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# Is there Seasonality in Home Prices—Evidence from CBSAs

*Norman G. Miller, Vivek Sah, Michael Sklarz, and Stefan Pampulov*

## Abstract

This study detects seasonality in home prices at the Core Base Statistical Area (CBSA) level. Using a unique database of home sales from 138 CBSAs from February 2000 to April 2011, we explore if monthly home prices vary systemically and significantly. Using a hedonic pricing model to account for housing characteristics and the standard HP filter system to extract the trend and the cyclical/seasonality component of the prices, the findings indicate significant price variations during the year for most months and most markets. At the aggregate level, the monthly price changes vary from an average of −2.78% on the downside to 1.93% on the upside. Aside from weather-induced seasonality and the geographic region, we find some differences in patterns based on whether or not the CBSA is a tourist destination.

Sales of homes in the United States take place throughout the year although at vastly different volumes. Sellers wait for the best offer on their houses, and when an offer meets their reservation price, they negotiate with the potential buyer hoping to enter into a binding contract. However, the decision as to when to attempt a sale is more often a need or consumption-driven decision rather than an investment-maximizing decision. Sellers may surmise that the price fetched by their property is independent of the time of year it is offered. This is not true and it appears that both consumers and appraisers have largely ignored seasonal price effects. There is already evidence of seasonally-induced sales volumes in the housing market.[1] Sales of homes peak at different times of the year. While it is a common knowledge among real estate agents, Goodman (1993) established the pattern of home sales peaking during the spring-summer season. With respect to new homes, the author explains that sales peak earlier because of recording differences as most new homes are sold before they are ready for occupancy. Having seen patterns with respect to home sale volumes, it is reasonable to question the existence of seasonality in home prices.

Most prior studies have looked at price changes over time. Case and Shiller (1989, 1990) find that the single homes market is inefficient across years with significant momentum in price trends. Using data from 1970 to 1986 for Atlanta, Chicago, Dallas, and San Francisco, the study finds that price changes in one year tend to continue for more than one year in the same direction. In another study, Kuo (1996) tests for seasonality in home prices. The study uses quarterly data of single-family homes of the same set of four cities as used by Case and Shiller (1987, 1989, 1990). The author uses both real and nominal prices to test for seasonality. The study finds no significance for the real price index for

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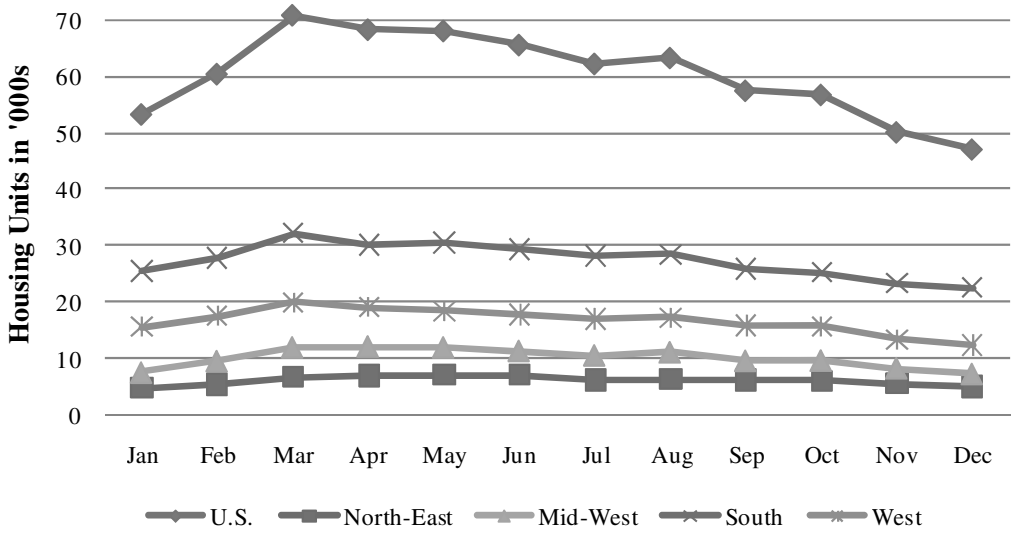
any city but strong significance for Chicago and San Francisco for the first three quarters, when nominal index is used.

In a comparative study by Ngai and Tenreyro (2007), the authors analyze hot and cold seasons in the U.S. and U.K. housing markets from 1991 to 2007. For the U.K. markets, their results indicate nominal price increases at an average 5% in the winters in all regions except for Northern Ireland, while in the summers the increase is 12% for all regions except for Northern Ireland, East Anglia, and the North East. For the U.S. markets, they find an average 3% difference in annualized percentage changes in house prices between winter (Q4 and Q1) and summer seasons (Q2 and Q3). In a more recent study of home prices, Kaplanski and Levy (2009) find a significant and persistent seasonality effect. Their study examines price changes within each year during the period of 1987 to 2007. They use two indices, the Case-Shiller Index and the House Price Index, to find evidence of price seasonality. Specifically, they find that the real rates of return on real estate are very low and even negative during the fall and early winter and positive and relatively high during the spring and early summer. Depending on the real estate price index employed, the prices are higher, on average, in the summer by 0.86% to 3.75%. However, the study uses indices to proxy for residential real estate prices. By using the Case-Shiller Index, the study is restricted to only 20 major metropolitan statistical areas (MSAs), a small set of major markets. (The other index used in the study is the House Price Index, which is restricted to nine divisions and much geographic smoothing.)

