The Factors Which Caused the Decline in the Amount of the Newly One Family Houses Sold in US

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ABSTRACT
The new privately owned one-family house sold (C25) is recognized as great indicator for economy. The monthly data indicates that 250.000 houses were sold in February 2011. Compared to 2006 when 1,061,000 were sold, we understand that the total number of houses sold decreased by 76% in 2011. The purpose of this paper is to analyze factors that determine the decline of number of C25 in US. The empirical results indicate when the interest rate increases 1%, the number of new privately owned one-family houses sold decreases by 20 thousand.When the unemployment rate increases 1%, the number of new privately owned one-family houses sold decreases 81 thousand, holding all other variables constant. The results show a positive relationship may exist if rising home prices increase the quantity demanded for housing. Income and house sold have positive relationship but it's not significant. For the population variable, the coefficient is a negative number. The result of monthly dummy test indicates that none of the months has significant effects. We could be able to conclude that current mortgage rate is significant at 1% level; mortgage rate at lag one time period is significant at 5% level; both real personal incomes at lag one time period and unemployment rate at lag two time period are significant at 10% level.
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Introduction

Sales of new and existing privately owned single-family homes[1] represent the number of housing units sold. New homes are newly constructed houses that are sold by the developer to the first owner. Existing homes are houses that are at least one year old. The number of new and existing homes available for sale indicates the inventory of unsold houses that are on the market.

Economic output is increased far more by the purchase of a new house than of an existing house because of the materials and construction work required in building a new house, although renovation work is sometimes done when an existing house is purchased. While existing-home sales have a much smaller direct impact on the economy than new-home sales, existing and new-home sales are in fact closely linked because existing-home owners often can afford to buy a new home only by selling their current home. Thus, the market for existing homes strongly influences sales of new homes. In addition, both new and existing home sales generate purchases of furniture, appliances, and other house furnishings, which is a secondary stimulus to the economy.

Home sales are sensitive to changes in economic conditions related to employment, personal income and saving, interest rates, housing starts, housing affordability index, and mortgage delinquency and foreclosure. Although housing is a necessity of living, home sales are highly cyclical because households are most likely to purchase a home during prosperous times when they can best afford it, but they tend to defer a home purchase during depressed times when they can least afford it (Chea, 2010).

The new privately owned one-family house sold[2] (C25) is recognized as great indicator for economy. The Housing Sales Survey is conducted by the Bureau of the Census under contract with the U.S Department of Housing and Urban Development. Sales of single-family homes were 250,000, according to the new monthly data[3] in February 2011. Compared to five years ago, 1,061,000 in 2006 were decreased by 76%.

1 Single-family homes are unattached houses and townhouses, including individually owned and operated housing units as well as single-family townhouse condominiums. Currently, some 66 percent of all U.S. housing consists of single or one-family homes (Listokin, D.,& Burchell, R.W. *Housing (shelter)*, Microsoft® Student 2009 [DVD], Redmond, WA: Microsoft Corporation).

2 It's commonly known as C25.

3 Measures of new-home sales and of new homes available for sale are prepared monthly by the Bureau of the Census in the U.S. Department of Commerce and the U.S. Department of Housing and Urban Development.

What are the causes to the dramatic decline of number of C25? The purpose of this paper is to analyze factors that determine the decline of number of C25 in US.

Literature Review

An extensive body of literature exists concerning housing demand and home sales with most works confined to specific subtopics within the housing market.

In recent years, researchers have devoted much of their effort to identify factors that determine the housing market mechanism (Sander and Testa, 2009; Lyytikäinen, 2009; Fratantoni and Schuh, 2003; Taylor, 2007; Bradley, Gabriel, and Wohar, 1995; Vargas-Silva, 2008). Many factors have been cited (Ewing and Wang, 2005; Baffoe-Bonnie, 1998; Huang, 1973; Thom, 1985) as sources of housing market dynamics; among these, housing price (Rapach and Strauss, 2009) and housing starts (Lyytikäinen, 2009; Ewing and Wang, 2005; Puri and Lierop, 1988; Huang, 1973) play a very important role. This literature review relates to the variables in statistical models and their explanatory power in the case of home sales and housing demand.

Rising home prices would tend to result in a decrease in the quantity demanded for housing. However, as Campbell and Cocco (2007) found, a positive relationship may exist if rising home prices increase the perceived wealth of house holds, or lead to relaxed borrowing constraints. Their work also suggested that a reverse causality could result, with relaxed borrowing constraints increasing housing demand and therefore prices. Goodwin (1986) noted that inflation –distorted home prices may actually increase demand by acting as inflation hedges, with homeowners using increased home equity to compensate for rising prices in other areas.

