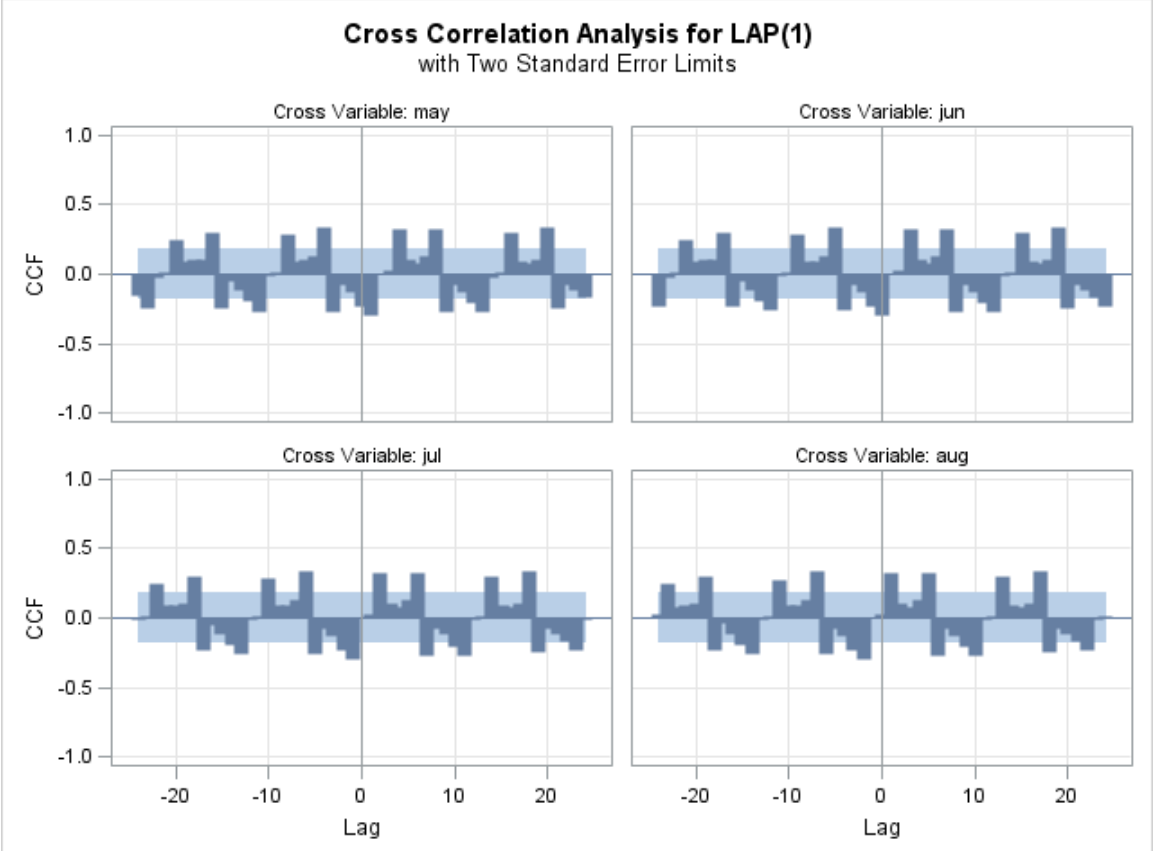

Trend and Correlation Analysis for LAP(1)
LAP(1)
Observation
ACF
Lag
PACF
Lag
IACF
Lag

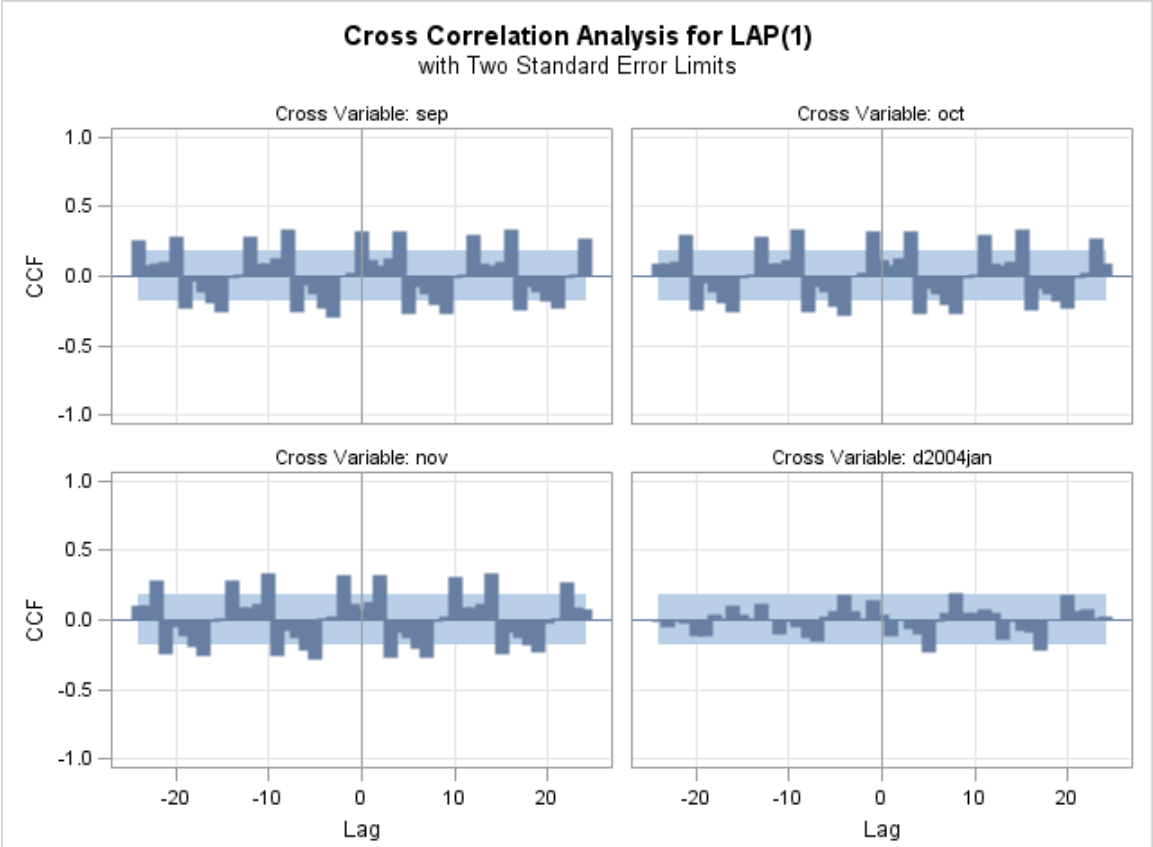

Cross Correlation Analysis for LAP(1)
with Two Standard Error Limits
Cross Variable: DUNEMP
Cross Variable: D1_LOG_CPI_LAG1
Cross Variable: D12_LOG_CPI_LAG3
Cross Variable: DCONS_CONF_LAG1
CCF
Lag

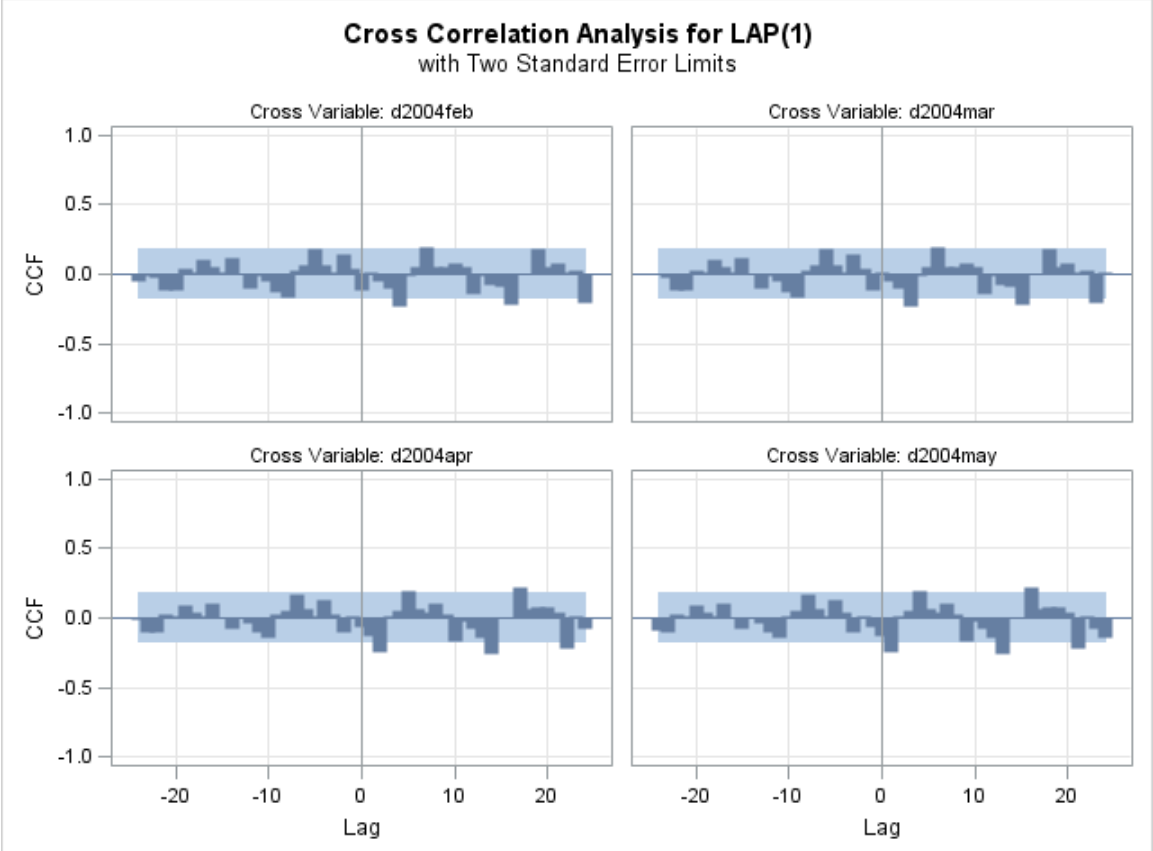

Cross Correlation Analysis for LAP(1)
with Two Standard Error Limits
Cross Variable: DRATE_F30_LAG1
Cross Variable: Dlog_MEDPRICE_E
Cross Variable: Dlog_STARTS
Cross Variable: DFHA_SHR
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

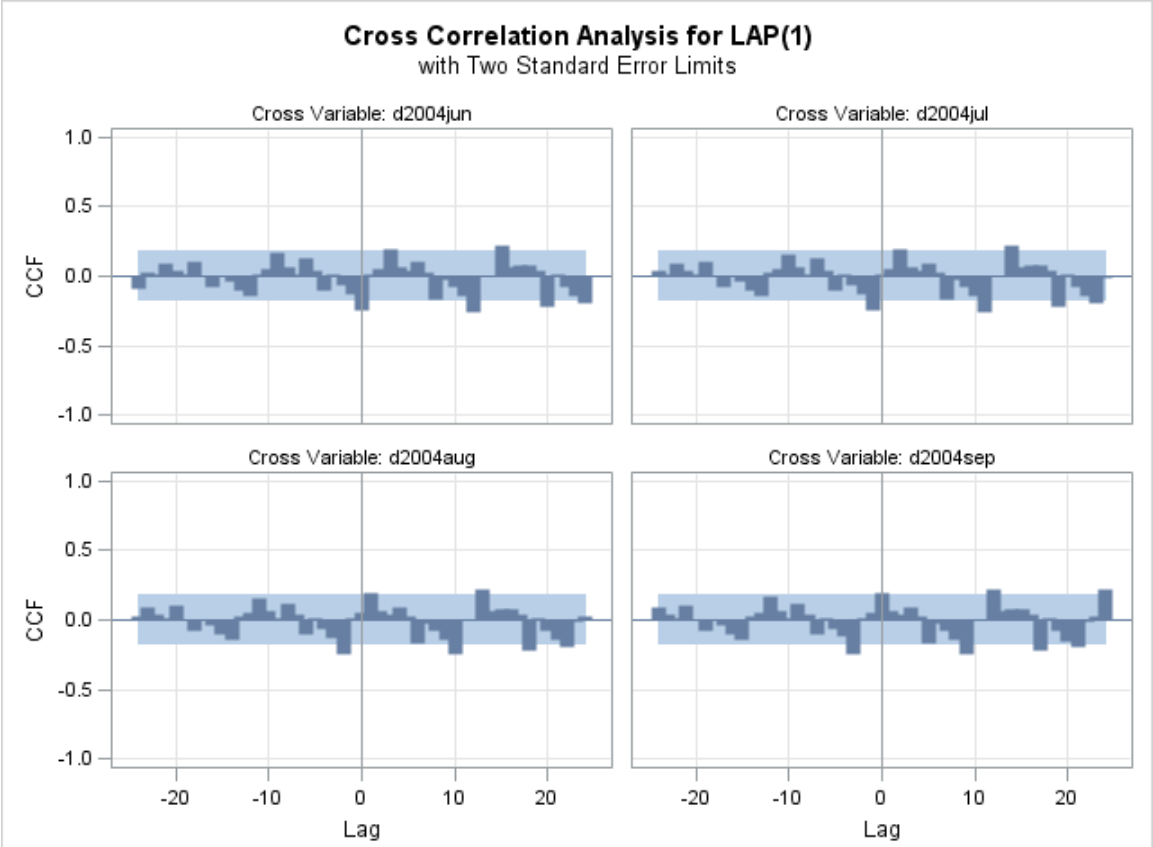

Cross Correlation Analysis for LAP(1)
with Two Standard Error Limits
Cross Variable: DARM_SHR
Cross Variable: DPCT_OO_HP
Cross Variable: DLTV_lag1
Cross Variable: DLTV9095_lag2
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

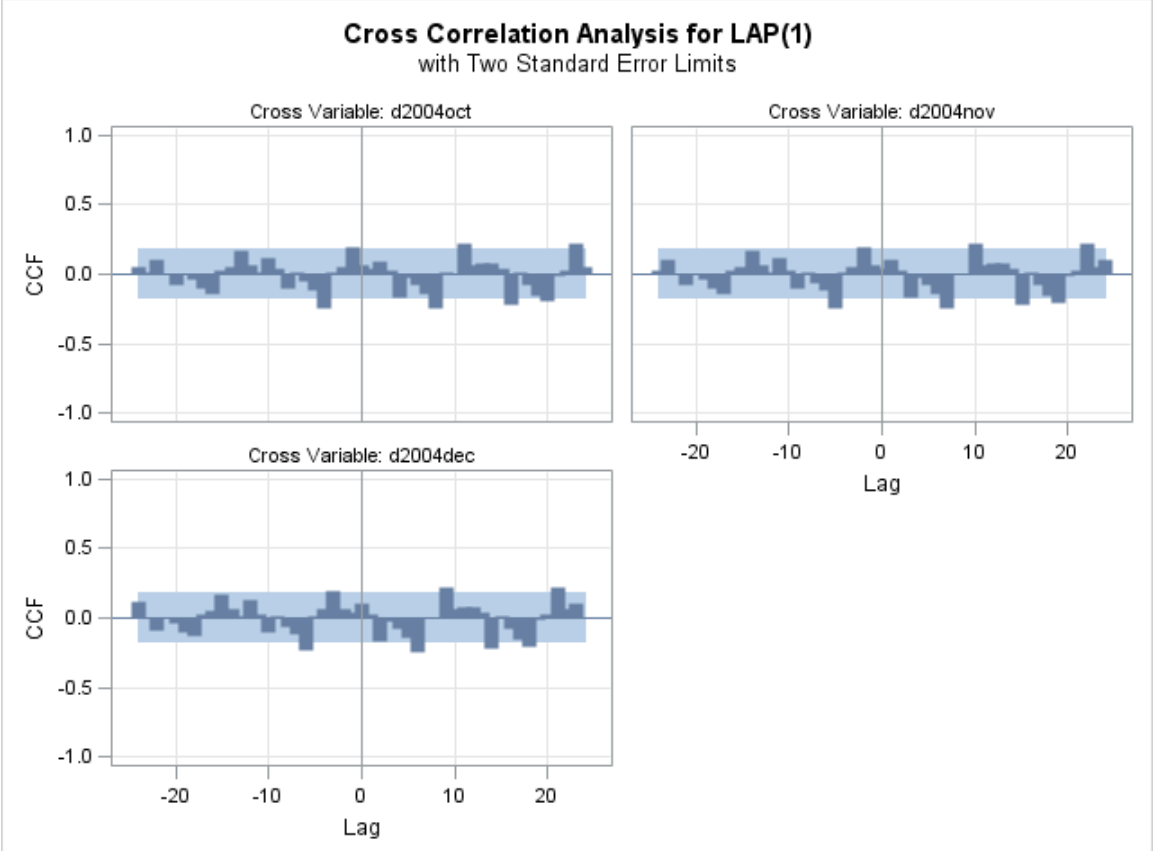

Cross Correlation Analysis for LAP(1)
with Two Standard Error Limits
Cross Variable: jan
Cross Variable: feb
Cross Variable: mar
Cross Variable: apr
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag


Cross Correlation Analysis for LAP(1)
with Two Standard Error Limits
Cross Variable: may
Cross Variable: jun
Cross Variable: jul
Cross Variable: aug
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