The objective of this study is to test whether or not there is seasonality in home prices. There have been a few studies that have found that home prices are seasonal. Some of the studies have used quarterly data, while others have looked at fewer cities in their sample. Both of these factors limit the scope of the findings. This study addresses both these limitations making two meaningful contributions to this area of research. First, our data set is very large and representative. Our sample consists of home prices from 138 Core Base Statistical Areas (CBSAs) over the last 10 years (135 seasonal months in total). Collectively, this is the most comprehensive data sample amongst all the studies done to date. Secondly, we use a methodology that is different from previous studies to test for seasonality. Specifically, the HP filter used in this study allows it to extract seasonality effects for each month of the year, allowing it to vary throughout the sample period. Our results indicate significant price variation over the months across all years for all CBSAs analyzed in this study, providing further evidence of significant market frictions based on households' mobility needs. If homeowners wished to maximize investment gains, they would certainly sell during the upward price peak months and purchase during the troughs. Unfortunately for most homeowners, the decision to move often creates the need for both selling and buying, lest the homeowners decide to temporarily rent and move twice, adding significant transaction costs to the move and negating much of the benefits from timing the purchase and sale. To the extent these moving costs are significant, the variations in price observed here over the course of the year is rational and explainable. Still, it does allow for some exploitation by first-time buyers or last-time sellers, as well as speculators in the housing market.

The rest of the paper is organized as follows. The next section discusses the literature in this field, followed by the description of the data and the methodology adopted. After that, we present the results. The last section summarizes the study, presents the conclusion and the implications from this study.

**Exhibit 1. New Single-Family Houses Sold (1973–2009)**




Source: census.gov.

## Literature Review

Previous studies have addressed the topic of inefficiencies in the housing market in various forms. With regard to knowledge of local markets, Lambson, McQueen, and Slade (2004) detect the presence of a home bias amongst buyers of property in Phoenix. In a study of homes bought by out-of-state buyers and in-state buyers in Phoenix, out-of-state buyers pay an average 5% higher price than in-state buyers.[2] The authors argue that this premium is a compensation for the information disadvantage that these out-of-state buyers have over their in-state counterparts.

When it comes to inefficiencies due to seasonal pattern in housing prices, there have been quite a few studies that have looked at seasonality. However, none of them have been targeted specifically at the topic of seasonality in prices.

Harris (1989), in a study analyzing the effect of real interest rates on housing prices, uses a model of house sales price that incorporates several variables including seasonality. He finds house prices to be seasonal with the prices peaking in the second quarter, while being the lowest in the fourth quarter. The effect of this seasonality in home prices can be seen in volumes of home sales. Exhibit 1 shows the average monthly pattern in new home sales volumes in the U.S. for a period of 37 years (1973–2009). As seen in Exhibit 1, the months March to June lead the volume tally for home sales. This is consistent at the regional level as well.

On similar lines, Reichert (1990), using quarterly data to study the impact of interest rates, income, and employment on regional housing prices finds support for seasonality in home prices. The author finds that housing prices are generally 2.2% higher during the second quarter in comparison to the first quarter. In a study to understand the

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mobility patterns of people around the country, Goodman (1993) finds evidence of transaction volume seasonality. Using data from the American Housing Survey, the author finds that moves are two times as likely to occur during the summer months as during the winter months. He also finds that this effect is similar for all the reasons that people move and not necessarily because of summer weddings and school calendars (they are part but not all of the factors driving seasonal volume). Also the seasonality is similar for all regions and climate zones. The author explains that new home developers take advantage of this seasonality in order to shorten their marketing period and secure higher premiums from consumers. With respect to the pricing of homes, Case and Shiller (1989, 1990) find that the market for single-family homes is not efficient. Using quarterly data of single-family homes for four cities, they find momentum in price changes in one direction for over a year. However, they did not look at monthly seasonality effects in home prices.

Ngai and Tenreyro (2007) compare seasonality in the U.S. and U.K. housing markets from 1991 to 2007. In their U.S. sample, they find an average 3% difference in house prices between the winter and summer seasons. For the U.K. markets, their results indicate nominal price increases at an average 5% during the winters in all regions except for Northern Ireland, while in the summers the increase is 12% for all regions except for Northern Ireland, East Anglia, and the North East. The authors explain that in the summer period, more houses are put up for sale. Because there are more houses (i.e., the quality of the matches, which is unobservable, is higher in the summer) and hence buyers can find better matches (i.e., they can get closer to their 'ideal houses'), their willingness to pay increases. This makes sellers even more willing to sell in the summer and thus generates a hot season with high prices and transaction volumes. In the winter, because there are few houses on sale, buyers are less likely to find good matches, thus willingness to pay decreases and prices and transactions are low. (Sellers might still sell in the winter if they are impatient or if search frictions are important.) The authors show that a small trigger suffices to generate hot and cold seasons. This is consistent with the finding that transactions peak in the summer. The authors suggest that real estate agents are well aware that summer seasons command higher prices and higher transaction volumes, so there does not exist much more scope for arbitrage during these seasons (In their study's model, there is no further scope for arbitrage for the marginal seller or buyer).