Unemployment, by lowering a person's income, would tend to dampen the demand for new housing. Literature concerning the effects of unemployment on housing have largely ignored this simple assumption and instead focused on the effect homeownership has on unemployment. Oswald (1996) found that a 10 percent increase in homeownership increased unemployment by 2 percent. A study using Spanish data by Garcia and Hernandez (2004) that included extensive demographic variables concerning age, income and marital status found that the previous literature was not relevant for the Spanish market, where high homeownership rates were negatively correlated to unemployment.

Inflation can produce a number of effects on the housing market. By increasing the price of housing, inflation can be assumed to reduce the demand for housing in inflationary times. Yet if used as an inflation hedge, housing demand may actually increase with inflation (Goodwin, 1986). The tax deductible nature of nominal rates of mortgage interest can actually lower the real cost of capital and therefore stimulates demand and homeownership (Rosen and Rosen, 1980), especially given the fact that capital gains are not taxable for first-time home sales. Kearl's (1979) often cited work stated that inflation's effect on housing costs serves to lower housing demand, while Feldstein and Summers (1978) observed that inflation decreases housing's attractiveness as an investment. Hendershott (1980) confirmed the negative relationship between inflation and housing demand, and found that carrying costs were much more important in determining this demand than capital gains.

According to Follain (1982), a 1 percent increase in the anticipated inflation rate reduced homeownership by more than three percentage points for all households with a larger effect occurring for non-elderly married couples. Complicit in this finding was the result that higher interest rates necessarily constrain borrowing. Homeownership usually necessitates borrowing, making the interest rate a key factor in the demand for housing. Aspergis (2003) stated that interest rates were the most important factor influencing housing demand, outweighing both inflation and unemployment as an explanatory variable which reinforced a conclusion suggested by Goodwin (1986), among others. Feldstein and Summers (1978) noted that the tax deductibility of mortgage interest plays a role in increasing the real interest rate, with cost depreciation lowering it. Their work also confirmed the Fisher effect link between inflation and nominal interest rates, with the two variables working together to either increase or decrease housing demand (Kagochi and Mace, 2009,p. 134-135).

Data and Research Methodology

The purpose of this paper is to analyze factors that determine the decline of number of the newly one-family houses sold in US. For this reason, our dependent variable is the new privately owned one-family house sold.

People have a tendency to buy a house when the mortgage rate is low. Historically, the new home sales usually have a lagged reaction to changing mortgage rates.

Therefore, our first independent variable is long–term mortgage rate. People have a tendency to buy a house when the mortgage rate is low.Our prediction to the sign of the slope should be negative.

We think people's income should be another cause to C25. Following the same idea, the unemployment rate will also capture people's expectation about their future income. If people lose their job, logically, they will not risk borrowing a 30 years mortgage.

Another rational thought would be a C25 increase when population increases. So, population in United States is our fourth independent variable.

A principle of microeconomics assumes that, holding all other factors equal, as the price of a product or service goes up, demand for that product or service declines. Conversely, if the price declines, demand goes up. Finally, we take the House Price Index for the United States as our last independent variable.

Thus, our independent variables include 30 years mortgage rate, real personal income (seasonal adjusted), unemployment rate, population, and house price index.

After determining our independent variables, we tried to search proper data to answer our question. The sample period is a time series of monthly data beginning February 1, 1980 and ending February 1, 2011. It contains 31 years and a total of 373 data sets. Data are collected from the Federal Reserve Bank of St. Louis economic research database.

The reason why we have chosen Federal Reserve Bank of St. Louis economic research database as our resource is twofold. First, most of the data sets come with a nice graph which is a good source for visualization. Second, all the data sets have a downloading option in excel. This option made our data input session smooth. However, there are still some problems we have encountered during the data gathering process. Variables such as mortgage rate, income, and unemployment rate are collected monthly. But the house price index is collected quarterly; the population is collected annually. In order to have the same statistical measurement, we duplicated the last two variables in a respective monthly time series.

Before we started to perform any test, we made some prediction about our variables' slope sign and the significance of the variables. We predicted that the slopes of real personal income and a population should be positive. It makes sense when

incomes increase people have more money to consume. Similarly, population increase should lead to more people needing houses. We also predicted that the slopes of mortgage rate, unemployment rate, and price index should be negative. As mortgage rates increase, people tend to borrow less to purchase houses. When a high unemployment rate occurs, people are more likely to have lower income expectation. The house price index is the average house price for a given period. Normally, we expect that a price increase leads to a demand decrease. That is the reason why the last three slopes are negative.