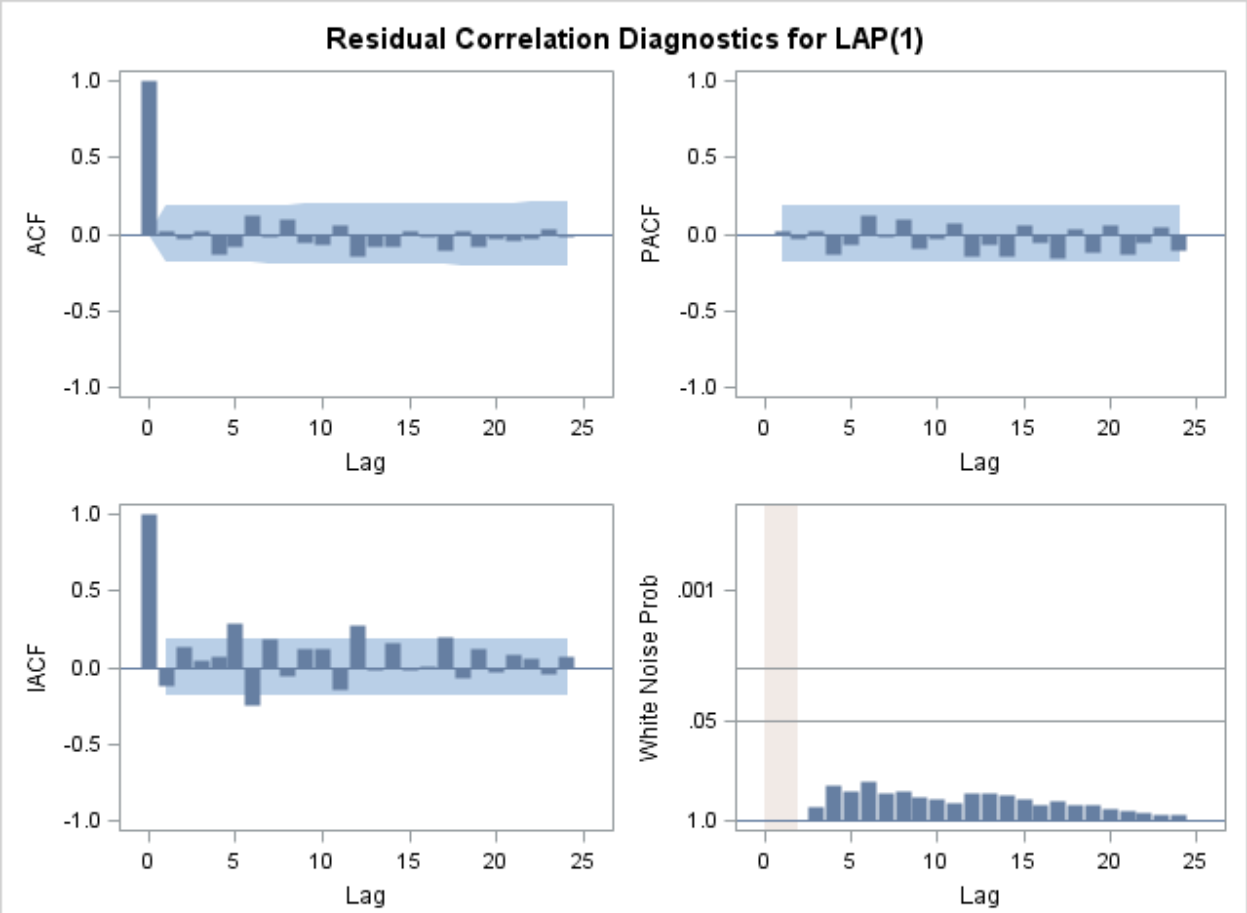

Cross Correlation Analysis for LAP(1)
with Two Standard Error Limits
Cross Variable: sep
Cross Variable: oct
Cross Variable: nov
Cross Variable: d2004jan
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

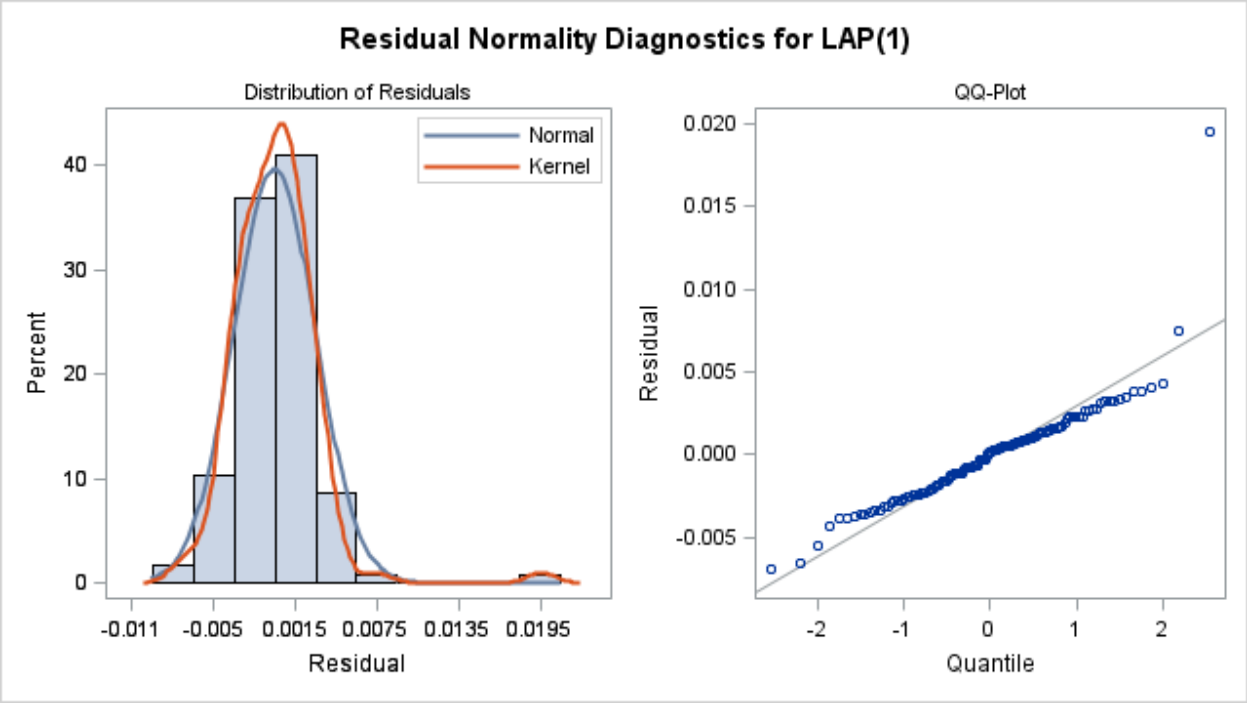

Cross Correlation Analysis for LAP(1)
with Two Standard Error Limits
Cross Variable: d2004feb
Cross Variable: d2004mar
Cross Variable: d2004apr
Cross Variable: d2004may
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag


Cross Correlation Analysis for LAP(1)
with Two Standard Error Limits
Cross Variable: d2004jun
Cross Variable: d2004jul
Cross Variable: d2004aug
Cross Variable: d2004sep
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

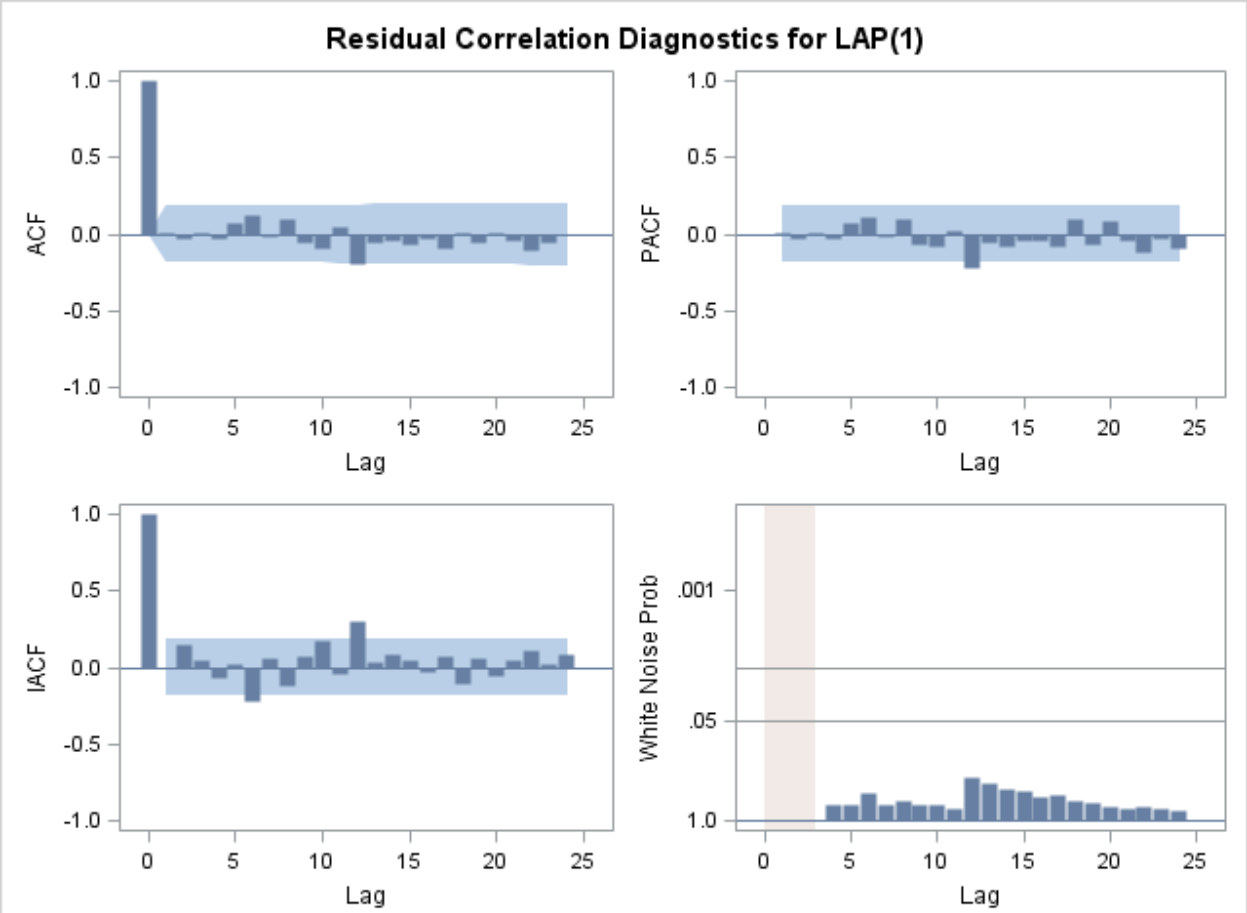

Cross Correlation Analysis for LAP(1)
with Two Standard Error Limits
Cross Variable: d2004oct
Cross Variable: d2004nov
Cross Variable: d2004dec
CCF
1.0
0.5
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

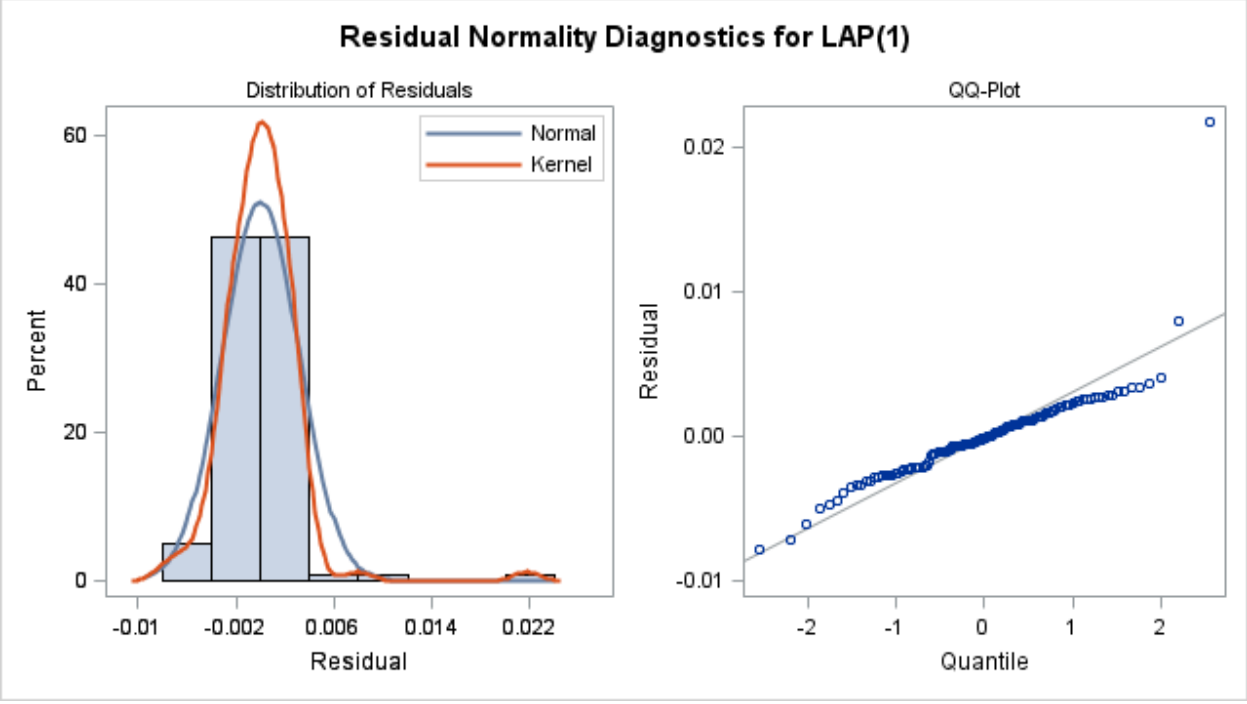
Full Model w/ 2004-07



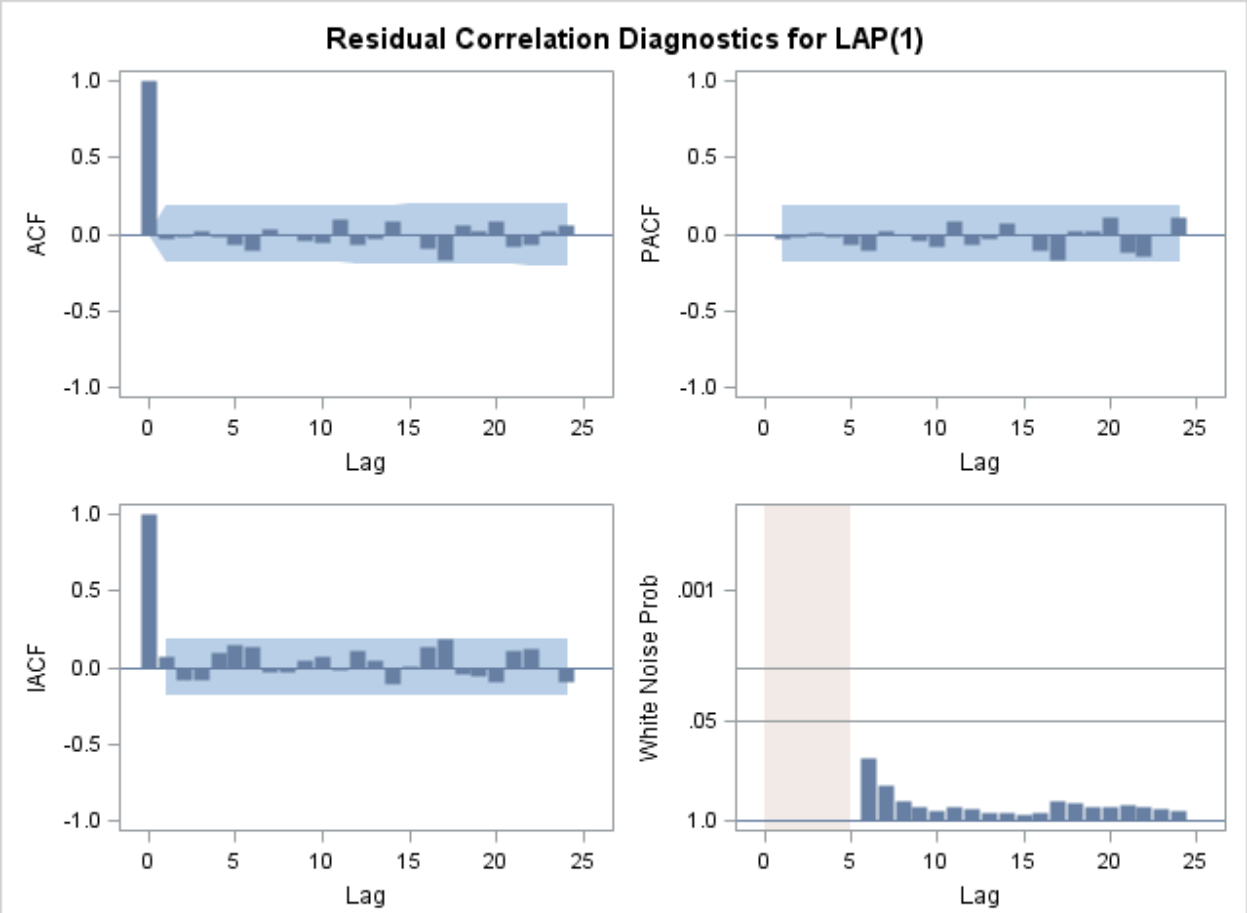


Best Fit w/ 2004-07





Full Model


Residual Correlation Diagnostics for LAP(1)
ACF
PACF
IACF
White Noise Prob
Lag
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0.0
-0.5
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0
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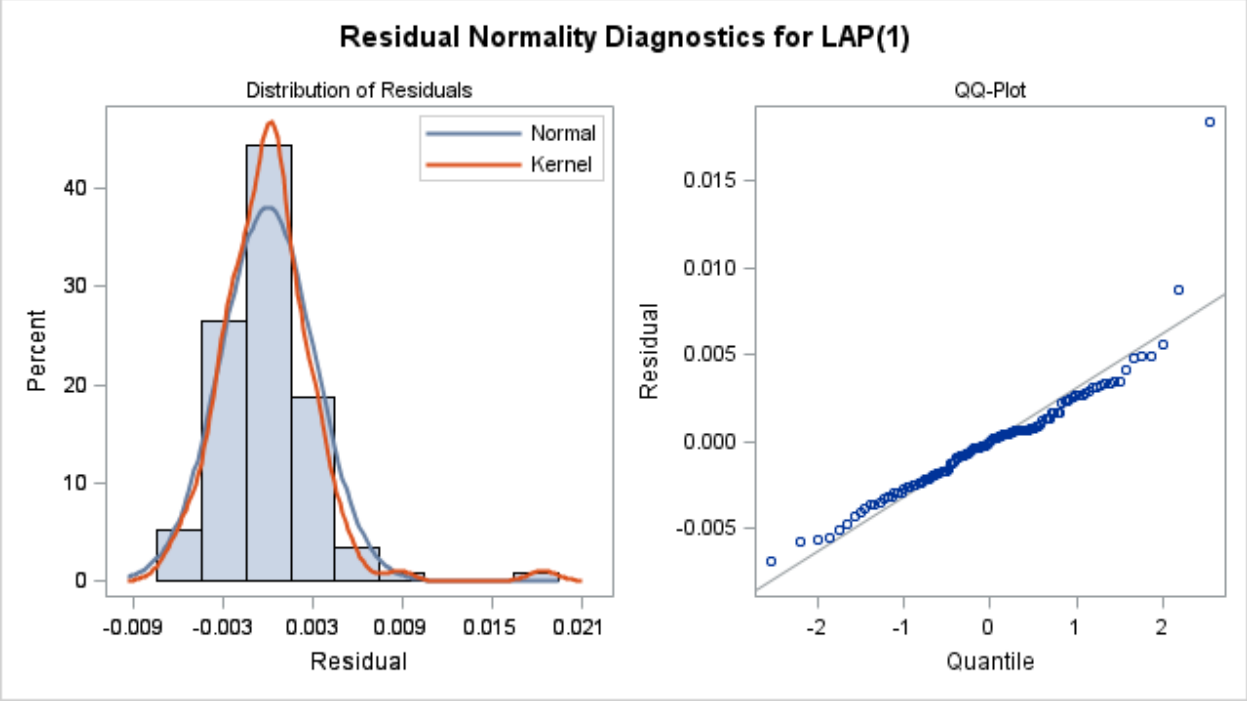
10
15
20
25
.001
.05
1.0