Kaplanski and Levy (2009) try to explain seasonality in home prices by two local factors: the monthly change in the number of daylight hours and the latitude, which should capture most of the climate impact. Using the Case-Shiller Index for 20 MSAs in the U.S. and the House Price Index for nine divisions, they find evidence of inefficiency in monthly home prices during the year; real rates of return on real estate are very low and even negative during the fall and early winter and are positive and relatively high during the spring and early summer. The prices are higher, on average, in the summer by 0.86% to 3.75%, depending on the real estate price index employed. The authors attribute this seasonality to what they call Seasonal Affective Disorder (SAD).

## Data and Methodology

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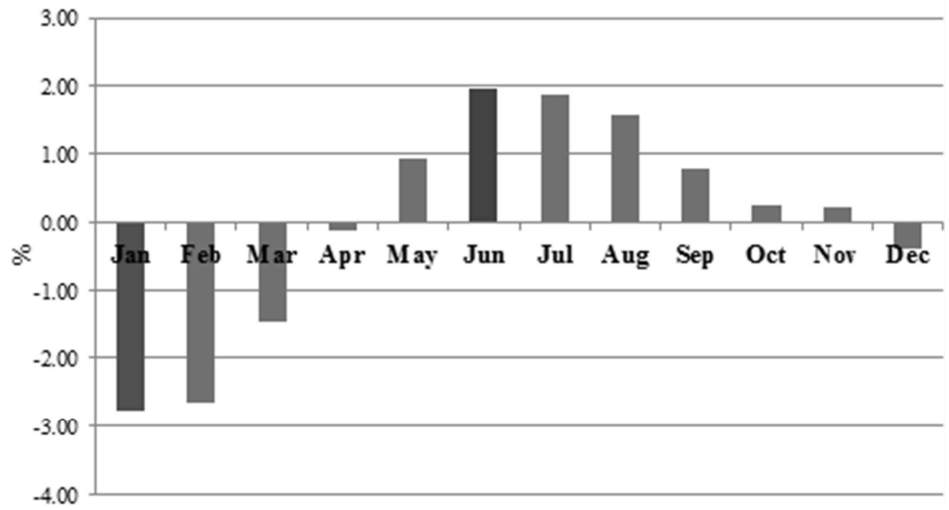
The data for this study are from Collateral Analytics. All types of information on home sales, including home characteristics such as the area of the living room, the number of

**Exhibit 2. Average Monthly Variation (February 2000–April 2011) for U.S. CBSAs**



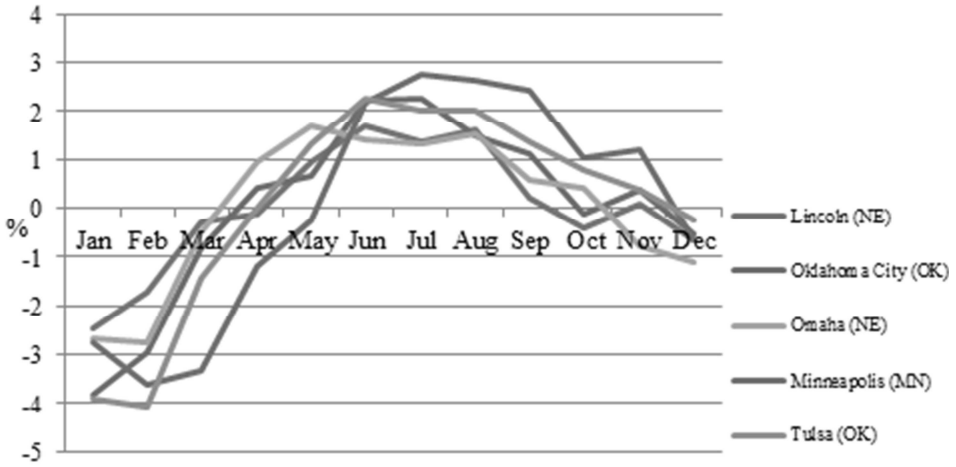

bedrooms and bathrooms, and age is obtained for 138 CBSAs from February 2000 to April 2011. This is one of the most comprehensive data sets of home sales available. Housing prices are explained by a hedonic pricing model, which accounts for housing size and quality characteristics. The pricing model includes the following primary variables: size of living space, lot size, number of bedrooms, number of bathrooms, age of the house, and a geographic location control.[3]

We breakdown the longer-term trend and the cyclical/seasonality component of the changes in prices using a so-called nested variable regression (i.e., the 12 months are ''nested'' in one year, but any month in a particular year is different from the same month in another year). For this reason, we use a standard HP filter system (Hodrick and Prescott, 1980) as used by McGough and Tsolacos (1995) but with a $\lambda = 100$. This is a value used for annual data. The HP filter is a linear filter that decomposes a time series, $P_t$, into a cyclical component (seasonality), $P_t^c$, and a growth component, $P_t^g$. Since our data runs from February 2000 to April 2011, we have 12 years of coefficients (percentage premium/discount over the average price of the house during the year) for the each of months of February, March, and April. For each of the remaining nine months, we have 11 years of coefficients. Thus our methodology allows us to extract a total of 135 seasonal coefficients ($12 * 3 + 9 * 11$) for the sample period.