Empirical Analysis

We used Gretl[4] as a tool to perform our entire statistics tests. The first test that we run was the Ordinary Least Squares (OLS). We generate a multiple regression model which include our dependent variable, Housesold and our independent variables, HPIndex_(β1), Mortgage_(β2), Population_(β3), Real personal income_(β4), and Unemployment_(β5). The result of Ordinary Least Squares model is shown in Table 1.

According to the Table 1, excluding the constant, mortgage rate and unemployment rate are significant at 1% significance level (p-value). Since the p-value of HPIndex, Population and RPIncome variables are above 0.10, these variables have no significant effect on house sold. The Gretl result also shows that the R^2 is 0.452. The interpretation of R^2 is the proportion of the variable explained by the regression model. In this case, we can use our five independent variables to explain 45% of the reason why the new house sold.

4 Gretl is an open-sourcestatistical package, mainly for econometrics. The name is an acronym for *G*nu*R*egression, *E*conometrics and *T*ime-series *L*ibrary. Though it can't be considered as a general-purpose statistical software (its main functions are time series analysis, regression analysis and various econometric tests), it is very useful thanks also to its perfect integration with R. and with two other statistical packages used in seasonal adjustments: Tramo-Seatss and X-12-Arima, http://gretl.sourceforge.net, 16.11.2012.

Table 1. Ordinary least squares, using observations 1-373, Dependent variable: Housesold

	coefficient	std. error	t-ratio	p-value
Const	2500.60	806.541	3.100	0.0021
HPIndex	0.698577	0.592120	1.180	0.2388
Mortgage	-20.3564	7.08586	-2.873	0.0043
Population	-5.68910	4.53039	-1.256	0.2100
RPIncome	0.0380852	0.0735233	0.5180	0.6048
Unemployment	-81.4594	6.11404	-13.32	2.63e-033

Mean dependent var	721.3190	S.D. dependent var	238.4758
Sum squared resid	11603099	S.E. of regression	177.8091
R-squared	0.451543	Adjusted R-squared	0.444071
F(5, 367)	60.43004	P-value(F)	7.86e-46
Log-likelihood	-2458.645	Akaike criterion	4929.289
Schwarz criterion	4952.819	Hannan-Quinn	4938.633
Rho	0.959309	Durbin-Watson	0.087015

Housesold=2,500.6+0.699HPindex-20.356Mortgage-5.689Population+0.038RPincome-81.459Unemployment

There are some surprises due to the sign of the slopes. Initially, we predicted the coefficient of population should be positive since more people need more houses. Nevertheless, the coefficient of the population in the OLS model is about -5. And our prediction for house price index coefficient is negative, but here it is positive 0.699. We need to continue a further investigation of this model or our data sets. Before we make any conclusion, we should interpret the OLS model first.

The coefficient for the 30-year Mortgage (β2) rate is negative 20.356. The p-value for the β2 is 0.0043. It shows that the β2 is significant at 1% significance level. The coefficient for the unemployment (β5) is negative 81.459. The p-value for β5 is smaller than 0.001. We can say that with 99% confidence level that the unemployment variable is significant. The p-value is 0.2388 for β1. It means that this variable is not significant at even the 10% significance level. The coefficient for real personal income is 0.038 and the p-value is 0.605.

In order to test the monthly effects, we include 11 month dummy variables in our new model. Since our data is time series, we notice that our Durbin-Watson

statistic is equal to 0.084. We also performed a Durbin-Watson test to check the autocorrelation error in the model. Table 2 shows the OLS, using observations for 1980:02 2011:02.

Table 2. Ordinary least squares, using observations 1980:02 2011:02

Dependent variable: Housesold (T = 373)

	coefficient	std. error	t-ratio	p-value
const	2657.05	868.735	3.059	0.0024
HPIndex	0.659071	0.607389	1.085	0.2786
Mortgage	-21.1217	7.30748	-2.890	0.0041
Population	-6.51837	4.92045	-1.325	0.1861
RPIncome	0.0499770	0.0790419	0.6323	0.5276
Unemployment	-81.2761	6.21222	-13.08	3.30e-032
dm1	-26.2139	45.8000	-0.5724	0.5674
dm2	-25.4406	45.7532	-0.5560	0.5785
dm3	0.327942	47.4696	0.006908	0.9945
dm4	-4.43171	47.3711	-0.09355	0.9255
dm5	-3.23851	46.5742	-0.06953	0.9446
dm6	-0.805373	46.6899	-0.01725	0.9862
dm7	2.85291	46.3886	0.06150	0.9510
dm8	-8.65891	46.2479	-0.1872	0.8516
dm9	-6.80871	46.2805	-0.1471	0.8831
dm10	-6.62623	46.1451	-0.1436	0.8859
dm11	-8.69124	45.9089	-0.1893	0.8500