Residual Normality Diagnostics for LAP(1)
Distribution of Residuals
Normal
Kernel
Percent
Residual
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30
20
10
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-0.003
0.003
0.009
0.015
0.021
QQ-Plot
Residual
Quantile
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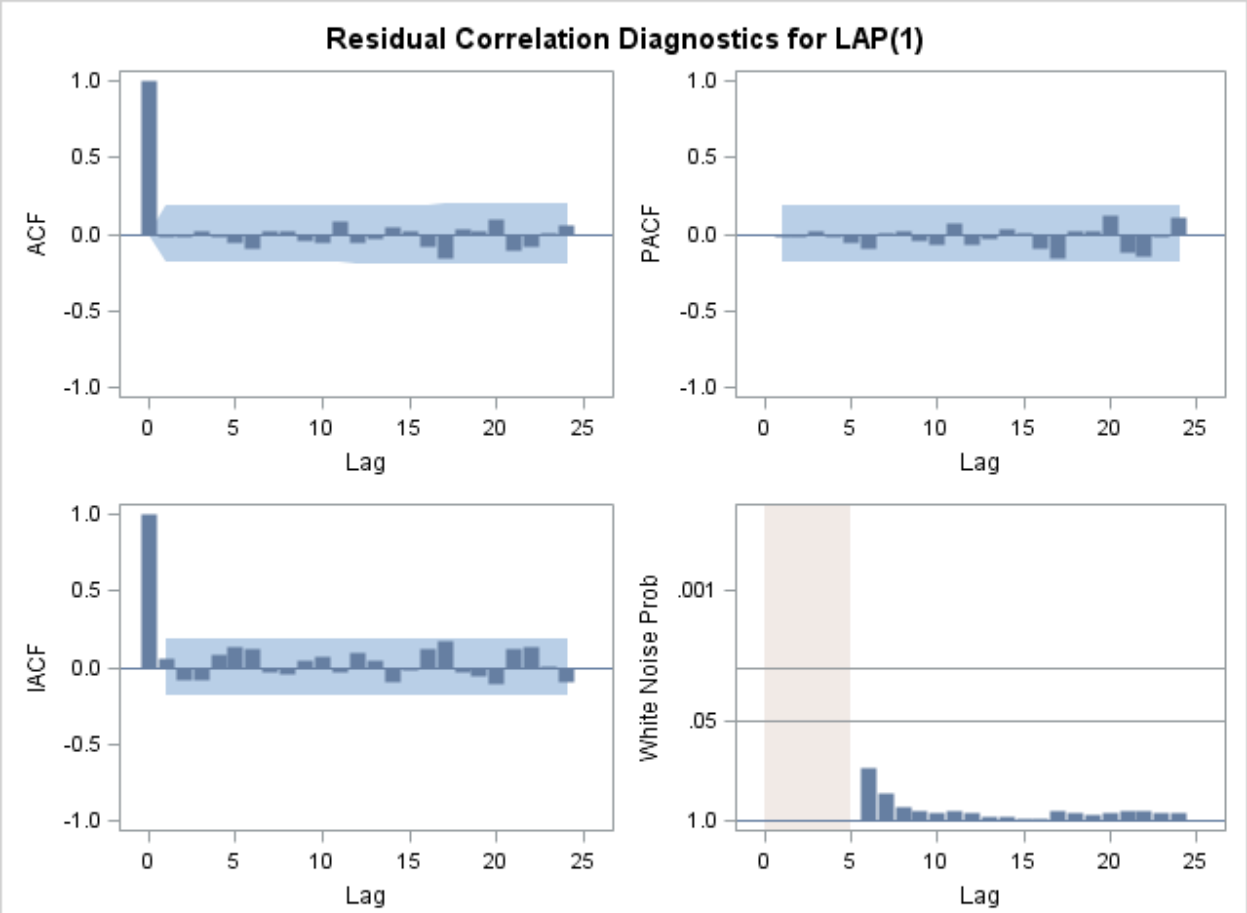
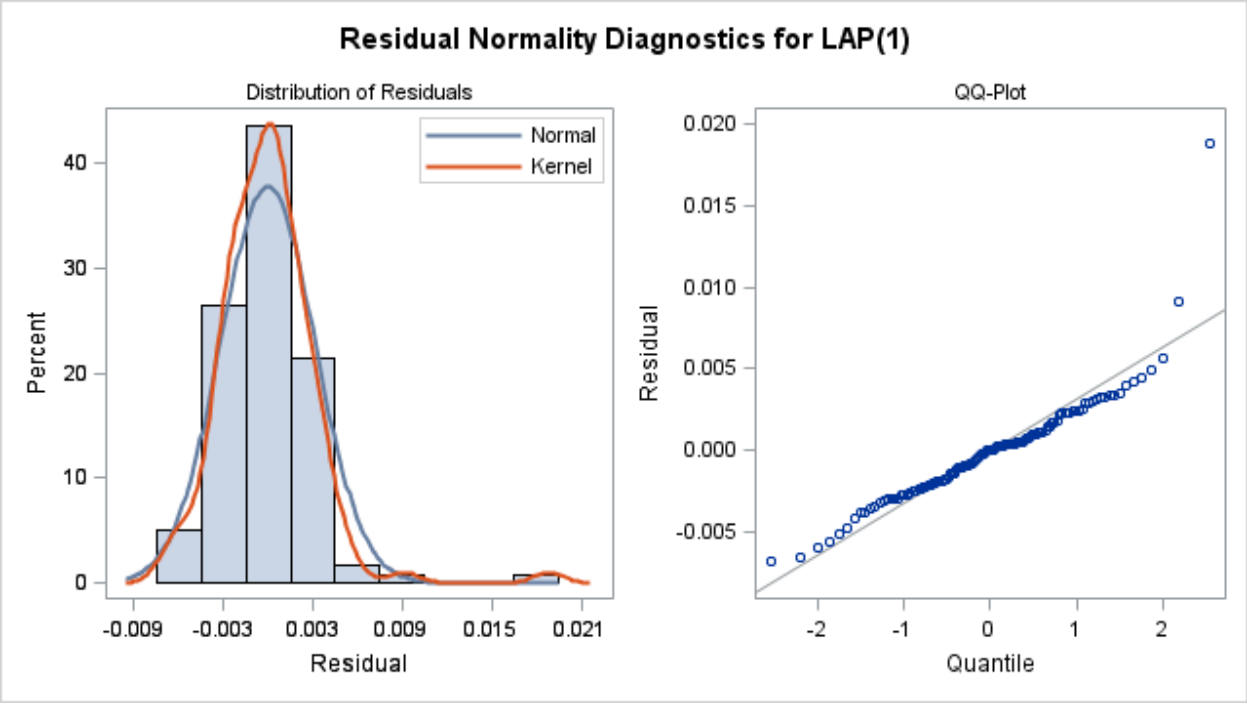
0.010
0.005
0.000
-0.005
-2
-1
0
1
2

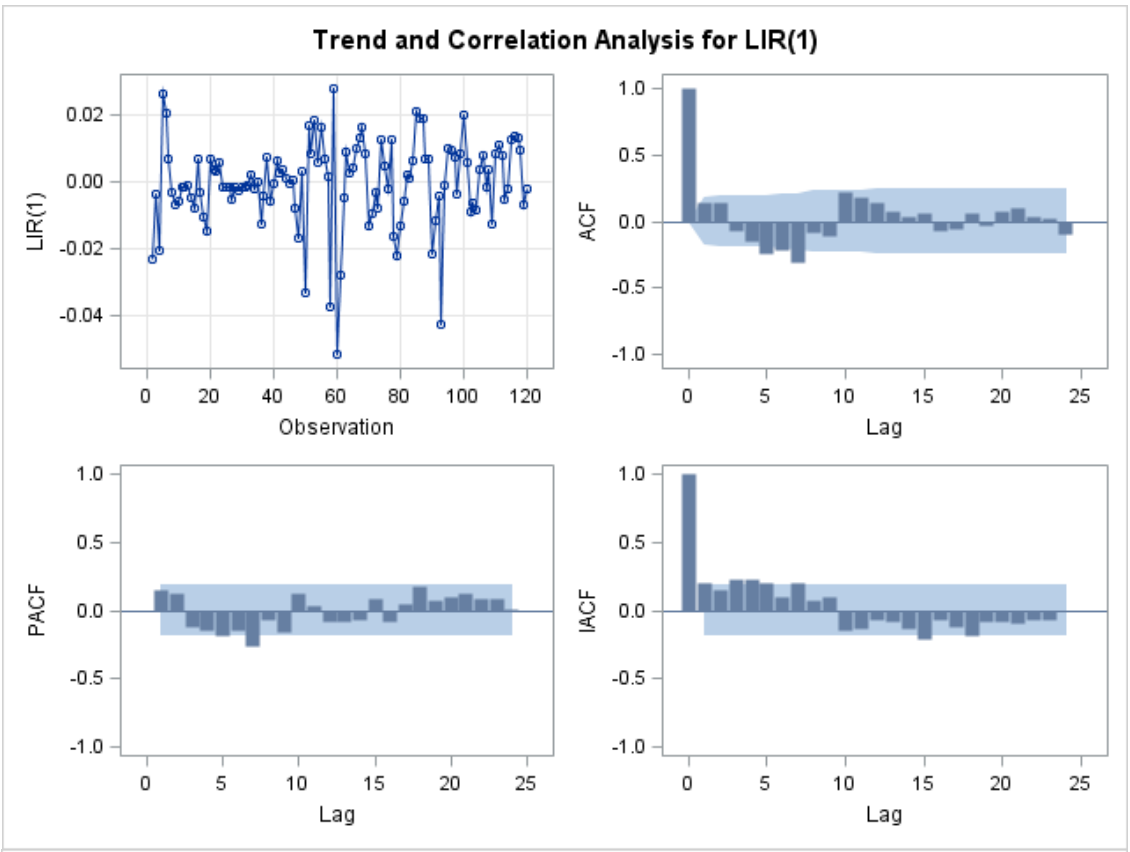
Best Fit Model

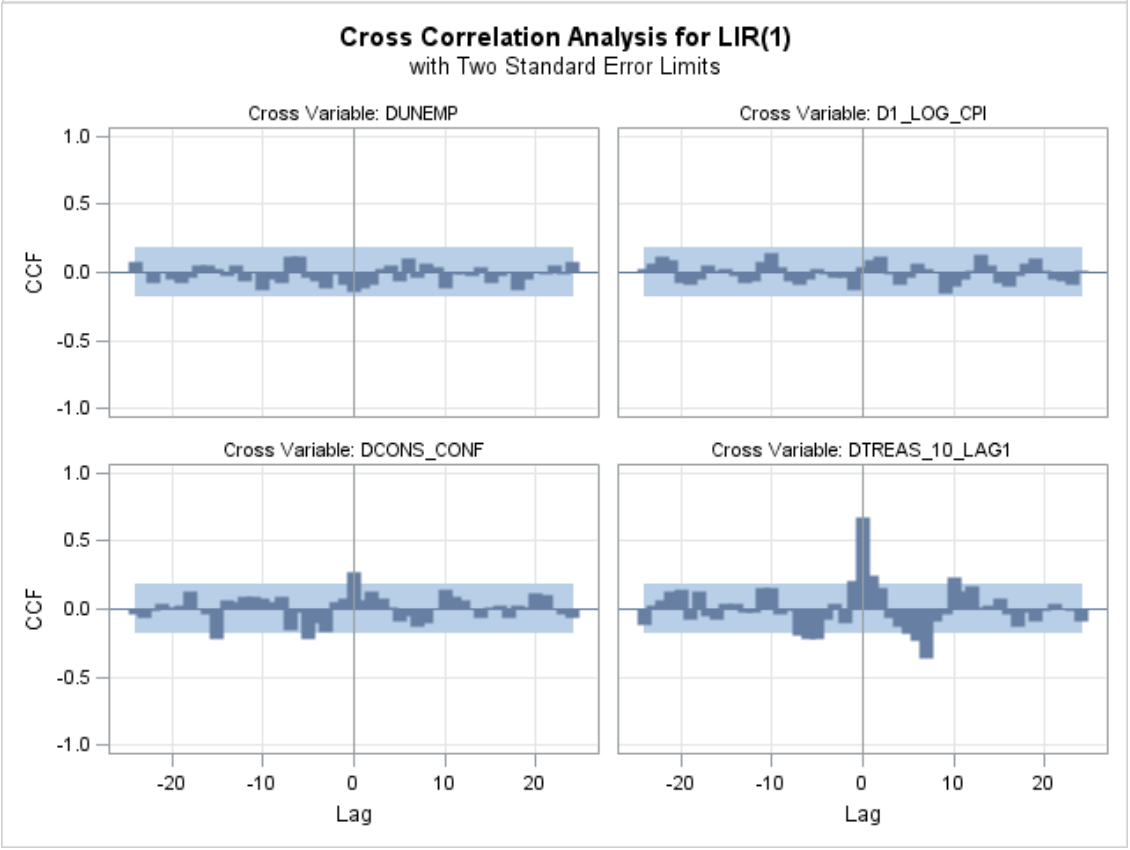


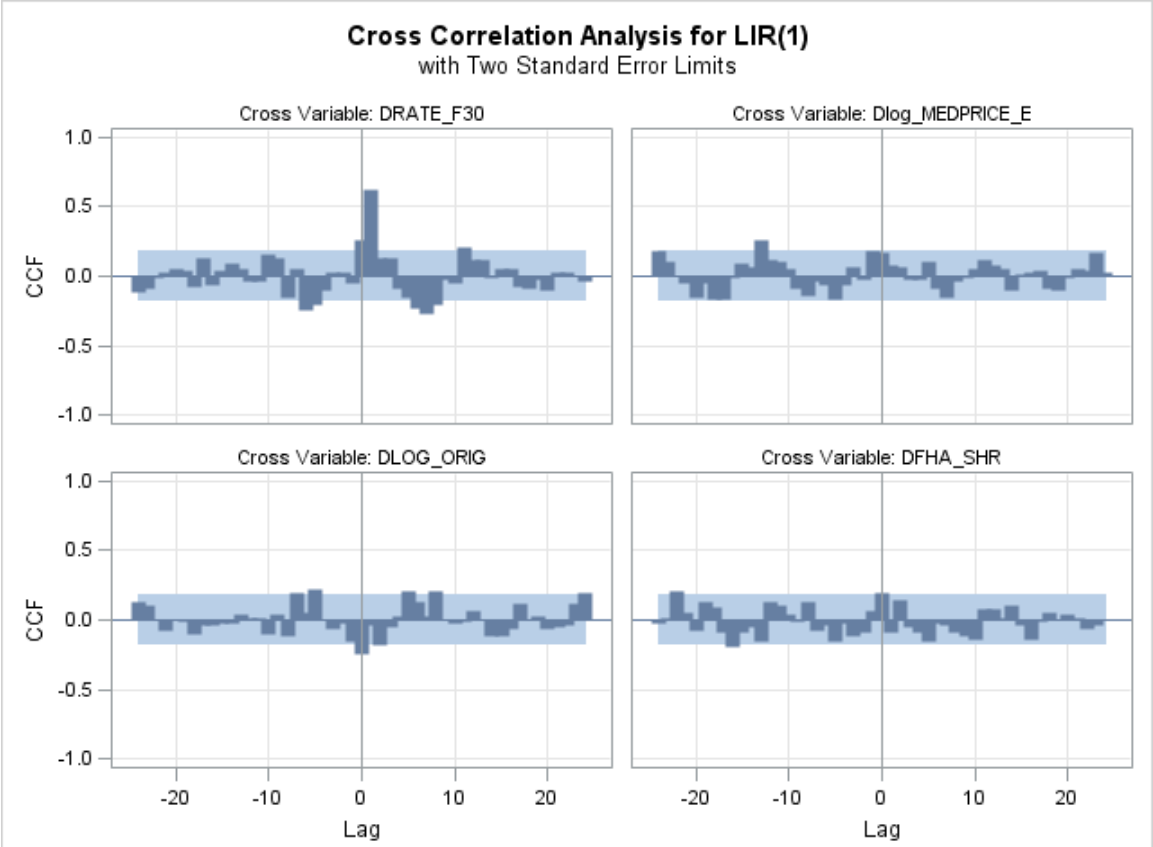


Appendix D

Low-Income Borrower Refinance Goal


Trend and Correlation Analysis for LIR(1)
LIR(1)
Observation
ACF
Lag
PACF
Lag
IACF
Lag


Cross Correlation Analysis for LIR(1)
with Two Standard Error Limits
Cross Variable: DUNEMP
Cross Variable: D1_LOG_CPI
Cross Variable: DCONS_CONF
Cross Variable: DTREAS_10_LAG1
CCF
Lag