## Results

As mentioned in the previous section, this study helps us extract a total of 135 seasonal effects. Exhibit 2 shows the average price variation over the year.[4] Note that the seasonality effects (premium/discount %) for any month are relative to the average home price during the year.[5] As seen in Exhibit 2, sale prices are higher during summer months

**Exhibit 3. CBSAs with the Most Weather Variety**




(Q2-Q3), peaking in June, while lowest during winter months (Q4-Q1), with the lowest in January. Prices are low in January through May, after which they start to rise. The price range variation is sizable, with the lowest being −2.78% and the highest being 1.93%. Note that the results are based on *closing* months as opposed to *contract* months. As such, the contracts were typically signed 30 to 60 days prior to closing.[6]

Next, we examine whether or not there is any commonality amongst the seasonal patterns observed in various CBSAs. For example, we plot cities with the least weather variety, the most weather variety, the maximum discount in a year, the most premium in a year, and cities with the least and most price variation (as measured by the range) during a year and look for correlated factors that might drive seasonality. The premium/discount of a month for any CBSA is the average of the month over the entire sample period. Thus we will have 11 observations each for May through January and 12 observations each for February through April. Last, we look at seasonality effects for the country during summer and winter months.

Exhibits 3 and 4 show the monthly variation in prices for CBSAs with the most and least weather variety in the nation respectively.[7] Cities with the least weather variety are more consistent in pattern than cities with the most intense weather variety.

Exhibits 5 and 6 show the CBSAs with the maximum premium and maximum discount during the year respectively. The CBSAs with the most extreme values belong to the Eastern and Southeastern region. Weather could be likely dominating these general regional observed price effects.

Next we look at CBSAs with the least and most price variation during the year as measured by range.[8] Exhibits 7 and 8 show this difference in terms of the minimum and maximum annual price variation. Most of the CBSAs with the least seasonality are from the Western region. The others are from Florida, and are major tourist destinations. As we can see from Exhibit 8, all but one of the CBSAs with the most price variation are from the South and Eastern regions of the country, areas with less temperature variation.

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**Exhibit 4. CBSAs with the Most Weather Variety**

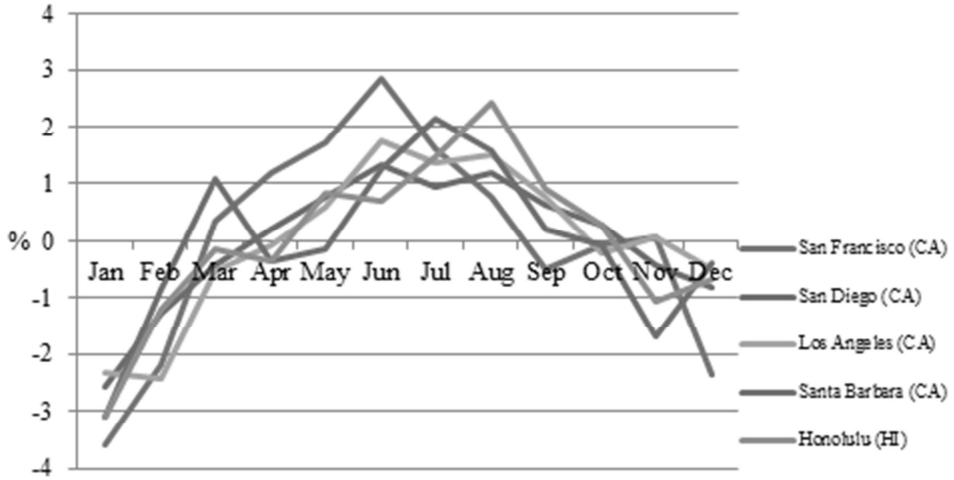
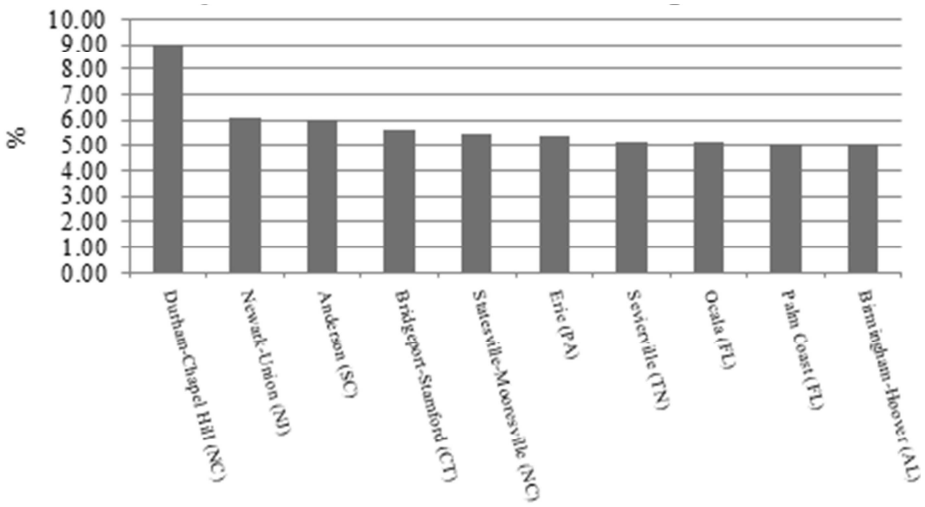



**Exhibit 5. Top 10 CBSAs: Maximum Premium During a Year**




## Statistical Tests

Once we get the price variations for all the CBSAs, we need to confirm that seasonality is significant statistically. For that, we aggregate the seasonality coefficients for each month. This is done by calculating the average across all CBSAs for each month for the entire sample period. This way we can test whether each month's (average) coefficient is statistically significant or not. As mentioned before, because of our sample period, we get 12 data points for the months of February, March, and April, while the rest of the months have 11 data points each.