Mean dependent var	721.3190	S.D. dependent var	238.4758
Sum squared resid	11572504	S.E. of regression	180.2971
R-squared	0.452989	Adjusted R-squared	0.428405
F(16, 356)	18.42562	P-value(F)	1.24e-37
Log-likelihood	-2458.152	Akaike criterion	4950.305
Schwarz criterion	5016.971	Hannan-Quinn	4976.777
rho	0.960583	Durbin-Watson	0.084113
Durbin-Watson statistic	0.0870146	p-value	0

According to the Durbin-Watson test, p-value is equal to zero shows that the model has autocorrelation problem. We should correct the model with a proper statistical method. Since the Durbin-Watson statistic equal to 0.087, it shows a positive first order autocorrelation.

The following result is the Prais-Winsten correction model, here we took lag-2 time period. Comparing to our lag-1 period result, the lag-2 period has a DW result closer to 2. This is the reason why we took lag-2 time period. Table 3 shows the Prais-Winsten correction model.

Table 3. Prais-Winsten, using observations 1980: 04 - 2011: 02

Dependent variable: Housesold (T = 371)

	Coefficient	std. error	t-ratio	p-value
const	-205.993	239.504	-0.8601	0.3903
HPIndex	-0.137471	1.03831	-0.1324	0.8947
HPIndex_1	0.122039	1.34883	0.09048	0.9280
HPIndex_2	-0.257960	1.01868	-0.2532	0.8002
Mortgage	-29.3433	9.40833	-3.119	0.0020
Mortgage _1	-3.93193	22.0249	-0.1785	0.8584
Mortgage _2	32.0894	15.5183	2.068	0.0394
Population	-1.35884	3.21593	-0.4225	0.6729
Population_1	6.66001	4.68142	1.423	0.1557
Population_2	-4.20546	3.35179	-1.255	0.2104
RPIncome	0.0493773	0.0445178	1.109	0.2681
RPIncome_1	-0.111914	0.0587686	-1.904	0.0577
RPIncome_2	0.0560686	0.0457059	1.227	0.2207
Unemployment	1.68362	15.3669	0.1096	0.9128
Unemployment _1	29.2876	23.5791	1.242	0.2150
Unemployment _2	-28.4143	15.1497	-1.876	0.0615

Statistics based on the rho-differenced data

Mean dependent var	722.4717	S.D. dependent var	238.5867
Sum squared resid	734764.0	S.E. of regression	45.62329
R-squared	0.965114	Adjusted R-squared	0.963434
F(17, 353)	827.8281	P-value(F)	2.0e-272
Rho	-0.038935	Durbin-Watson	2.076334

After the Prais-Winsten correction (Table 3), we noticed that the Durbin-Watson statistic is 2.076. It means that the autocorrelation error is very low. In this new model, current mortgage rate is significant at 1% level; mortgage rate at lag -1time period is significant at 5% level; both real personal incomes at lag-1 time period and unemployment rate at lag-2 time period are significant at 10% level.

The new R Square, 96%, is much higher than the OLS model. It also has a lower t-ratio. These indications might reveal a multicollinearity relationship existing among the independent variables. When a multicollinearity problem exists in this model, it is possible that each of the individual coefficients may be individually insignificant, but the joint effect may have a significant impact on the dependent variable. Since some independent variables in this model are not significant, we decided to perform a Wald-test to test the joint effect of these factors: Price index, real personal income, unemployment rate, and population.

H0: $\beta1=\beta2=\beta3=\beta5=\beta7=\beta8=\beta9=\beta10=\beta12=\beta13=\beta14=0$
H1: at least one of the β is not zero

The Wald-test result is below:
Wald-test formula: $F = [(ESS_R - ESS_U) / m] / \{ESS / [N - (k + 1)]\}$
Test statistic: $F(12, 353) = 1.94718$, with p-value = 0.0282136

Where the following notation applies:
ESS_R, error sum of squares of Model R
ESS_U, error sum of squares of Model U
ESS, error sum of squares

Model R is called the restricted model
Model U is called the unrestricted model

m=number of restrictions
N= number of observations
k= number of regressors in unrestricted regression

Since the p-value of the Wald-test is 0.028, we do have enough evidence to reject the null hypothesis at 5% significance level. In another word, the joint effects of the non-significant variable are great than zero. Given the result of Wald test, we should continue an investigation the multicollinearity among the independent variables. Therefore, we carried on a series of Auxiliary Regressions. By using Auxiliary regressions, we can compute variance inflation factor(VIF) which is a measure of the effect of multicollinearity on the variance parameter estimates. The auxiliary regression and VIF result is presented in Table 4.