Cross Correlation Analysis for LIR(1)
with Two Standard Error Limits
Cross Variable: DRATE_F30
Cross Variable: Dlog_MEDPRICE_E
Cross Variable: DLOG_ORIG
Cross Variable: DFHA_SHR
CCF
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0.5
0.0
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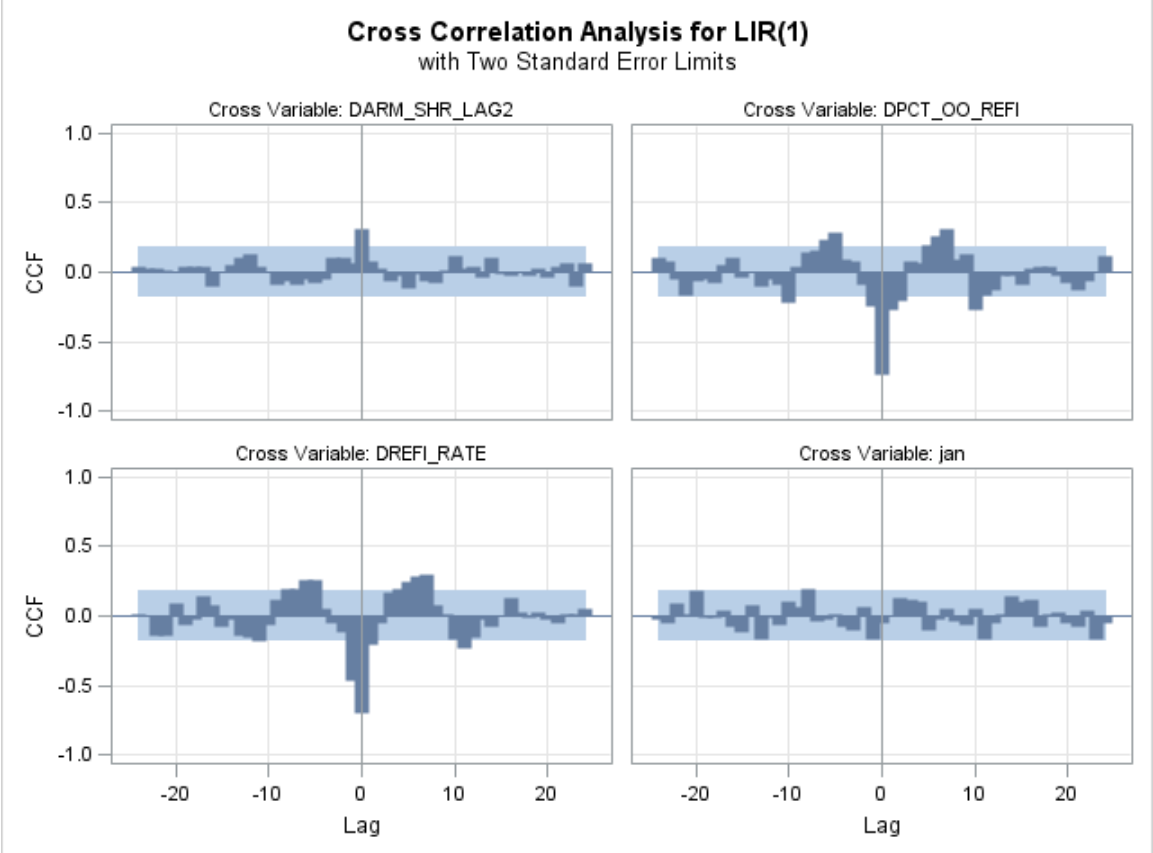
-1.0
-20
-10
0
10
20
Lag


Cross Correlation Analysis for LIR(1)
with Two Standard Error Limits
Cross Variable: DARM_SHR_LAG2
Cross Variable: DPCT_OO_REFI
Cross Variable: DREFI_RATE
Cross Variable: jan
CCF
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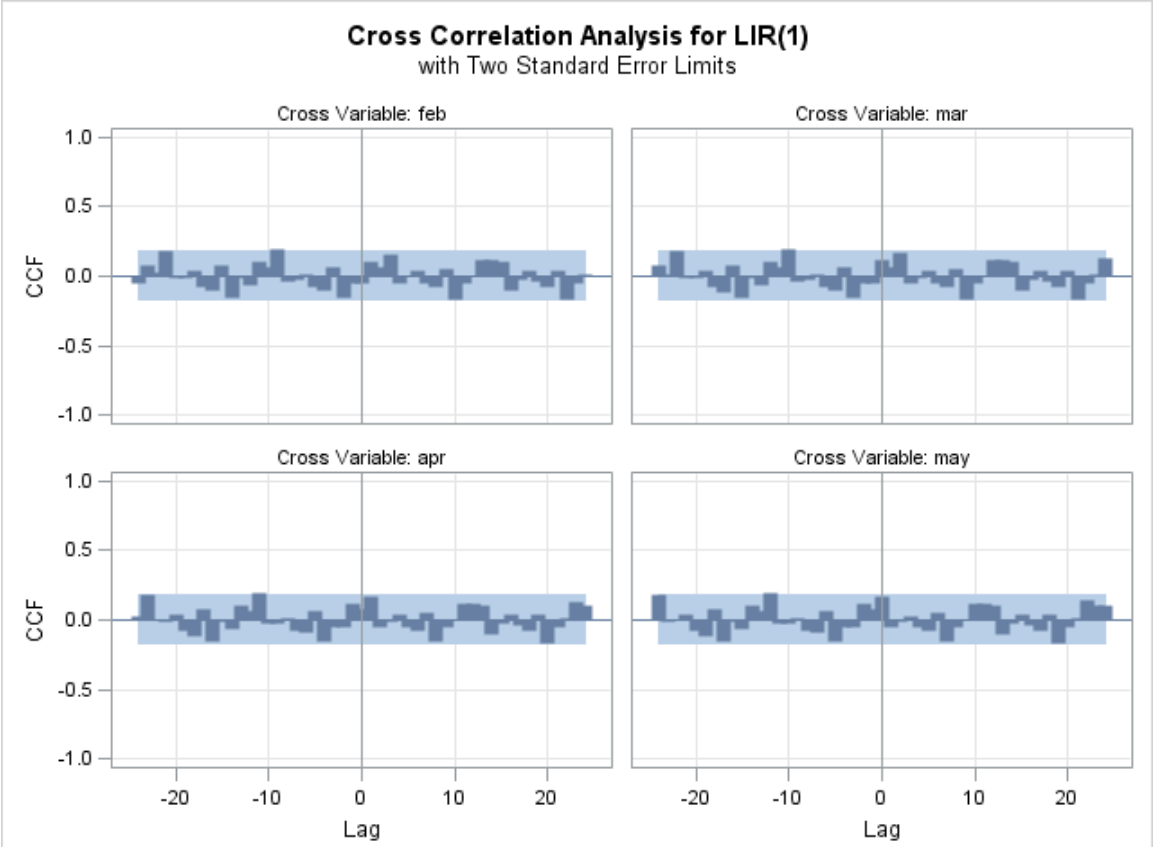
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag


Cross Correlation Analysis for LIR(1)
with Two Standard Error Limits
Cross Variable: feb
Cross Variable: mar
Cross Variable: apr
Cross Variable: may
CCF
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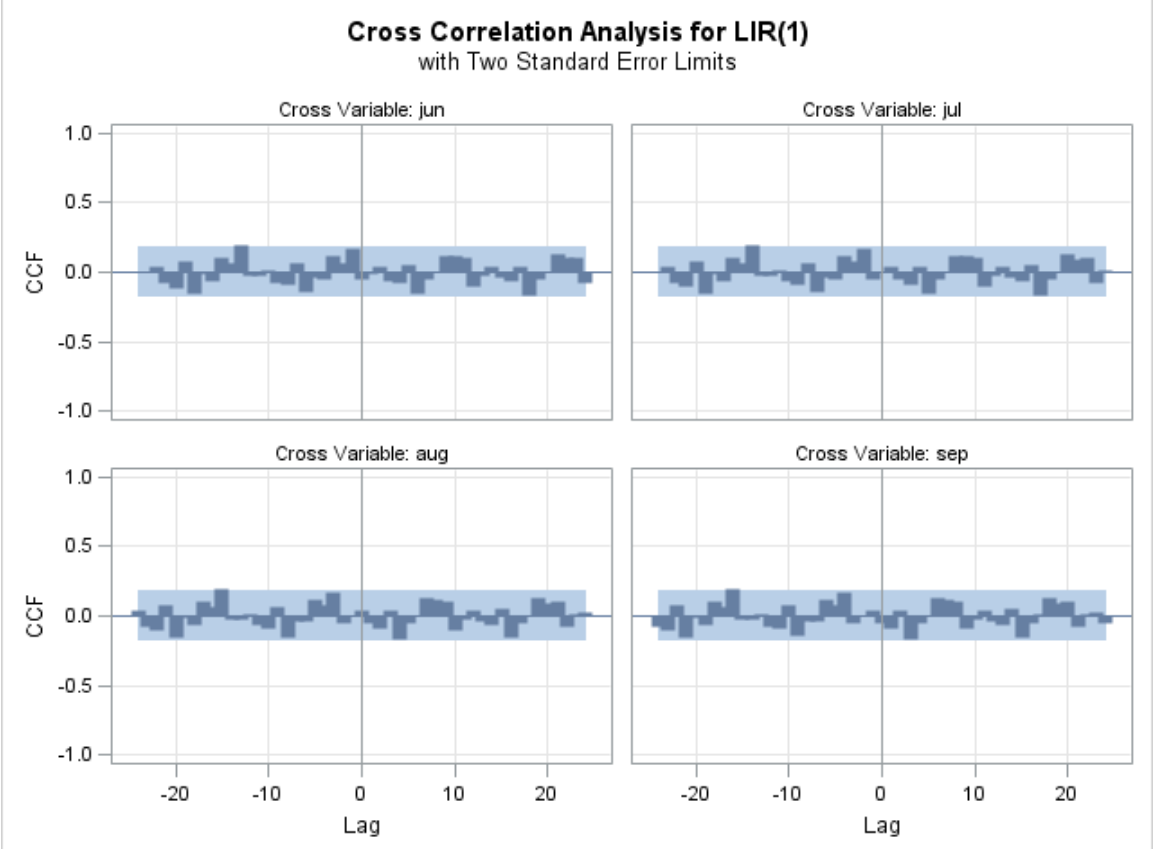
-1.0
-20
-10
0
10
20
Lag


Cross Correlation Analysis for LIR(1)
with Two Standard Error Limits
Cross Variable: jun
Cross Variable: jul
Cross Variable: aug
Cross Variable: sep
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-1.0
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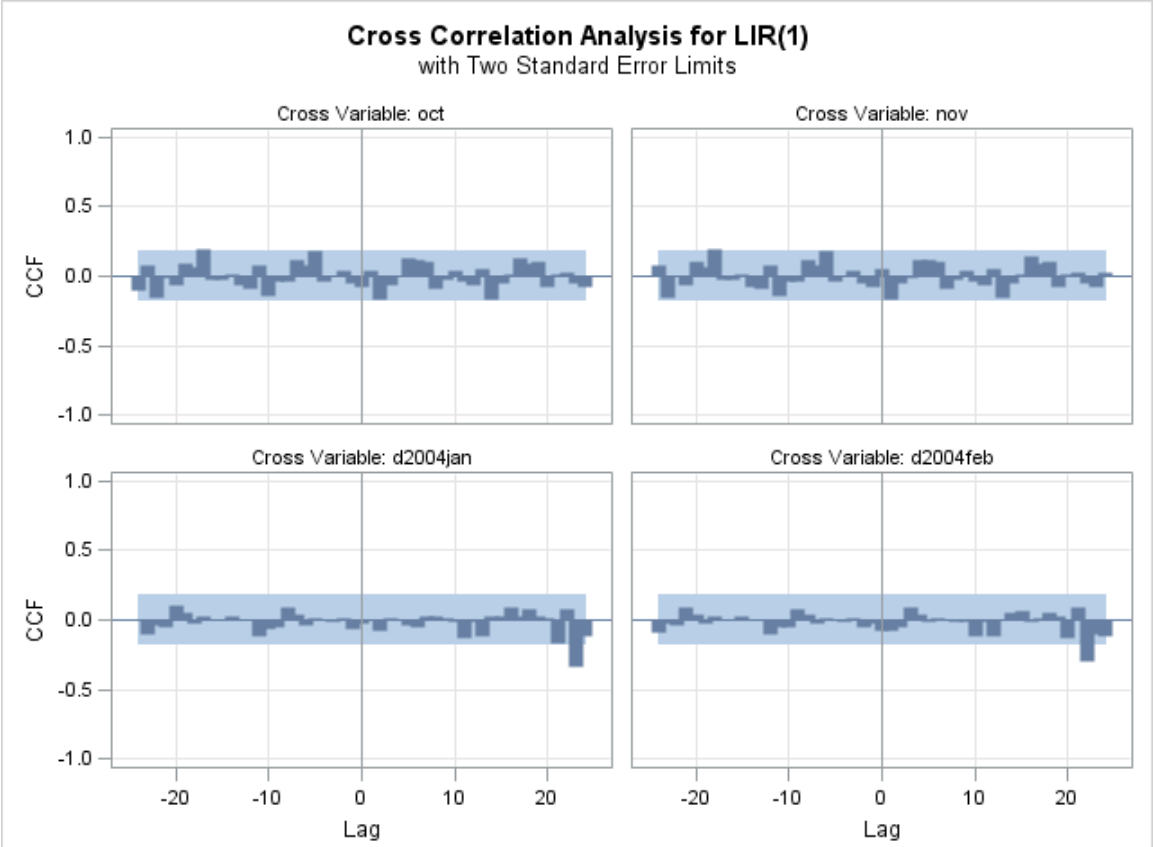
-10
0
10
20
Lag


Cross Correlation Analysis for LIR(1)
with Two Standard Error Limits
Cross Variable: oct
Cross Variable: nov
Cross Variable: d2004jan
Cross Variable: d2004feb
CCF
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-1.0
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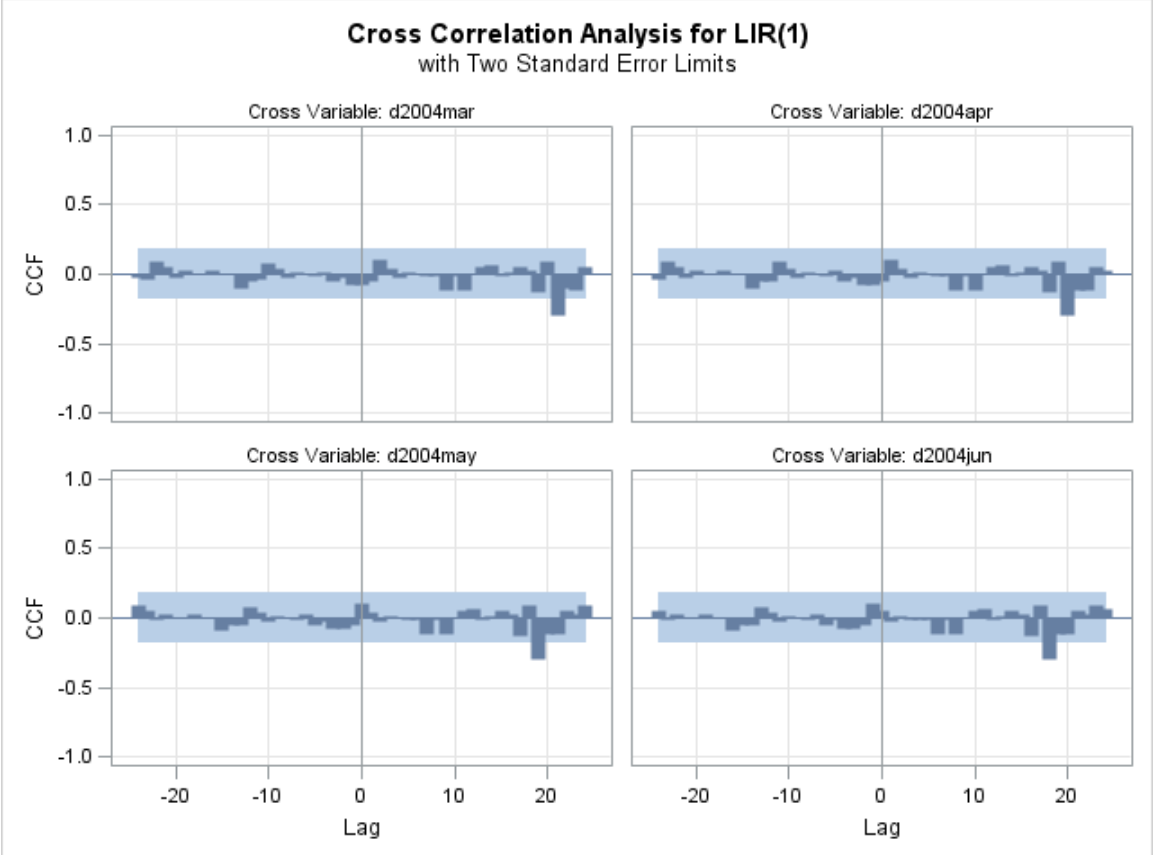
-10
0
10
20
Lag


Cross Correlation Analysis for LIR(1)
with Two Standard Error Limits
Cross Variable: d2004mar
Cross Variable: d2004apr
Cross Variable: d2004may
Cross Variable: d2004jun
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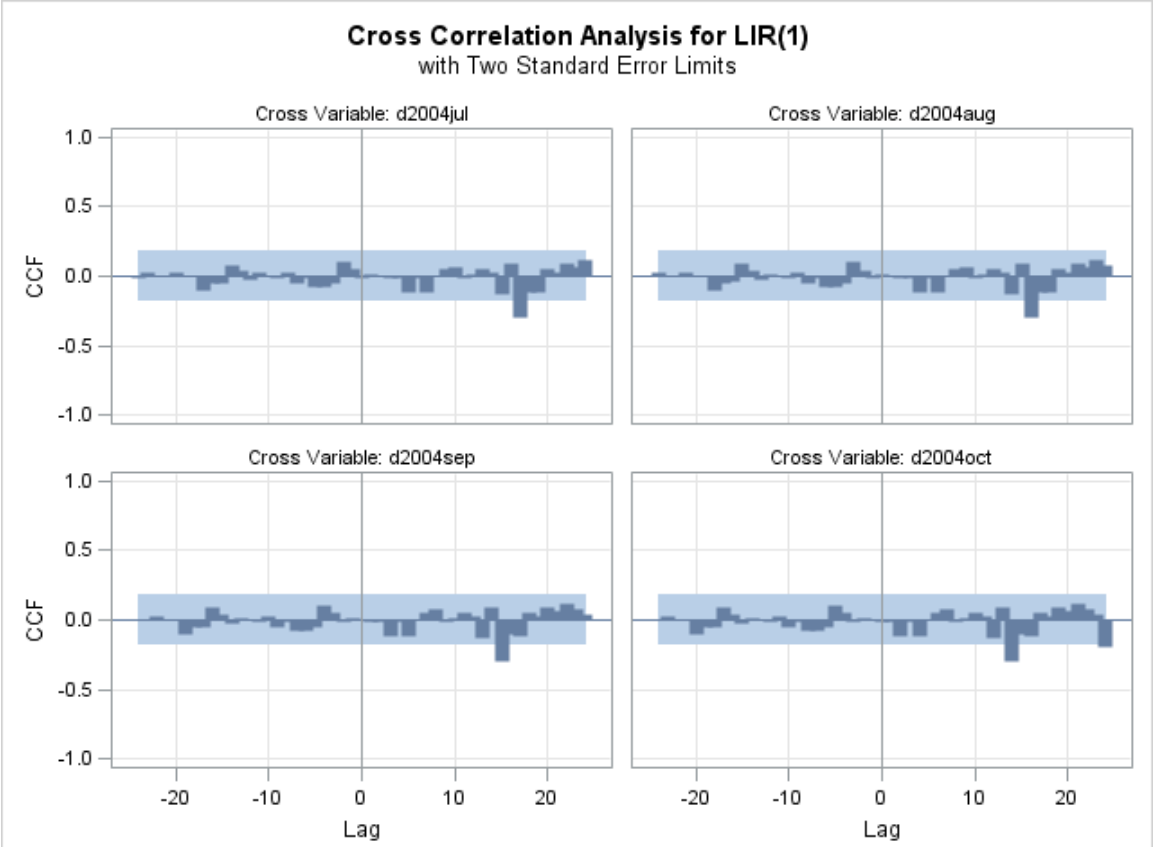
0
10
20
Lag