**Exhibit 6. Top 10 CBSAs: Maximum Discount During a Year**

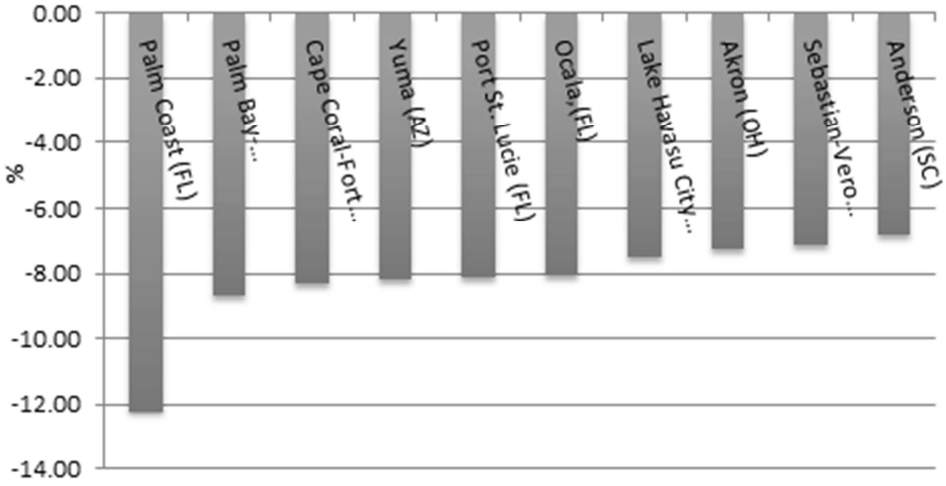
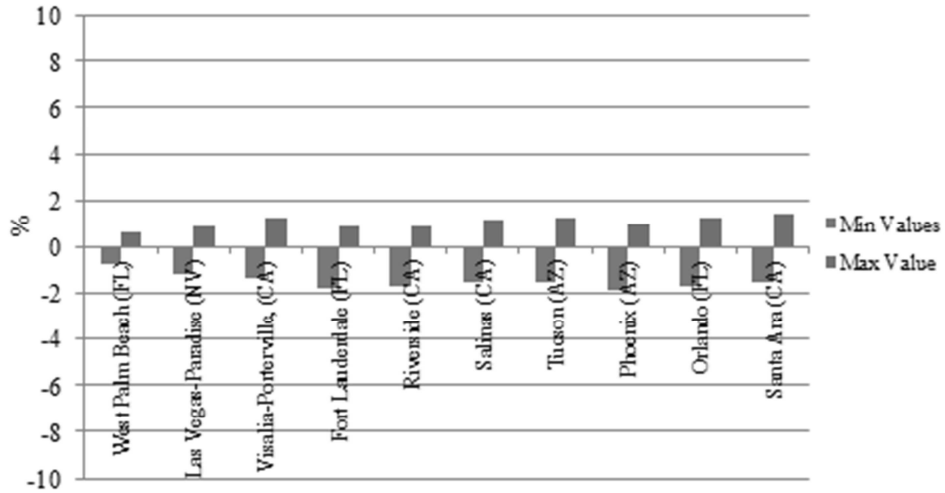



**Exhibit 7. CBSAs with the Least Seasonality (Smallest Range) in Home Prices**




Because of the limited data points for each month, we run the Wilcoxon signed-rank non-parametric test for significance. Exhibit 9 shows each month's seasonality coefficient and the significance level. All but four months show high significance. The results prove that seasonality exists in home prices and it is significant for most of the months during the year. Some studies in the past (Harris, 1989; Reichert, 1990; and Ngai and Tenreyro, 2007) have shown that prices peak in summers and are lowest in winters. Exhibits 10 and 11 show the price variations in the U.S. during the winter and summer season respectively.

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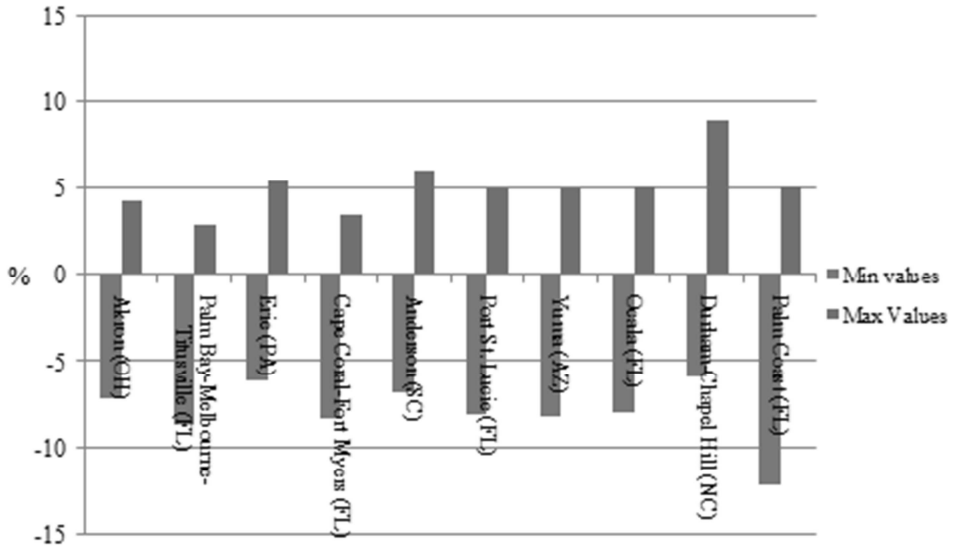
**Exhibit 8. CBSAs with the Most Seasonality (Largest Range) in Home Prices**




We can see that most winter months across the sample period have negative price changes, while most summer months have positive price variations. This is consistent with previous studies.