Table 4. The Auxiliary regression and VIF result

In-Variables	HPIndex	Mortgage	PoPula	RPI	Unemp
VIF	433.35	150.01	188.52	238.63	105.828
In-Variables	HPIndex_1	Mortgage_1	Popula_1	RPI_1	Unemp_1
VIF	2084.58	392.72	2093.87	1798.31	213.71
In-Variables	HPIndex_2	Mortgage_2	Popula_2	RPI_2	Unemp_2
VIF	1378.97	136.64	1236.1	1208.83	103.95

High VIFs suggest the presence of a multicollinearity problem. When VIF>30 usually indicates a sever multicollinearity. The VIF results for all the variables are great than 30. It means that all the variables are highly correlated. It also means that we have a small sample size.

Conclusion

Housing sales play a significant role as leading indicator of the economy, and thereforeunderstanding the market dynamics cannot be overemphasized, especially in light of the recenthousing market turmoil and its effect on the economy as a whole. Since, the factors in thehousing market will likely continue to play an important role in the business and economy (Gupta& Das, 2010; Bernanke and Gertler, 1995), understanding the market mechanism, specifically thelead-lag relationship between factors can offer policy makers a notion about the direction of theoverall market trajectory in advance, and thus, provides a better control for designing appropriatepolicies for housing market stabilization (Choudhury**,** 2010, p.45).

As a result of such importance of the housing market on the economy,the purpose of this paper is to analyze factors that determine the decline of number of C25 in US. The study found that the coefficient for the 30-year Mortgage (β2) rate is negative 20.356. It indicates when the interest rate increases 1%, the number of new privately owned one-family houses sold decreases by 20 thousand, holding all other variables constant. This is not a surprise result for this regression analysis. The mortgage rate plays a critical role in house market. The 30-year mortgage rate decreases more than 50% from 13% in the1980s to 5%-7% in the 2000s. At the same time, the number of houses sold increases about 50% from 541,000 in the 1980s to 1,000,000 in 2006, before the 2007 recession.

The coefficient for the unemployment (β5) is negative 81.459. It indicates when the unemployment rate increases 1%, the number of new privately owned one-family houses sold decreases 81 thousand, holding all other variables constant. This result proves our prediction in the sign of the slope. New houses sold and labor markets tend to go together. When the unemployment rate is low, people have a positive expectation for their future income. These expectations will strengthen the house market. Similarly, when a large number of people lose their jobs, the house market will move slowly. It's also true that these two factors are strong indicators for the economy. Currently, we have a slow house market and a low employment rate.

One of the unexpected results is the positive sign of the coefficient β1for the house price index. As we explained previously, we thought when price goes up the demand should go down. But it doesn't fit in this case. One possible explanation is that this is all a function of rising demand and the rising prices for houses simply reflects the rising demand and the inadequate supply of new construction for homes. The second possibility is that rising prices actually cause an increase in demand. This is because the purchase of a house has two components: the usefulness of the house as a place to live, and the anticipated future income to be obtained from selling the house later at a higher price. Rising home prices increase buyers' expectation of future profits from selling their houses, so they are willing to pay more for a house.

The coefficient β4 for the real personal income variable is 0.038 and the p-value is 0.605. This result indicates that income and house sold have positive relationship but it's not significant. This may due to the unemployment rate variable which captures most income effects. In another way, it shows that real personal income and unemployment have a high correlation.For the population variable, the p-value is 0.21, so it has no significance effect on house sold.

In order to test the monthly effects, we include 11 month dummy variables in our new model. The result of monthly dummy test indicates that none of the months has significant effects. However, from March to July the slopes of the months have positive or lower negativeeffects. It means that these few months have more houses sold than other months.

Consequently, it's impossible to determine all the causes to the number of new house sold since many factors are interrelated. However, through our series of statistical tests, wecould be able to conclude that current mortgage rate is significant at 1% level; mortgage rate at lag one time period is significant at 5% level; both real

personal incomes at lag one time period and unemployment rate at lag two time period are significant at 10% level.

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