Cross Correlation Analysis for LIR(1)
with Two Standard Error Limits
Cross Variable: d2004jul
Cross Variable: d2004aug
Cross Variable: d2004sep
Cross Variable: d2004oct
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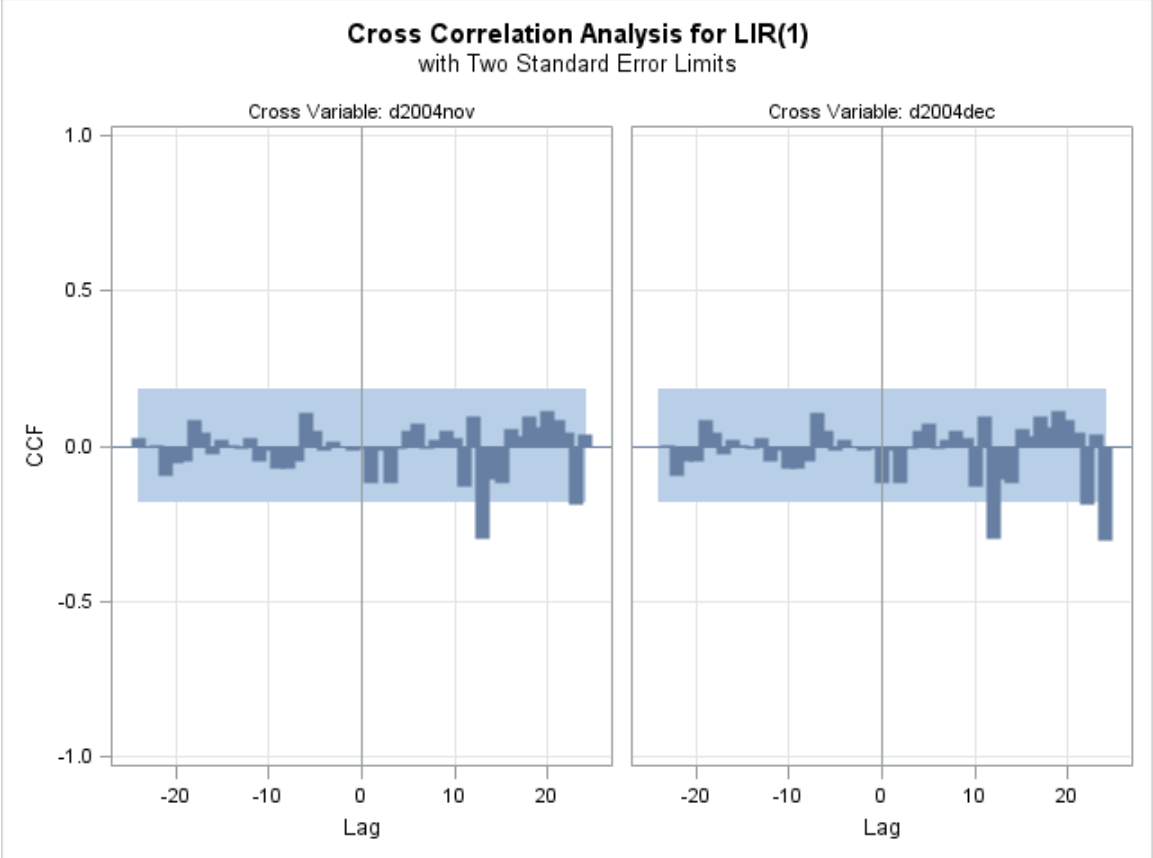
-1.0
-20
-10
0
10
20
Lag


Cross Correlation Analysis for LIR(1)
with Two Standard Error Limits
Cross Variable: d2004nov
Cross Variable: d2004dec
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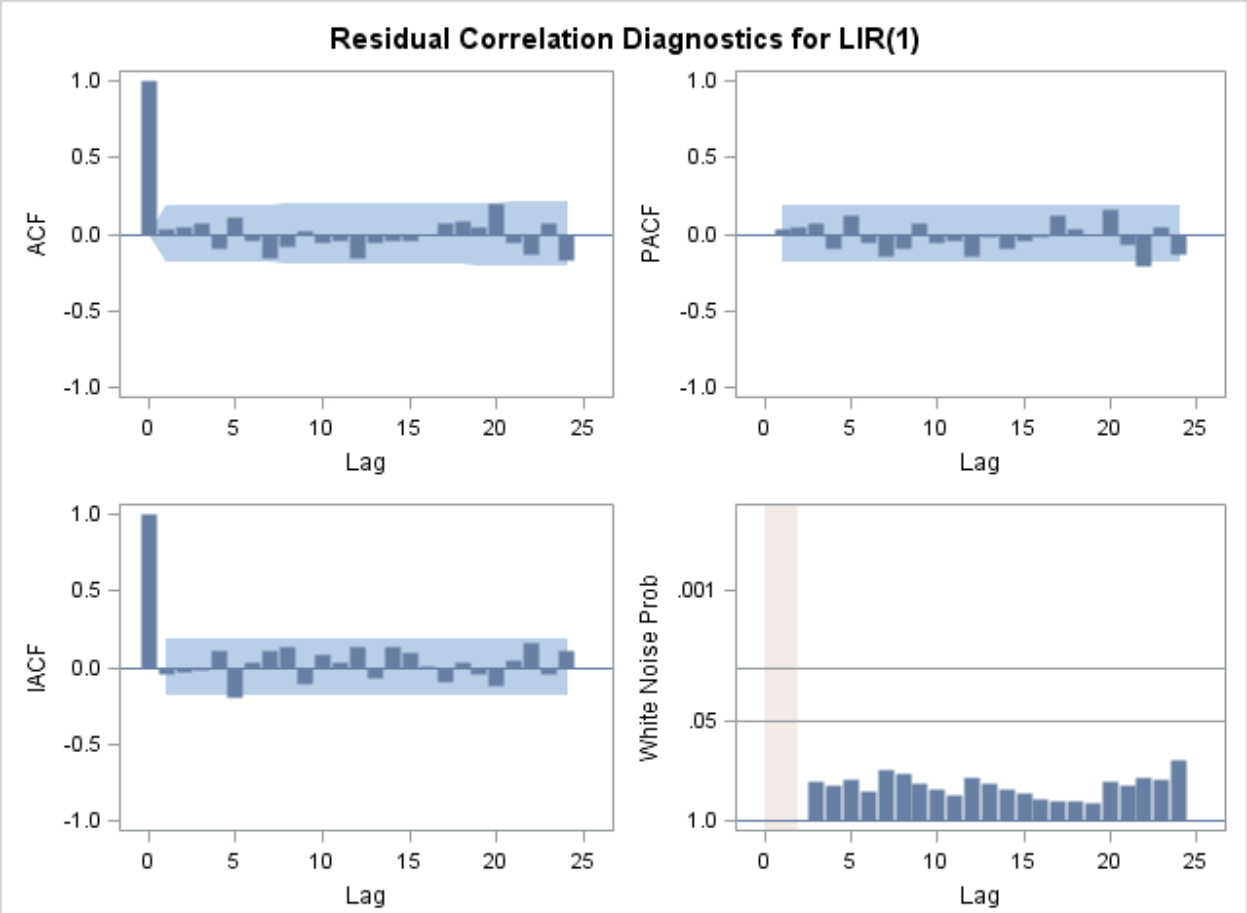
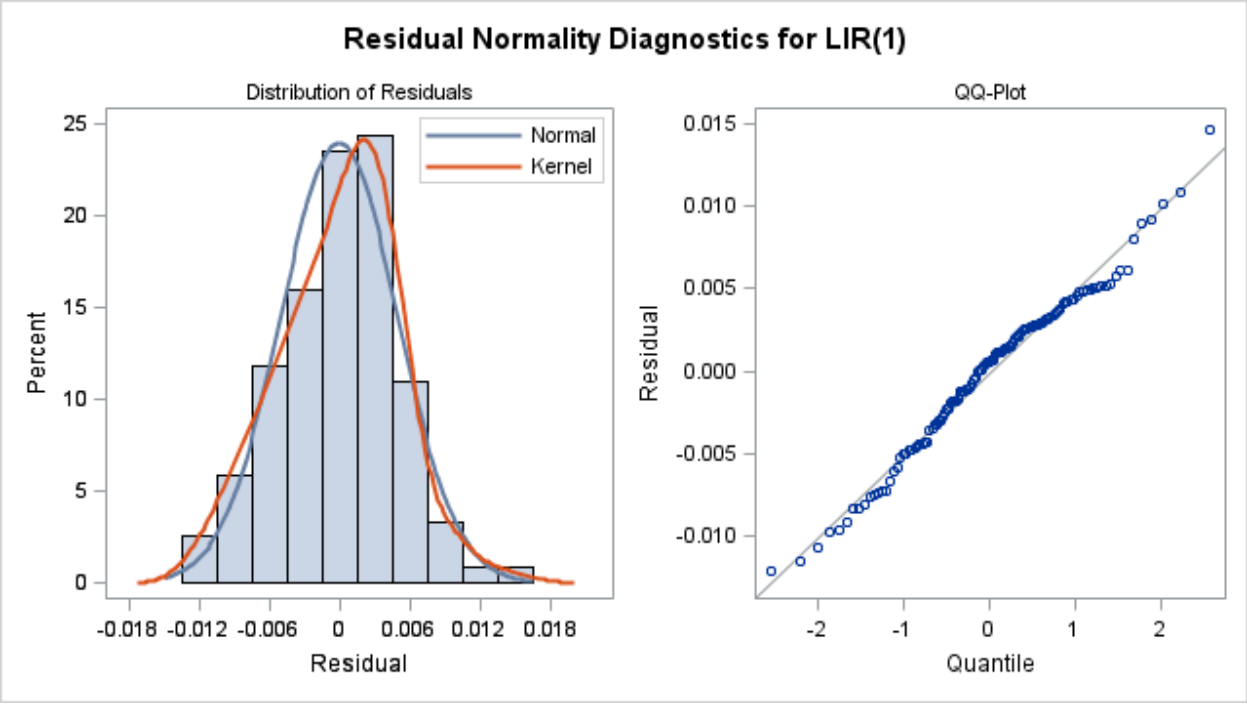
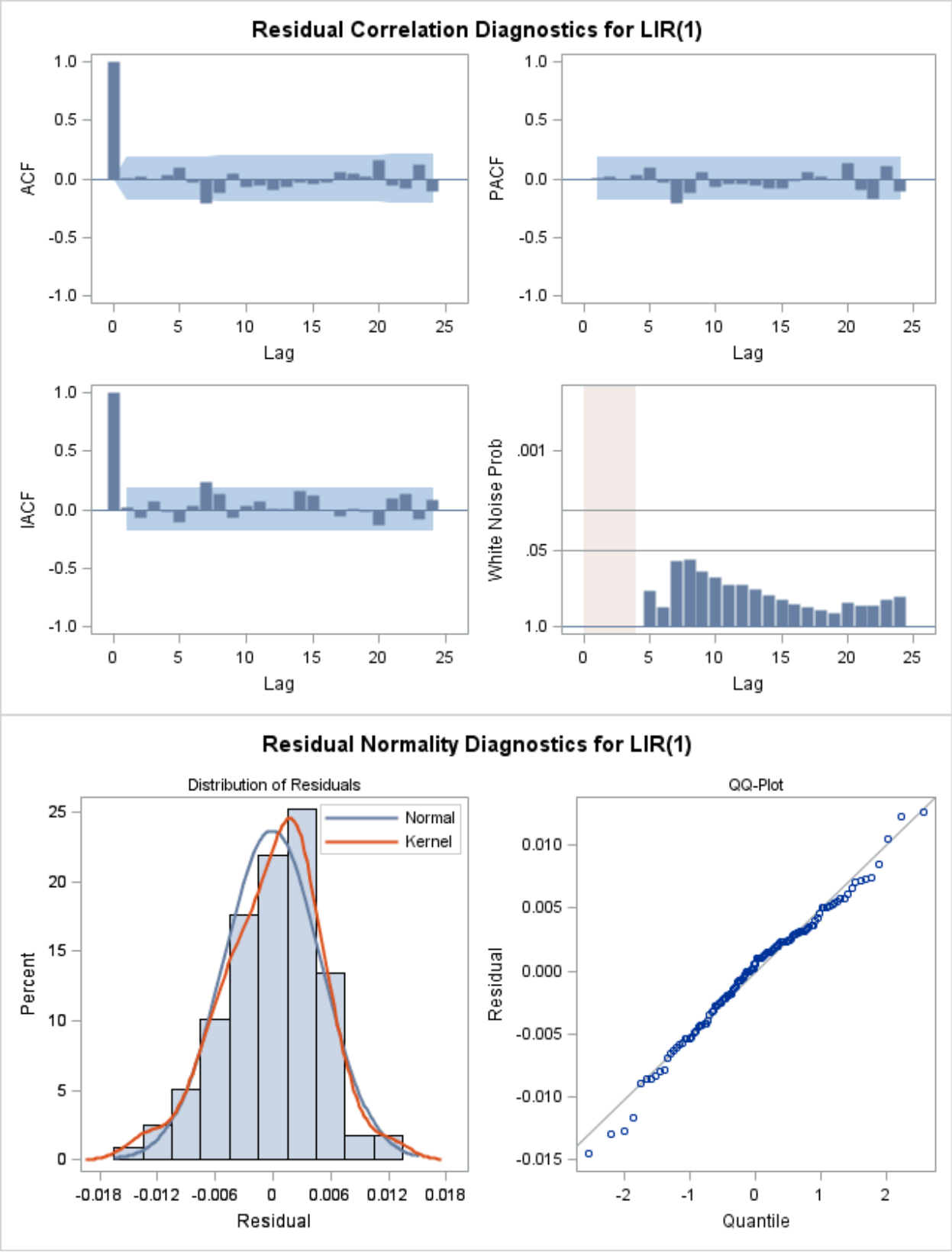
0.0
-0.5
-1.0
-20
-10
0
10
20
Lag