A t-test of difference between the two seasons (Q2-Q3 vs. Q1-Q4) shows high significance (*P*-value = 0.00), with the average variation in the winters being −1.16%, while for the summers is 1.13%. Finally, we look at the regional wise price variation in home prices. Exhibit 12 shows the seasonality affects for the four regions as categorized by the U.S. Census Bureau. The Midwest region dominates both on minimum and maximum price variation during the year.

## Exploratory Analysis

The core focus of this study is finding evidence of seasonality in home prices. However, we also undertake a small fishing expedition as well. As an additional analysis, we test for some factors that may help explain seasonality. Since studies (e.g., Goodman, 1993; Kaplanski and Levy, 2009) have looked at certain factors to explain seasonality such as daylight savings, marriages, summer relocations, school holidays, etc., we look at alternate factors that could help explain seasonality. Although, there is no clear literature on such explanatory factors, geographic region, tourism, ethnicity, and weather variation may seem to be some intuitive factors. We run a regression to test these factors, with the dependent variable being the variation in seasonality in the CBSA as measure by standard deviation:

$$MStd_i = \alpha + \gamma_1 W_i + \gamma_2 O_i + \gamma_3 D_{iTou} + \gamma_4 D_{iRegn} + \gamma_5 Tem\_Range + \mu, \qquad (1)$$

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**Exhibit 9. Seasonality Coefficients Averaged Across All CBSAs**

| | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2001 | −2.10 | −1.16 | −1.25 | −0.22 | 1.08 | 1.47 | 1.38 | 1.15 | 0.10 | −0.38 | 0.21 | −0.69 |
| 2002 | −2.00 | −2.51 | −1.14 | 0.47 | 0.81 | 1.77 | 2.03 | 1.70 | 0.35 | −0.18 | 0.07 | −0.45 |
| 2003 | −2.04 | −2.61 | −1.43 | −0.60 | 0.82 | 1.62 | 1.43 | 1.63 | 0.56 | −0.11 | 0.25 | −0.30 |
| 2004 | −2.22 | −1.63 | −1.00 | −0.33 | 0.76 | 1.49 | 1.53 | 1.88 | 1.27 | −0.37 | −0.88 | −1.48 |
| 2005 | −1.39 | −1.86 | −1.11 | −0.31 | 1.28 | 2.28 | 1.43 | 1.11 | 0.46 | −0.64 | −1.19 | −1.30 |
| 2006 | −2.65 | −2.14 | −1.23 | −0.09 | 0.24 | 1.38 | 1.59 | 1.55 | 1.48 | 0.56 | 0.00 | 0.01 |
| 2007 | −3.09 | −2.03 | −0.60 | 0.16 | 0.85 | 1.67 | 1.70 | 1.16 | 0.35 | −0.08 | −0.41 | −0.72 |
| 2008 | −3.51 | −2.48 | −1.23 | 0.28 | 1.22 | 2.14 | 2.39 | 1.99 | 0.71 | 0.31 | 0.25 | 0.02 |
| 2009 | −5.78 | −3.27 | −1.58 | −0.77 | 1.17 | 2.50 | 2.81 | 2.41 | 1.69 | 2.06 | 0.64 | −0.67 |
| 2010 | −3.14 | −4.90 | −4.22 | −3.02 | −0.71 | 1.30 | 2.89 | 1.91 | 1.66 | 1.63 | 2.29 | 0.26 |
| 2011 | −2.64 | −3.97 | −1.52 | 0.54 | 2.76 | 3.63 | 1.14 | 0.83 | −0.20 | −0.09 | 1.03 | 0.81 |
| 2012 | | −3.46 | −1.04 | 2.37 | | | | | | | | |
| Average | −2.78 | −2.67 | −1.45 | −0.13 | 0.93 | 1.93 | 1.85 | 1.57 | 0.77 | 0.25 | 0.21 | −0.41 |
| *P*-value | 0.00 | 0.00 | 0.00 | 0.58 | 0.00 | 0.00* | 0.00* | 0.00* | 0.00 | 0.92 | 0.42 | 0.11 |

Note: A Wilcoxon Signed Rank non-parametric test is run for statistical significance. All numbers are in percentage price variation over the average sale price during the year.
* Significant at 1% level.