Full Model w/ 2004-07

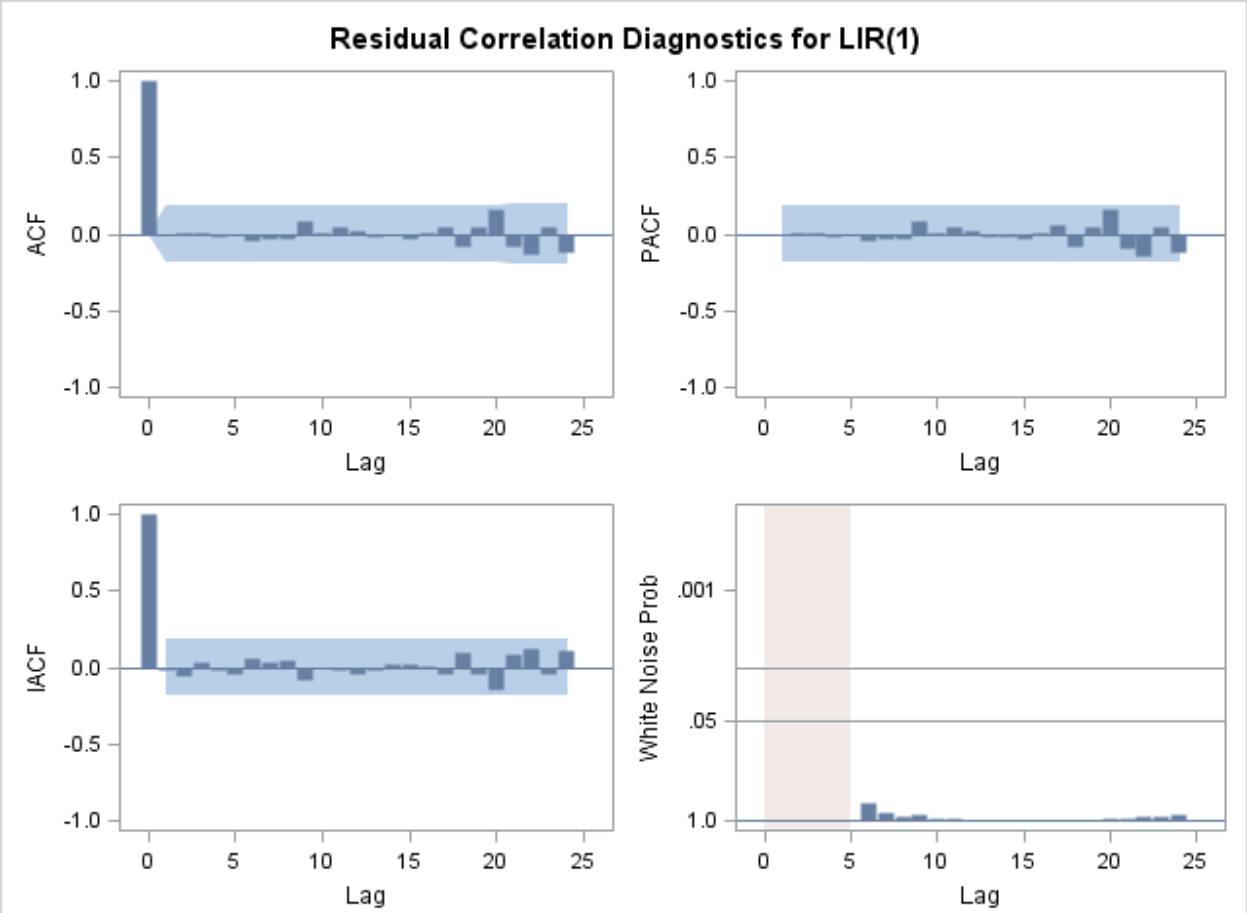




Best Fit w/ 2004-07



Full Model


Residual Correlation Diagnostics for LIR(1)
ACF
PACF
IACF
White Noise Prob
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0.0
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-1.0
0
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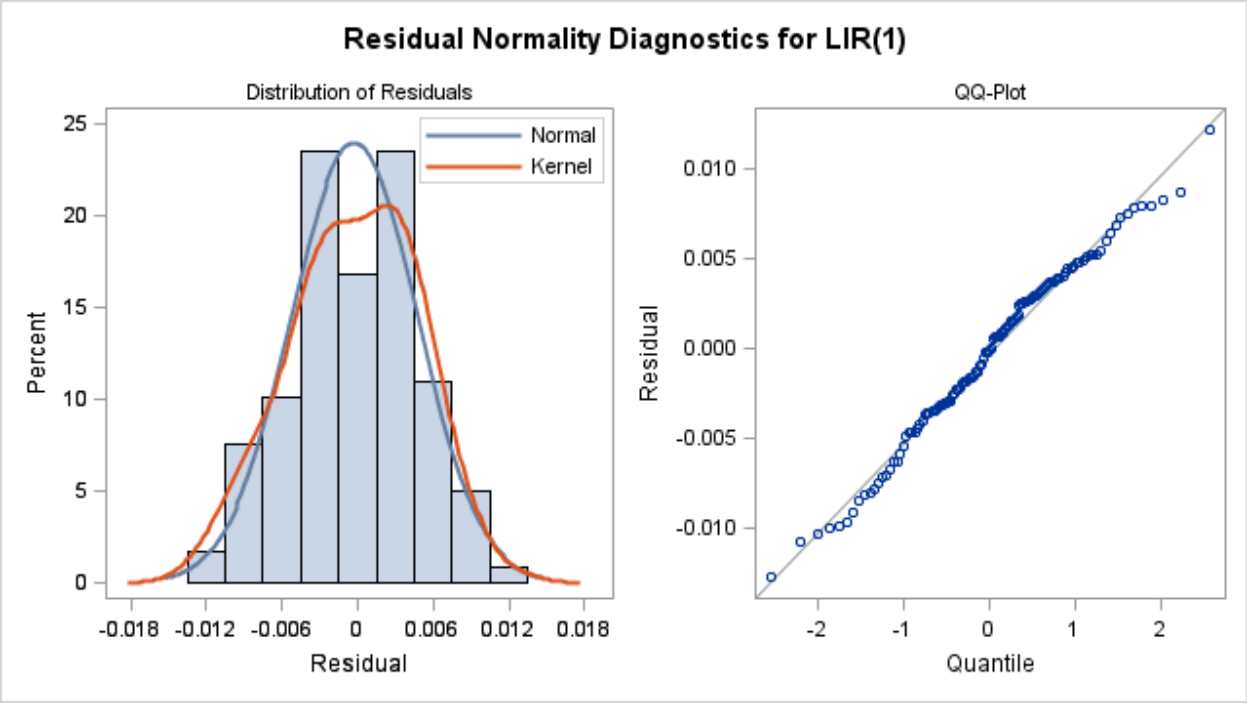
10
15
20
25
.001
.05
1.0


Residual Normality Diagnostics for LIR(1)
Distribution of Residuals
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Kernel
Percent
Residual
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-0.006
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0.006
0.012
0.018
QQ-Plot
Residual
Quantile
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0.005
0.000
-0.005
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-2
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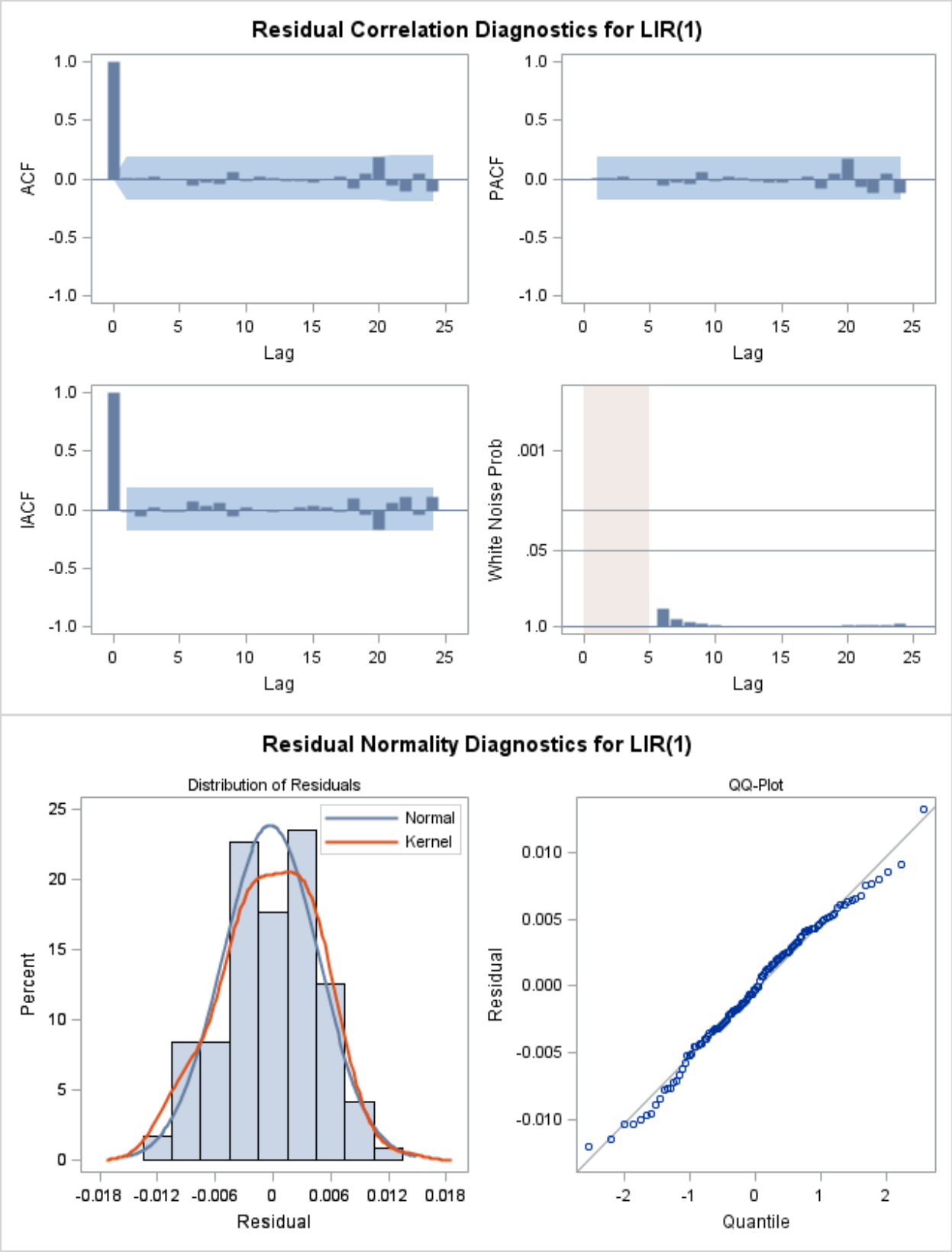
0
1
2

Best Fit Model



APPENDIX E

Alternative HMDA Data Specifications

The model that is used in setting the benchmark levels for the goals uses HMDA data starting in 2004 as the source for historical market statistics. FHFA's forecasts for 2015-2017 do not use HMDA data prior to 2004 for several reasons. Data sources prior to 2004 are not available for explanatory variables that were found to be predictive in one or more of the models. Pre-2004 HMDA data did not identify property type, lien status, Home Ownership Equity Protection Act (HOEPA) status, and the Average Prime Offer Rate (APOR) rate spread. Pre-2004 HMDA data were also less precise in identifying manufactured housing loans and subprime loans. All of these differences make it difficult to use pre-2004 data to forecast goal-qualifying shares for 2015-2017.

FHFA did test model specifications that included monthly data going further back to January 1996, and this appendix includes a detailed description of that analysis. The results using pre-2004 data may be less reliable because either the confidence intervals are wider using the 1996-2013 data (as in the case of the single-family, low-income borrower home purchase goal and low-income areas subgoal), or the predicted trends do not coincide with what we have observed in recent months (in the case of the single-family, very low-income home purchase and low-income refinance goals) and the predicted trends resulting from the models using the shorter 2004-2013 time series are preferable.

In 2004 the Federal Financial Institutions Examination Council (FFIEC) implemented a major change to HMDA data. Among the changes to the reporting requirements were the identification of manufactured housing loans, HOEPA identified loans, subordinate lien loans, and no lien loans. In addition, when the Annual Percentage Rate (APR) of a mortgage is greater

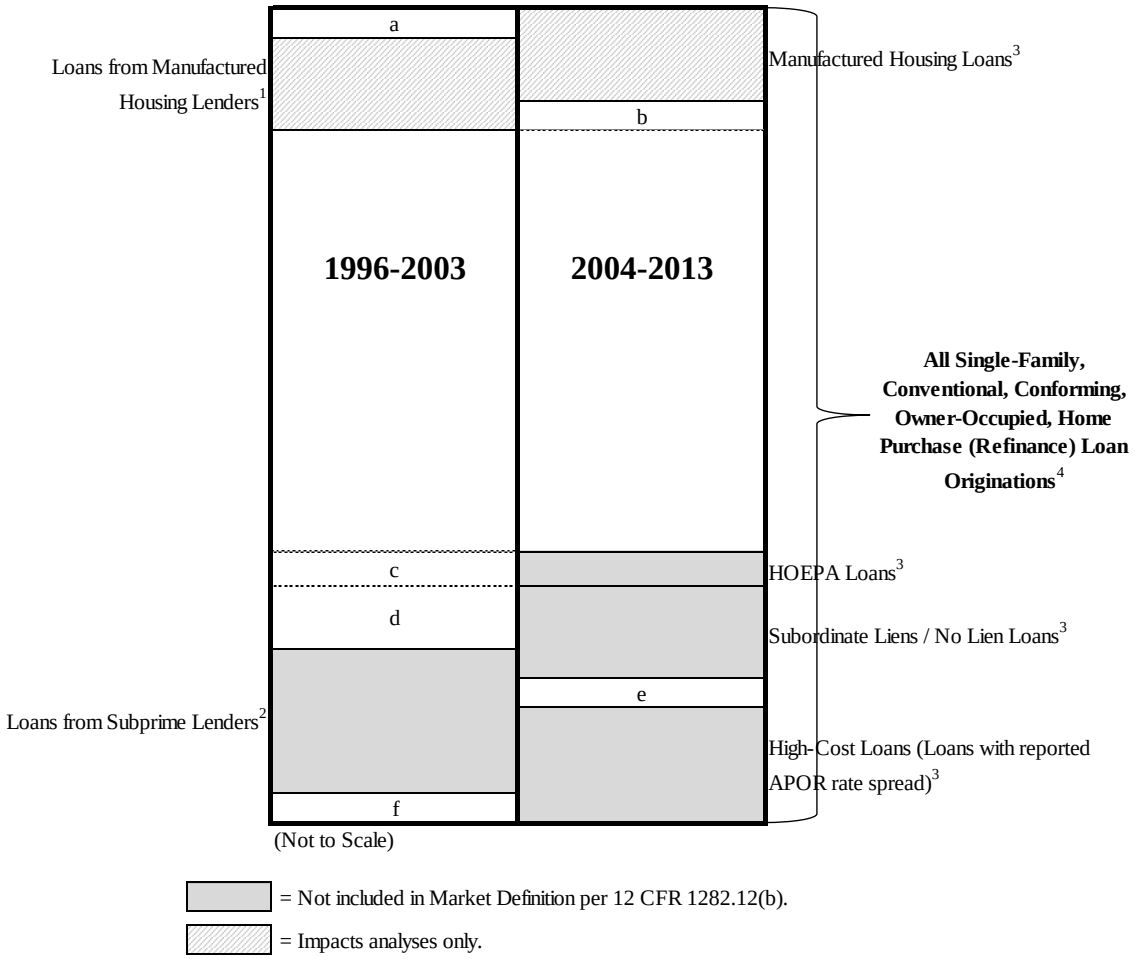
than 300 basis points over the corresponding Treasury note rate, the spread between that APR and the note rate must be reported in the HMDA data (this was later amended to apply when the APR is greater than 150 basis points over the APOR for the week in which the mortgage rate was determined). The changes in HMDA data attributes are shown in **Figure E.1**.

Prior to 2004, subprime loans were identified based on the lender that originated the loan. The Department of Housing and Urban Development (HUD) maintained a list of "Subprime Lenders." Three issues materialized from this method: not all loans from lenders on the "Subprime Lender" list were subprime loans; not all subprime loans were originated by these lenders; and the possibility of miscategorization of lenders on the list. HOEPA, subordinate lien, and no lien loans were not identified in any form prior to 2004.

Now that there are 10 years of this expanded HMDA data, FHFA has decided to base the mortgage affordability share forecasts on it, instead of the longer time series configured on a less

Figure E.1

HMDA Data Used to Define the Market for the Single-Family Housing Goals



a. Not all mfg. housing loans are originated by lenders on the "Mfg. Housing" List.
b. Not all loans from lenders on the "Mfg. Housing" List are mfg. housing loans.
c. HOEPA loans are goal accretive, but are not eligible for goal credit. (HOEPA loans that were originated by "subprime" lenders would have been removed as a result of that.)
d. Subordinate/no lien loans are goals accretive.
e. Some loans from lenders on the "Subprime" List are prime loans and included.
f. Not all high-cost loans are originated by lenders on the "Subprime" List. High-cost is thought to be a better indicator of subprime than the "Subprime" list.
(e and f are not equivalent in scale, nor composition.)

---

[1] Based on annual List of "Manufactured Housing" Lenders, as developed by HUD, 1996-2004 (may erroneously identify some non-mfg. housing loans as mfg. housing).

[2] Based on annual List of "Subprime" Lenders, as developed by HUD, 1996-2004 (may erroneously identify some prime loans as subprime).

[3] Not identified in 1996-2003 HMDA data.

[4] Where borrower incomes and geography information are not missing.

precise definition. In this appendix, forecast models based on the longer (1996-2013) time series and the less precise definition of the market are explored. As in **Section D**, four models are presented for each housing goal. The **Full Model** includes all possible explanatory variables, whether they have a significant impact or not. For explanatory variable categories where there are several variables to choose from (e.g., the category of volume includes home sales, housing starts and mortgage originations), at least one variable will be included in the model specification and all variables with a significant impact will be included. In addition to all possible explanatory variables, the **Full Model w/2004-07** includes a set of monthly binary variables for the years 2004 through 2007 to capture time specific effects of the mortgage boom period. The **Best Fit Model** includes explanatory variables that provide the best fit specification, as determined by significance of the variable, low model variance, minimizing white noise, and model goodness of fit.[21] The **Best Fit Model w/2004-07** is the best fit specification when the 2004 through 2007 binary monthly variables are included. In addition, for reference, the best fit model chosen in **Section D** is included as the final column in each table.

Low-Income Borrower Home Purchase Goal. **Table E.1** shows the four model specifications analyzed for the Low-Income Borrower Home Purchase Goal (LIP). The **Best Fit Model** is determined to provide the best model for forecasting this goal. The AIC statistic for this specification is lowest, indicating it has the best goodness of fit. The Best Fit Model w/2004-2007 specification does better in reducing white noise, as determined by the Chi Square statistic. The number of observations is almost doubled when using the extended data series, from 119 to 215, and the AIC statistic is much improved, while the model used to forecast market

[21] In the following tables, white noise is minimized when the probability of a larger Chi Square statistic (i.e., $P(>\chi^2)$) is highest. A better goodness of fit is determined by the lowest (most negative) Akaike Information Criterion (AIC) statistic.

Table E.1

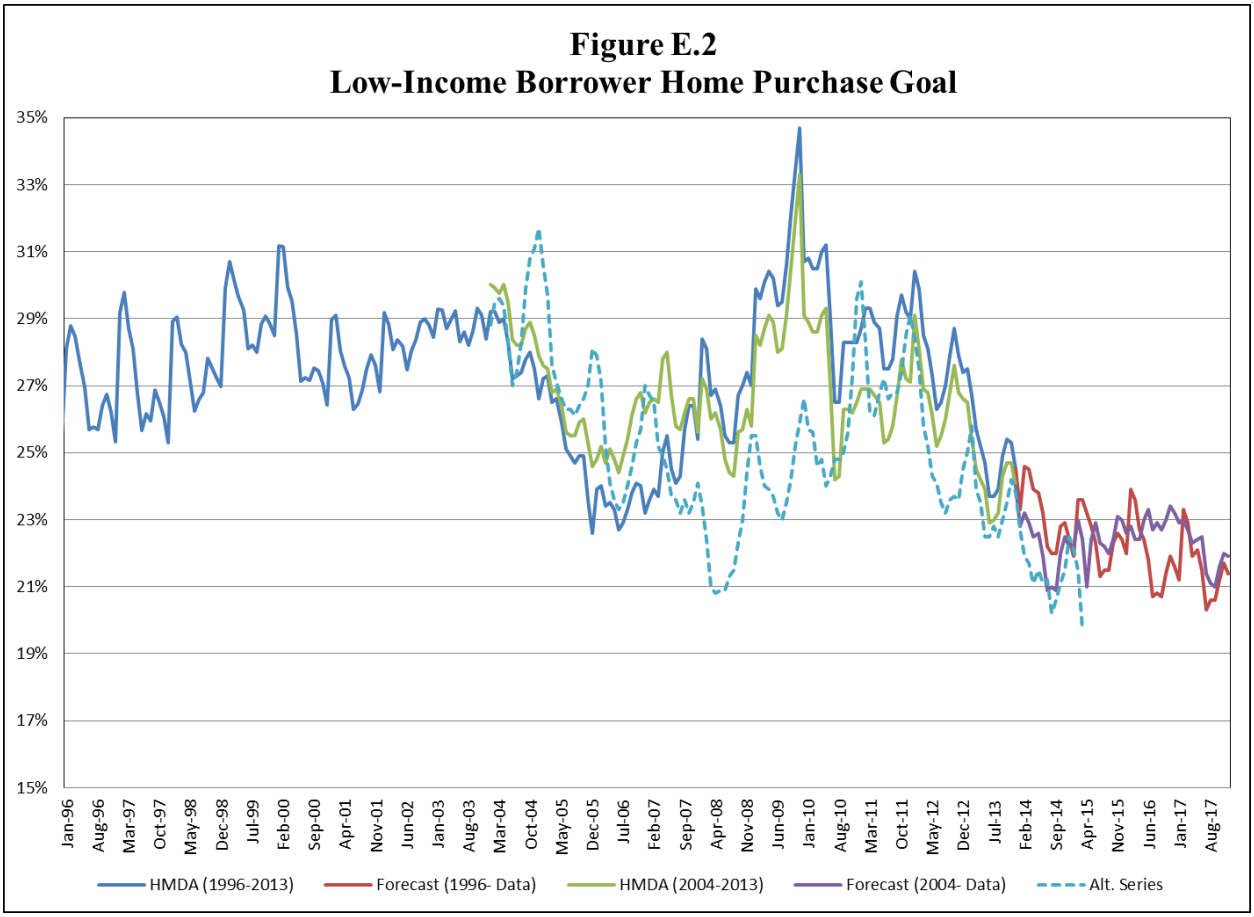
Low-Income Borrower Home Purchase Goal

		Full Model w/ 2004-07	Best Fit w/ 2004-07	Full Model	Best Fit Model	New HMDA Def. Model
	AR(1)	0.132 *	0.127 *	0.099	0.098	-0.169
		(0.076)	(0.076)	(0.074)	(0.073)	(0.105)
	AR(2)		-0.021	0.003	-0.007	0.256 **
			(0.076)	(0.074)	(0.072)	(0.108)
	AR(3)		-0.071	-0.164 **	-0.157 **	-0.021
			(0.076)	(0.075)	(0.072)	(0.108)
	AR(4)		-0.098			-0.231 **
			(0.077)			(0.105)
	AR(5)		0.062			
			(0.076)			
	AR(6)		0.141 *			
			(0.076)			
	Unemplment Rate$_{t-1}$	0.584 **	0.539 **	0.607 **	0.717 ***	0.464 *
		(0.254)	(0.249)	(0.243)	(0.231)	(0.264)
	Ln(Core CPI$_{M/M}$)			0.836 **	0.815 **	
				(0.389)	(0.383)	
	Ln(Core CPI$_{Y/Y}$)	-0.212 ***	-0.208 ***	-0.202 ***	-0.199 ***	-0.146 **
		(0.059)	(0.060)	(0.050)	(0.049)	(0.060)
Interest Rates	10-Year Treas. Yield$_{t-1}$	-0.212		-0.007		-0.628 **
		(0.180)		(0.200)		(0.253)
	30-Year Fixed Mort. Rate					-0.646 **
						(0.295)
	Rate Spread	-0.205		-0.438		
		(0.361)		(0.353)		
House Prices	Ln(Med. Price, Exist. Homes)					-0.177 ***
						(0.047)
	Ln(HPI)$_{t-1}$	0.111				0.125 *
		(0.078)				(0.071)
	Ln(HAI)			0.026	0.035 *	-0.068 *
				(0.024)	(0.020)	(0.040)
Volume	Ln(Home Sales)	0.020		0.027 **	0.027 **	0.042 ***
		(0.013)		(0.013)	(0.013)	(0.014)
	Ln(Housing Starts)					0.011 **
						(0.006)
	Ln(Mortgage Originations)		0.005 *			
			(0.003)			
	FHA Share	0.107 **	0.101 **	0.044		
		(0.049)	(0.045)	(0.046)		
	ARM Share$_{t-3}$	0.005	0.000 ***	-0.008		-0.095 ***
		(0.018)	(0.000)	(0.017)		(0.032)
	Owner-Occupied Share	0.311 ***	0.324 ***	0.368 ***	0.406 ***	0.570 ***
		(0.112)	(0.098)	(0.108)	(0.095)	(0.105)
	---------- Monthly Binary Variables ----------					
	[2004-2007 Monthly Binary Variables]					
	σ^2	0.000029	0.000028	0.000029	0.000029	0.000021
		(0.005354)	(0.005300)	(0.005407)	(0.005379)	(0.004596)
	χ^2	25.890	13.080	17.880	18.470	3.640
	P(>χ^2)	0.007	0.042	0.037	0.030	0.888
	AIC	-1607.740	-1611.870	-1610.980	-1617.600	-920.310
	Number of Observations	215	215	215	215	119
	95% Confidence Interval (2017)	+/- 7.8%	+/- 7.7%	+/- 6.6%	+/- 6.5%	+/- 5.2%

Standard Errors are reported in parantheses.
* indicates significance at the 90% level.
** indicates significance at the 95% level.
*** indicates significance at the 99% level.

performance for the LIP goal does better at reducing white noise and has narrower confidence intervals.

As can be seen in **Figure E.2**, the two data series track each other closely and the forecasts are similar. The forecast based on the extended time series does pick up the seasonality characteristics evident in the pre-2000 data.



Very Low-Income Borrower Home Purchase Goal. **Table E.2** shows the four model specifications analyzed for the Very Low-Income Borrower Home Purchase Goal (VLIP).

Table E.2

Very Low-Income Borrower Home Purchase Goal

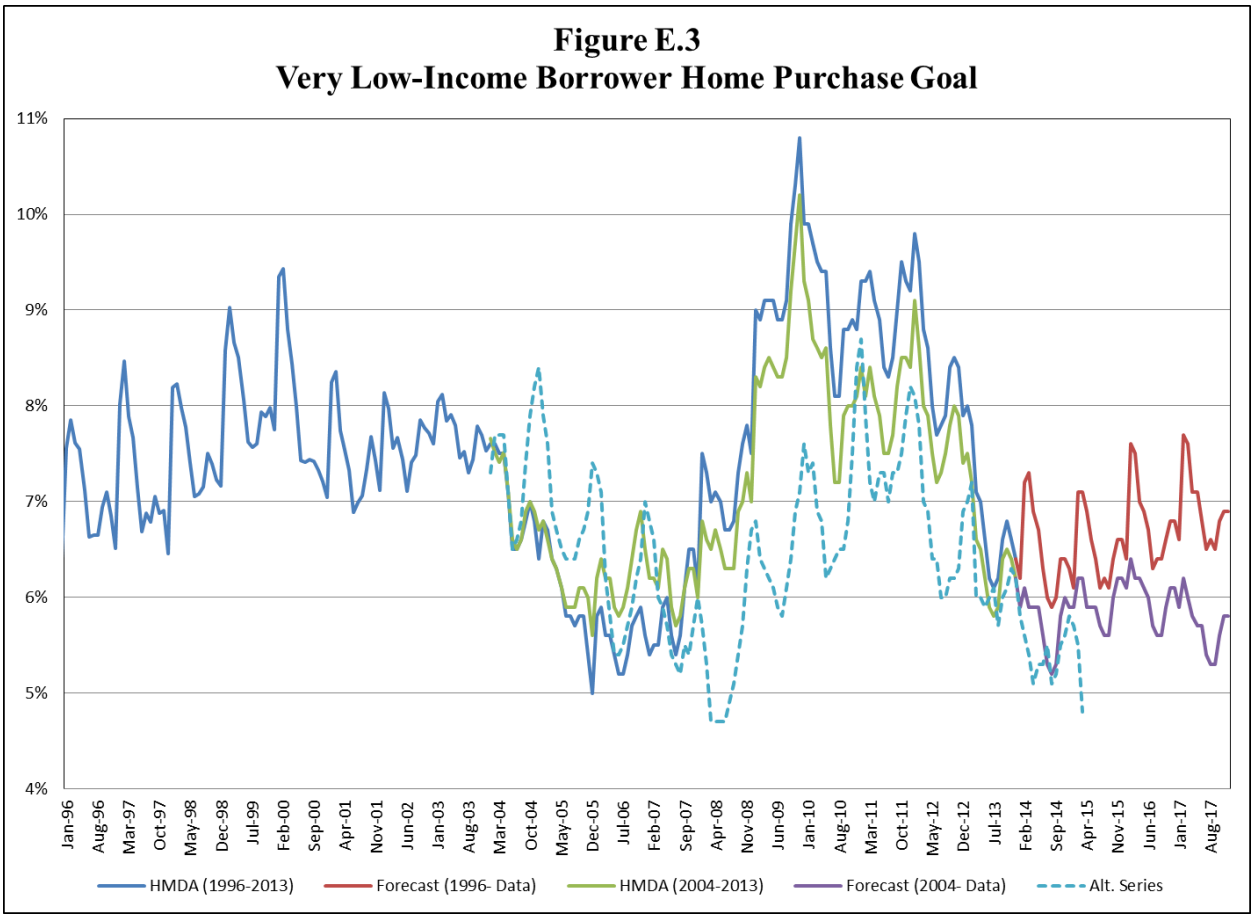
		Full Model w/ 2004-07	Best Fit w/ 2004-07	Full Model	Best Fit Model	New HMDA Def. Model
	AR(1)	0.181 **	0.188 **	0.141 *	0.147 **	-0.001
		(0.077)	(0.076)	(0.072)	(0.071)	(0.101)
	AR(2)	-0.021	-0.010	-0.015	-0.039	0.305 ***
		(0.077)	(0.077)	(0.073)	(0.072)	(0.100)
	AR(3)	-0.189 **	-0.191 **	-0.226 ***	-0.244 ***	
		(0.076)	(0.077)	(0.073)	(0.072)	
	AR(4)		-0.052			
			(0.078)			
	AR(5)		0.062			
			(0.077)			
	AR(6)		0.128 *			
			(0.076)			
	Unemplment Rate$_{t-1}$	0.225 **	0.249 **	0.265 **	0.289 ***	0.283 **
		(0.101)	(0.100)	(0.105)	(0.099)	(0.125)
	Ln(Core CPI$_{M/M}$)	0.377 **	0.389 **	0.453 ***	0.482 ***	
		(0.173)	(0.174)	(0.169)	(0.162)	
	Ln(Core CPI$_{Y/Y}$)	-0.079 ***	-0.076 ***	-0.079 ***	-0.074 ***	-0.106 ***
		(0.024)	(0.026)	(0.022)	(0.021)	(0.030)
	Consumer Confidence$_{t-3}$	0.000 *		0.000 **		
		(0.000)		(0.000)		
Interest Rates	10-Year Treas. Yield					-0.238 ***
						(0.083)
	10-Year Treas. Yield$_{t-1}$			-0.034		
				(0.078)		
	10-Year Treas. Yield$_{t-2}$	-0.096				
		(0.073)				
	30-Year Fixed Mort. Rate	-0.086		0.000 ***		
		(0.089)		(0.000)		
	Rate Spread			-0.119		
				(0.149)		
House Prices	Ln(Med. Price, Exist. Homes)					-0.034 ***
						(0.012)
	Ln(HPI)$_{t-1}$	-0.056 *	-0.072 **	-0.075 **	-0.063 **	
		(0.032)	(0.032)	(0.032)	(0.029)	
	Ln(HAI)$_{t-1}$				0.017 **	
					(0.009)	
Volume	Ln(Home Sales)	0.009	0.011 **	0.012 **	0.015 ***	0.027 ***
		(0.006)	(0.005)	(0.006)	(0.005)	(0.005)
	Ln(Mortgage Originations)$_{t-2}$					-0.003 *
						(0.002)
	FHA Share	0.012		-0.007		
		(0.021)		(0.021)		
	ARM Share$_{t-3}$	-0.003		-0.002		
		(0.007)		(0.007)		
	Owner-Occupied Share	0.028		0.063		
		(0.047)		(0.047)		
	----------	----------	---------- Monthly Binary Variables ----------		----------	----------
		[2004-2007 Monthly Binary Variables]				
	σ^2	0.000005	0.000005	0.000006	0.000006	0.000004
		(0.002253)	(0.002250)	(0.002368)	(0.002352)	(0.002016)
	χ^2	18.040	17.100	19.640	24.830	21.160
	P(>χ^2)	0.035	0.009	0.020	0.003	0.020
	AIC	-1977.370	-1980.140	-1965.840	-1973.190	-1122.010
	Number of Observations	215	215	215	215	119
	95% Confidence Interval (2017)	+/- 2.9%	+/- 3.4%	+/- 2.9%	+/- 2.8%	+/- 3.8%

Standard Errors are reported in parantheses.
* indicates significance at the 90% level.
** indicates significance at the 95% level.
*** indicates significance at the 99% level.

The Best Fit Model w/2004-2007 Monthly Binary Variables is determined to provide the best model for forecasting this goal. The AIC statistic for this specification is lowest, indicating it has the best goodness of fit. The Full Model w/2004-2007 specification does better in reducing white noise, as determined by the Chi Square statistic. The number of observations is almost doubled when using the extended data series, from 119 to 215, the AIC statistic is much improved, while the full models and the model used to forecast market performance for the VLIP goal do better at reducing white noise. The confidence interval is slightly smaller than the interval produced by the model used for the forecast.

As can be seen in **Figure E.3**, the two data series track each other closely. The forecast based on the extended time series has a distinct positive slope, while the forecast based on the new HMDA specification is flatter. As with the LIP series, the forecast from the extended series picks up the seasonality characteristics evident in the pre-2000 data.

Figure E.3
Very Low-Income Borrower Home Purchase Goal



Low-Income Areas Home Purchase Subgoal. **Table E.3** shows the four model specifications analyzed for the Low-Income Areas Home Purchase Subgoal (LAP). The **Best Fit Model** is determined to provide the best model for forecasting this goal. The AIC statistic for this specification is lowest, indicating it has the best goodness of fit. This model specification does as well as the other models when it comes to reducing white noise, as determined by the Chi Square statistic. The number of observations is almost doubled when using the extended data series, from 117 to 215, the AIC statistic is much improved, and this model does better at reducing white noise than the model used to forecast market performance

Table E.3

Low-Income Areas Home Purchase Subgoal

		Full Model w/ 2004-07	Best Fit w/ 2004-07	Full Model	Best Fit Model	New HMDA Def. Model
	AR(1)	-0.069	-0.072	-0.042	-0.075	-0.087
		(0.078)	(0.073)	(0.075)	(0.073)	(0.106)
	AR(2)			-0.100	-0.062	-0.226 **
				(0.075)	(0.073)	(0.108)
	AR(3)			0.079	0.118	0.191 *
				(0.075)	(0.074)	(0.116)
	AR(4)			-0.117		
				(0.075)		
	Unemplment Rate	-0.439 **		-0.335 **	-0.375 **	-0.491 **
		(0.175)		(0.170)	(0.169)	(0.200)
	Ln(Core $CPI_{Y/Y}$)			0.089 ***	0.093 ***	
				(0.033)	(0.034)	
	Ln(Core $CPI_{Y/Y}$)$_{t-3}$	0.048				0.100 *
		(0.041)				(0.054)
	Consumer Confidence$_{t-1}$					0.000 *
						(0.000)
	Consumer Confidence$_{t-3}$	0.000		0.000		
		(0.000)		(0.000)		
Interest Rates	10-Year Treas. Yield	0.223		-0.096		
		(0.238)		(0.142)		
	30-Year Fixed Mort. Rate	-0.569 *				
		(0.322)				
	30-Year Fixed Mort. Rate$_{t-1}$					0.445 **
						(0.210)
	Rate Spread			-0.216		
				(0.280)		
House Prices	Ln(Med. Price, Exist. Homes)	-0.064 **		-0.051 ***	-0.053 ***	-0.058 **
		(0.027)		(0.018)	(0.018)	(0.025)
	Ln(HPI)	-0.190 **	-0.214 ***			
		(0.085)	(0.068)			
	Ln($HPI_{Y/Y}$)	0.025 ***	0.028 ***			
		(0.009)	(0.008)			
	Ln(HAI)	-0.040 *				
		(0.023)				
	Ln(HAI)$_{t-2}$		-0.041 ***	-0.032 **	-0.038 ***	
			(0.014)	(0.014)	(0.014)	
Volume	Ln(Home Sales)	0.014		0.016 *	0.016 *	
		(0.010)		(0.009)	(0.009)	
	Ln(Housing Starts)$_{t-2}$			0.011 ***	0.011 ***	0.008 **
				(0.004)	(0.004)	(0.004)
	FHA Share	-0.042				
		(0.036)				
	FHA Share$_{t-1}$			-0.041		
				(0.026)		
	ARM Share	0.022 *		0.019		
		(0.013)		(0.013)		
	Owner-Occupied Share	0.066		-0.110 *	-0.120 *	
		(0.084)		(0.065)	(0.065)	
		---------- Monthly Binary Variables ----------				
		[2004-2007 Monthly Binary Variables]				----------
	σ^2	0.000014	0.000014	0.000014	0.000014	0.000014
		(0.003763)	(0.003794)	(0.003676)	(0.003686)	(0.003704)
	χ^2	12.510	6.510	5.340	5.310	10.440
	$P(>\chi^2)$	0.326	0.837	0.721	0.806	0.316
	AIC	-1757.000	-1761.710	-1775.130	-1779.230	-951.131
	Number of Observations	215	215	215	215	117
	95% Confidence Interval (2017)	+/- 4.1%	+/- 4.1%	+/- 3.7%	+/- 4.2%	+/- 3.8%

Standard Errors are reported in parantheses.

* indicates significance at the 90% level.