**Exhibit 10. Seasonality Effects in U.S. Years During Winter**

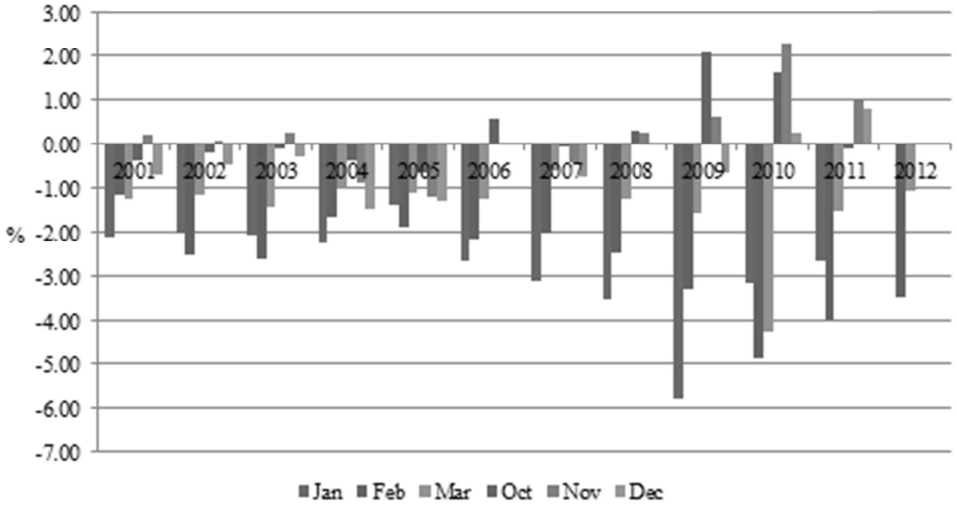
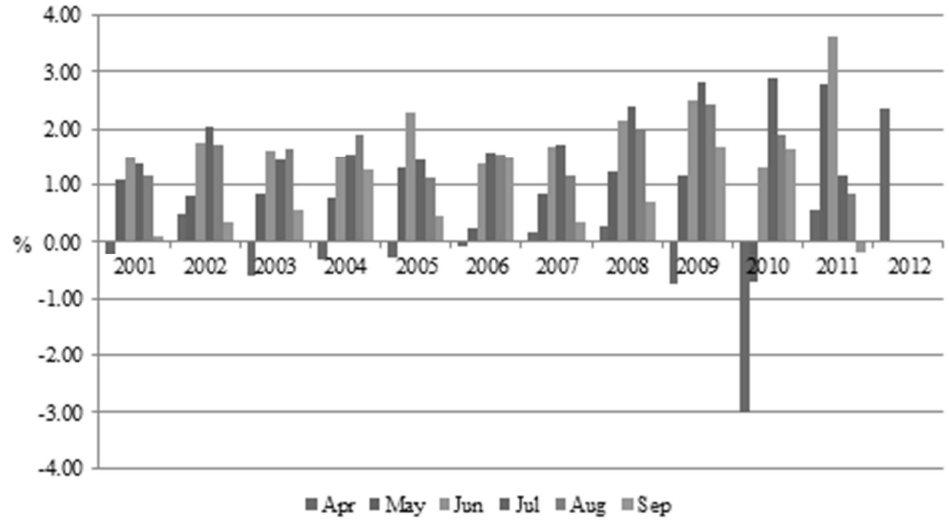
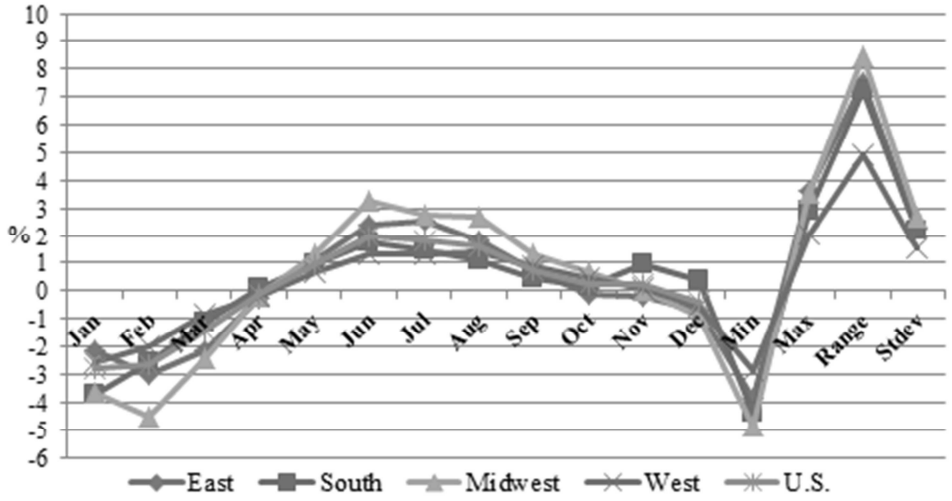



**Exhibit 11. Seasonality Effects in U.S. Years During Summer**




where $MStd_i$ is the standard deviation of the seasonality factor across all the months (premium or discount %) for the i[th] CBSA,[9] $W_i$ is the percentage population of White Americans in that CBSA for the most recent data (2010) from the Bureau of Labor Statistics, and $D_{iTou}$ is a dummy if the CBSA is a tourist city or not. Due to lack of any other measure, defining this variable is difficult, so we use a Wikipedia description to ascertain this. If the CBSA's description mentions tourism in its economy, it is considered to be a tourist city, otherwise not. $D_{iReg}$ is a regional dummy (West, Midwest, South, and East) as classified by the U.S. Census Bureau. *Tem_Range* is the variable for the

**Exhibit 12. Seasonality: Region-wide Average (Feb. 2000–April 2011)**




Note: Each of the month's value is the average of the month's coefficient during the sample period for a CBSA. The CBSAs are then grouped according to their region and a regional average calculated for each month.

**Exhibit 13. Results for the Regression Analysis**

| | Standardized Coeff. | *P*-value |
|---|---|---|
| Others | 0.03 | 0.65 |
| $D_{iTou}$ | −0.15 | 0.05** |
| *G1* | −0.37 | 0.00* |
| *G2* | 0.18 | 0.03** |
| *G3* | −0.02 | 0.75 |
| *Tem_Range* | −0.04 | 0.61 |
| $R^2$ | 0.22 | |

Notes: The dependent variable is standard deviation in prices during the year for a CBSA.
* Significant at the 1% level.
** Significant at the 5% level.

temperature and is measured as the difference between the average summer temperature minus the average winter temperature of the CBSA. $\mu_i$ is the error term, which is assumed to be normally distributed.