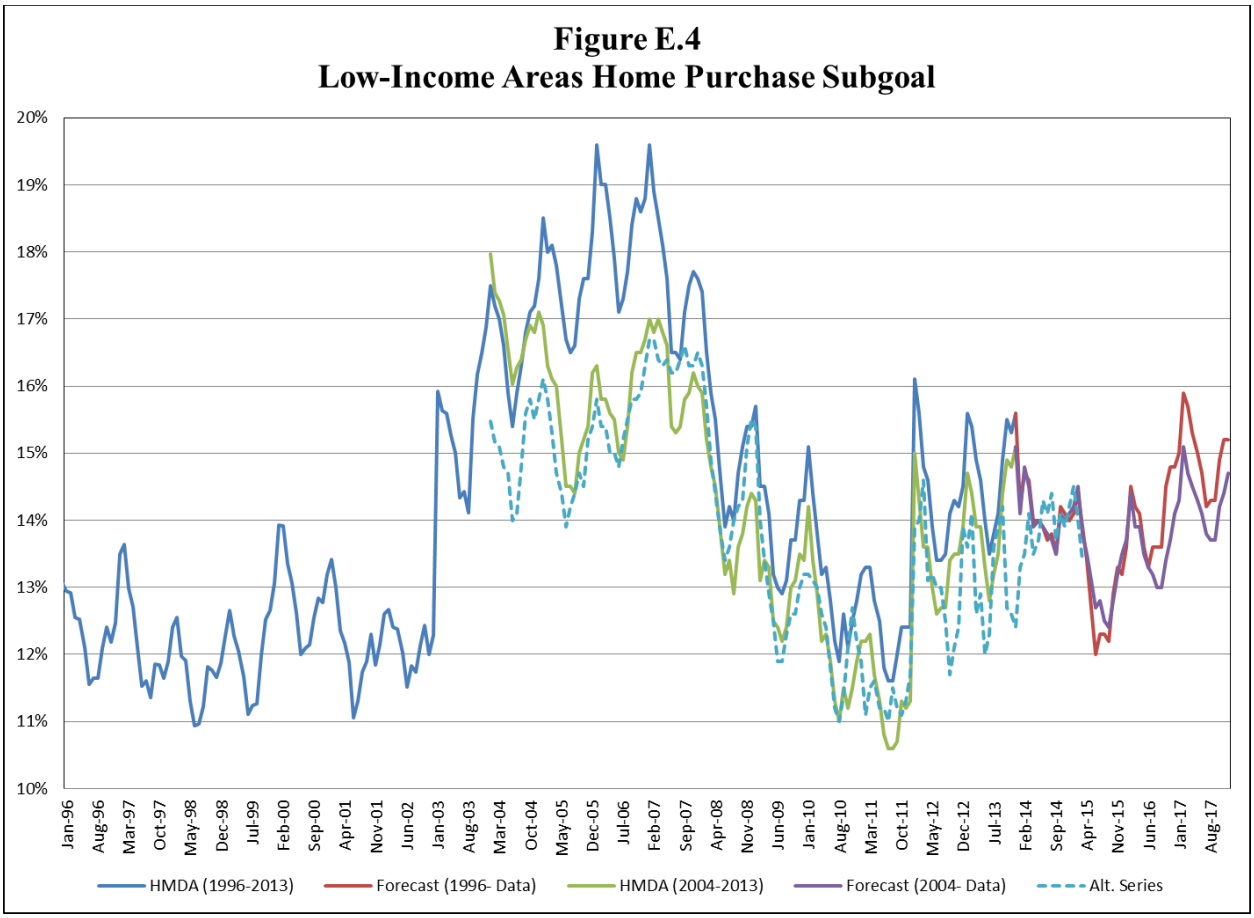
** indicates significance at the 95% level.

*** indicates significance at the 99% level.

for the LAP subgoal. However, the confidence interval is slightly larger than the interval produced by the model used for the forecast.

As can be seen in **Figure E.4**, except for a brief period during the housing bubble, the two data series track each other closely and the forecasts are similar.

Figure E.4
Low-Income Areas Home Purchase Subgoal



Low-Income Borrower Refinance Goal. **Table E.4** shows the four model specifications analyzed for the Low-Income Borrower Refinance Goal (LIR). The **Best Fit Model w/2004-2007 Monthly Binary Variables** is determined to provide the best model for

Table E.4

Low-Income Borrower Refinance Goal

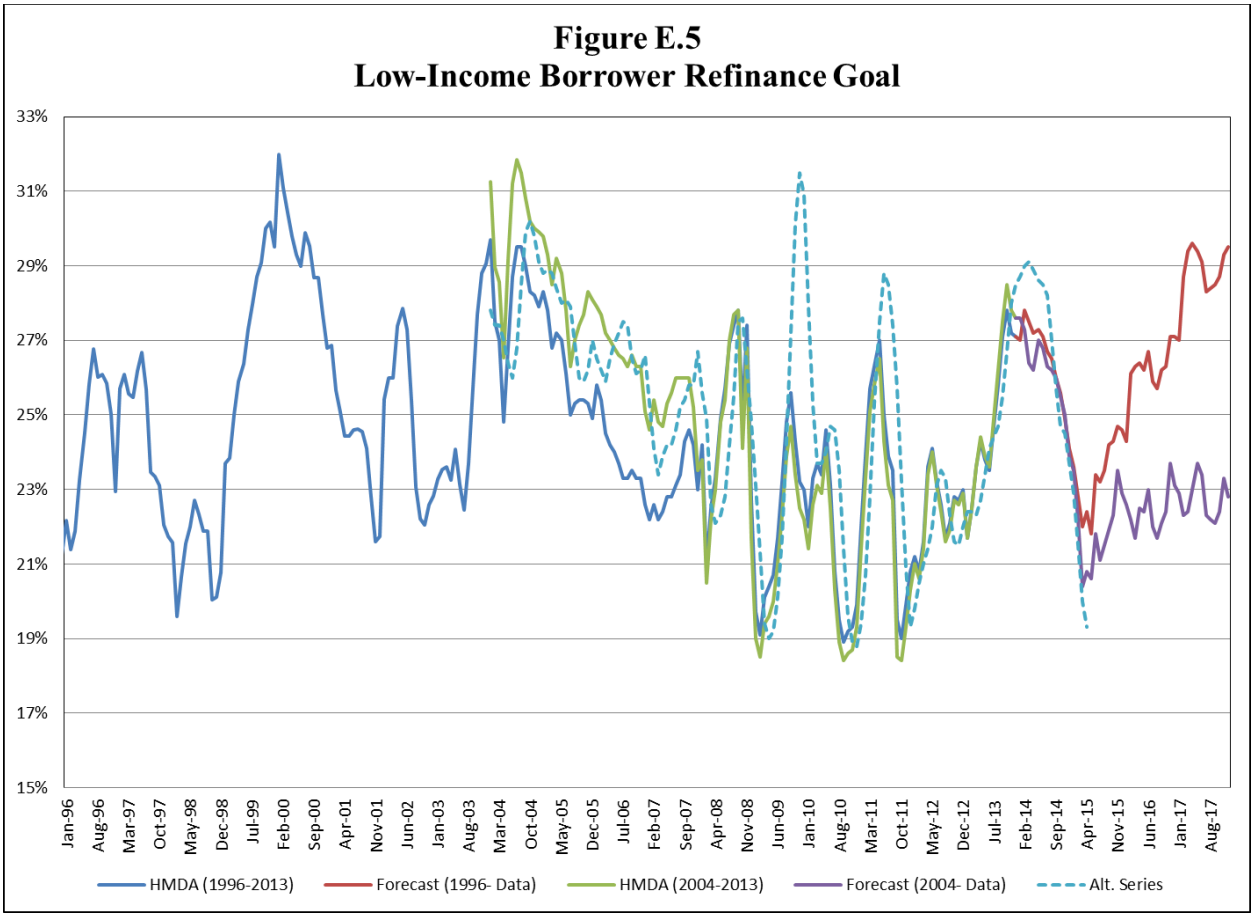
		Full Model w/ 2004-07	Best Fit w/ 2004-07	Full Model	Best Fit Model	New HMDA Def. Model
	AR(1)	-0.270 ***	-0.261 ***	-0.191 **	-0.177 **	-0.335 ***
		(0.074)	(0.073)	(0.075)	(0.073)	(0.114)
	AR(2)			0.008	0.000	-0.052
				(0.078)	(0.076)	(0.125)
	AR(3)			0.156 **	0.144 **	0.185
				(0.074)	(0.073)	(0.117)
	AR(4)					-0.032
						(0.118)
	AR(5)					0.200 *
						(0.110)
	Unemplment Rate$_{t-1}$	-0.622 **	-0.625 **	-0.631 **	-0.544 *	
		(0.274)	(0.271)	(0.297)	(0.293)	
	Ln(Core CPI$_{M/M}$)$_{t-1}$					-1.289 **
						(0.542)
	Ln(Core CPI$_{M/M}$)$_{t-3}$	0.376		0.242		
		(0.411)		(0.405)		
	Consumer Confidence	0.000 **	0.000 **	0.000 **	0.000 **	0.000 **
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Interest Rates	10-Year Treas. Yield$_{t-1}$	0.704 **	0.778 ***	0.596 *	0.685 **	1.203 ***
		(0.307)	(0.263)	(0.322)	(0.273)	(0.369)
	Rate Spread$_{t-1}$	-0.226		-0.302		
		(0.445)		(0.458)		
House Prices	Ln(HPI)$_{t-1}$	0.321 ***	0.307 ***	0.320 ***	0.285 **	0.404 ***
		(0.114)	(0.111)	(0.118)	(0.112)	(0.120)
	Ln(HPI$_{Y/Y}$)	-0.029 **	-0.026 **	-0.038 ***	-0.036 ***	-0.041 ***
		(0.013)	(0.012)	(0.013)	(0.013)	(0.012)
Volume	Ln(Home Sales)					-0.052 ***
						(0.015)
	Ln(Home Sales)$_{t-2}$	-0.027 *	-0.028 **	-0.017		
		(0.014)	(0.014)	(0.013)		
	Ln(Mortgage Originations)					-0.015 ***
						(0.006)
	FHA Share					0.159 ***
						(0.052)
	FHA Share$_{t-2}$	0.133 ***	0.141 ***	0.115 **	0.097 **	
		(0.046)	(0.046)	(0.048)	(0.045)	
	ARM Share$_{t-2}$	0.031		0.039 *	0.039 *	0.108 ***
		(0.020)		(0.021)	(0.021)	(0.038)
	Owner-Occupied Share	-0.395 ***	-0.396 ***	-0.445 ***	-0.438 ***	-0.748 ***
		(0.111)	(0.111)	(0.116)	(0.115)	(0.140)
		----------	Monthly Binary Variables	----------		
		[2004-2007 Monthly Binary Variables]				
	σ^2	0.000037	0.000037	0.000040	0.000039	0.000032
		(0.006084)	(0.006084)	(0.006294)	(0.006284)	(0.005692)
	χ^2	13.820	14.890	14.380	13.990	0.430
	P(>χ^2)	0.243	0.188	0.110	0.123	0.511
	AIC	-1551.110	-1553.480	-1544.770	-1548.050	-868.513
	Number of Observations	215	215	215	215	119
	95% Confidence Interval (2017)	+/- 5.7%	+/- 5.7%	+/- 7.1%	+/- 7.0%	+/- 7.3%

Standard Errors are reported in parantheses.
* indicates significance at the 90% level.
** indicates significance at the 95% level.
*** indicates significance at the 99% level.

forecasting this goal. The AIC statistic for this specification is lowest, indicating it has the best goodness of fit. It also does reasonably well in reducing white noise, as determined by the Chi Square statistic. The number of observations is almost doubled when using the extended data series, from 119 to 215, the AIC statistic is much improved, while the model used to forecast market performance for the LIR goal does better at reducing white noise. This model/data specification does result in narrower confidence intervals.

As can be seen in **Figure E.5**, except for a brief period during the housing bubble, the two data series track each other closely. The forecast based on the extended time series has a distinct positive slope, while the forecast based on the new HMDA specification is flatter.

Figure E.5
Low-Income Borrower Refinance Goal



Summary The additional data points from using a longer time series improve many of the regression statistics, especially the goodness of fit statistics. However, the regression statistics and resulting forecasts from the shorter time series are reasonable, and the shorter time series data are based on a more precisely defined market. A summary of the forecasts for the longer (1996-2013) time series and the shorter (2004-2013) time series is provided in **Table E.5**.

Table E.5

ACTUAL HMDA MARKET PERFORMANCE AND PROJECTED MARKET

Low-Income Borrower Home Purchase Share

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Actual Market	25.3%	29.6%	27.2%	26.5%	26.6%	24.0%				
Proposed Rule						23.4% +/- 3.0	21.4% +/- 5.2	20.9% +/- 6.7	20.2% +/- 7.9	19.8% +/- 9.0
HMDA Data (1996-)							23.1% +/-2.3	22.4% +/-3.8	21.9% +/-5.2	21.5% +/-6.3
HMDA Data (2004-)							22.0% +/- 2.0	22.4% +/- 3.2	22.9% +/- 4.2	22.0% +/- 5.0

Very Low-Income Borrower Home Purchase Share

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Actual Market	6.5%	8.8%	8.1%	8.0%	7.7%	6.3%				
Proposed Rule						6.5% +/- 1.0	5.7% +/- 1.4	5.8% +/- 2.5	5.7% +/- 3.2	5.6% +/- 3.8
HMDA Data (1996-)							6.5% +/-1.3	6.5% +/-2.2	6.8% +/-2.9	6.9% +/-3.3
HMDA Data (2004-)							5.7% +/- 1.4	5.9% +/- 2.5	6.0% +/- 3.2	5.7% +/- 3.8

Low-Income Area Home Purchase Share

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Actual Market	14.1%	13.0%	12.1%	11.4%	13.6%	14.2%				
Proposed Rule						13.4% +/- 1.6	14.3% +/- 2.9	14.7% +/- 4.1	14.7% +/- 5.1	14.2% +/- 5.9
HMDA Data (1996-)							14.0% +/-0.5	12.9% +/-1.6	14.0% +/-3	14.9% +/-3.9
HMDA Data (2004-)							14.0% +/- 0.6	13.2% +/- 1.5	13.6% +/- 2.8	14.2% +/- 3.6

Low-Income Borrower Refinance Share

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Actual Market	23.4%	20.8%	20.2%	21.5%	22.3%	24.3%				
Proposed Rule						22.4% +/- 3.3	27.6% +/- 5.3	31.0% +/- 6.8	33.5% +/- 8.1	34.2% +/- 9.1
HMDA Data (1996-)							26.5% +/- 1.5	23.3% +/- 2.6	26.2% +/- 4.2	28.8% +/- 5.4
HMDA Data (2004-)							26.2% +/- 1.5	21.8% +/- 2.7	22.4% +/- 4.7	22.8% +/- 6.2

APPENDIX F

Data Sources

Federal Financial Institutions Examination Council, Home Mortgage Disclosure Act Data

Low-Income Borrower Home Purchase Mortgage Share
Very Low-Income Borrower Home Purchase Mortgage Share
Low-Income Area Home Purchase Mortgage Share
Low-Income Borrower Refinance Mortgage Share
Refinance Mortgage Share, 2004 - 2013
FHA Home Purchase Mortgage Market Share, 2004 - 2013
Investor Share
http://www.ffiec.gov/hmda/default.htm

Federal Housing Finance Agency

House Price Index
http://www.fhfa.gov/DataTools/Downloads/Pages/House-Price-Index.aspx

U.S. Department of Commerce, Bureau of Economic Analysis

Gross Domestic Product
http://www.bea.gov/

U.S. Department of Commerce, Census Bureau

Housing Starts
http://www.census.gov/construction/nrc/historical_data/

New Home Sales
Median and Sales Price of New One-Family Houses Sold
http://www.census.gov/construction/nrs/historical_data/

U.S. Department of Housing and Urban Development

FHA Production Reports
http://portal.hud.gov/hudportal/HUD?src=/program_offices/housing/hsgrroom/fhaprodrpt

U.S. Department of Labor, Bureau of Labor Statistics

Consumer Price Index
http://www.bls.gov/cpi/data.htm

Unemployment Rate
http://www.bls.gov/cps/

Federal Reserve Bank of St. Louis

Monthly average of the 10-Year Treasury Constant Maturity Rate
Monthly average of the 1-Year Treasury Constant Maturity Rate
http://research.stlouisfed.org/fred2/categories/115

Mortgage Bankers Association

Single-Family Originations
Refinance Mortgage Share, 2014 Q1 – 2014 Q3
Forecast
http://www.mortgagebankers.org/ResearchAndForecasts/ForecastsAndCommentary

Freddie Mac

Monthly average of the 30-Year Fixed Rate Mortgage Rate
Monthly average of the 5-Year Adjustable Rate Mortgage Rate
Monthly average of the 1-Year Adjustable Rate Mortgage Rate
http://www.freddiemac.com/pmms/release.html

Forecast
http://www.freddiemac.com/finance/ehforecast.html

Fannie Mae

Forecast
http://www.fanniemae.com/portal/research-and-analysis/emma.html

National Association of Realtors

Monthly Housing Affordability Index
http://www.realtor.org/topics/housing-affordability-index

Existing-Home Sales
Median Sales Price - Existing-Homes
http://www.realtor.org/topics/existing-home-sales

Forecast
http://www.realtor.org/research-and-statistics

Wells Fargo

Forecast
https://www.wellsfargo.com/com/insights/economics/monthly-outlook

PNC Financial

Forecast
https://www.pnc.com/webapp/unsec/NCAboutMicrositeNav.do?siteArea=/pnccorp/PNC/Home/About+PNC/Media+Room/Economic+Reports

National Association of Home Builders

Forecast
http://www.nahb.org/reference_list.aspx?sectionID=138

Standard and Poor's

S&P/Case-Shiller Home Price Indices
http://www.spindices.com/index-family/real-estate/sp-case-shiller

Forecast
http://www.standardandpoors.com/en_US/web/guest/home

Wall Street Journal Survey

Forecast
http://projects.wsj.com/econforecast

The Conference Board

Forecast
http://www.conference-board.org/data/chiefeconomist.cfm

Federal Reserve Board of Governors, Federal Open Market Committee

Forecast
http://www.federalreserve.gov/monetarypolicy/fomccalendars.htm

Raymond James Financial

Forecast
http://raymondjames.com/monit2.htm

Trading Economics

Forecast
http://www.tradingeconomics.com/united-states/forecast

Federal Reserve Bank of Philadelphia

Community Outlook Survey
http://www.philadelphiafed.org/community-development/community-outlook-survey/

Forecast
http://www.philadelphiafed.org/research-and-data/real-time-center/survey-of-professional-forecasters/