Exhibit 13 summarizes the results for the regression analysis. We find the dummy for two regions and tourist city to be significant. The base category for the regional dummy is the Eastern region. G1, G2, and G3 are the dummies for the West, Midwest, and South regions, respectively. The Western region and the Midwestern region variables are significant at the 1% and 5% levels, respectively, while the dummy for the Southern region

is not significant. The coefficients for the regional dummies suggest that the Western regions have 37% less variability in prices during the year than the Eastern region, while CBSAs in the Midwest region have 18% more price variation during the year than the Eastern region. This result can also be seen graphically to some extent in Exhibit 12. The significance on the tourism dummy suggests that CBSAs that are tourist attractions have 15% less seasonality during the year than those that are not tourist hubs. What may be surprising is that the temperature variable is not significant. One may argue that there should be some relationship between seasonality and weather. However, our regional variables may be picking up much of the weather-driven effects.

## Implications and Conclusions

This study explores seasonality in home prices at the Core Base Statistical Area (CBSA) level. Using a unique database of home sales from 138 CBSAs over the period from February 2000 to April 2011, we study monthly home prices variations during the year. Using a hedonic pricing model to account for housing characteristics, we use the standard HP filter system (Hodrick and Prescott, 1980) to extract the trend and the cyclical/seasonality component of the prices. Our findings indicate significant price variations during the year for most months. At the aggregate level, monthly price changes vary significantly from an average of −2.78% on the downside for January, to 1.93% on the upside for June. Our results indicate, in general during a year, the summer months (Q2 to Q3) at an average have higher prices than winter months (Q4 to Q1). Additionally, this study finds two factors affecting price changes: one is whether or not the CBSA is a tourist destination; the other being the geographic region it is located in. Our data are based on closings and since it typically takes 30 to 60 days to close a transaction, the negotiated contracts occurred prior to the peaks and troughs shown here. Summer time peaks are generally based on mid to late spring time contracting. January closings, when the market is slower, typically are generated from late November and December contracting.

The results from this study have significant implications for consumers, appraisers, lenders and policymakers. Appraisers could easily be off of true values by several percent when ignoring seasonal price effects. Because appraisers use historical transactions, often from sales up to 12 months ago in attempts to find good comps, existence of significant seasonal variations in home prices within local markets should require adjustments to the comparable property data. One exception would be if the comparable property entered into contract exactly one year before it is being used to value a subject property.[10] Then, the appraiser need only consider the longer-term price trend. Because seasonality exists in markets, incorporating these effects while valuing properties is essential to reduce appraisal errors that otherwise appear to be noise, but are not. The valuation errors will depend upon both the time of year and the magnitude of price changes within that local market. Markets that have higher price seasonality will obviously have more appraisal error when price seasonality is not factored into adjustments.

From a tax assessment point of view in counties, the timing of property valuation could have a significant financial impact on a county's revenues. The timing of appraisal by the assessor's office may either increase or decrease revenues. If the appraisal is conducted

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in months in which prices are higher, it will lead to higher property values and, hence, increased property taxes. This may well benefit the given county. On the other hand, from the property owner's perspective, appraisal appeals based on comparable properties selected from months of lower prices will benefit the owner. So we do see the possibility for the strategic use of the seasonal price effects found here. Finally, from an investor's perspective, our results show that if one can buy in the down seasons, one can significantly benefit from the seasonal price variations. There is clearly an arbitrage opportunity in the housing market for time-flexible buyers and sellers.

The focus of this study is to find evidence of seasonality in home prices by using a comprehensive and representative data sample, and improving on the methodology to detect seasonality. Although, we try to explain this phenomenon by conducting an exploratory analysis using some factors, the analysis is not very comprehensive or robust. This will be an area of future research by using more factors, both economic and non-economic, and employing a robust methodology to achieve significant results.

## Endnotes

[1] See Goodman (1993) and Exhibit 1.

[2] A similar but smaller effect is found in ''The Effects of Housing Transaction Phenomena on the Housing Market,'' Norman G. Miller's dissertation, Ohio State University, 1977.

[3] Please note that all of the analysis is done using nominal prices. Inflation adjustments may make some sense but we de-trended the series, so any inflation that is part of the general trend has been eliminated. Hence, the results would be the same regardless of the pricing base.

[4] By calculating the average of each month over the sample period across all CBSAs.

[5] The average of the seasonality affects for all months for any year is zero for any CBSA.

[6] For example, sale contracts completed in December will generally close in January or February.

[7] http://www.weatherpages.com.

[8] The results do not change much if we use standard deviation as a measure.

[9] In Equation 1, we use both range and standard deviation of the seasonality as dependent factors. Although, we just show standard deviation, the results do not change if we use range.

[10] This means the sale probably closed about 10 to 10.5 months before the date of the appraisal.

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Norman G. Miller, University of San Diego, San Diego, CA 92110 or nmiller@sandiego.edu.

Vivek Sah, University of San Diego, San Diego, CA 92110 or viveksah@sandiego.edu.

Michael Sklarz, Collateral Analytics, Honolulu, HI 96816 or msklarz@collateralanalytics.com.

Stefan Pampulov, Collateral Analytics, Honolulu, HI 96816 or spampulov@collateralanalytics.com.

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