Housing and the US Business Cycle: Price or Quantity?*

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Ⅰ. Introduction

The global boom and bust in house prices in the past decade re-ignited a debate on a long-standing issue, the link between housing and the business cycle. While house prices are expected to affect the economy via different channels, two ostensible channels have drawn attention in the theoretical literature, i.e., the wealth effect channel and the collateral effect channel. Probably, the first channel is best advocated in the speeches of Greenspan (2003, 2005), stressing the role of housing market booms in fueling consumption in the early 2000s. The second channel is centered around the role of housing wealth as collateral: house price increases can help loosen up homeowners' borrowing constraint and thus increase their consumption, as argued by Aoki et al. (2004) and Iacoviello (2005)[1]. In contrast to the clear theoretical predictions above, however,

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1) Iacoviello (2005) further notes that, since higher price level and house prices

the empirical evidence for the US on the role of house prices over the business cycle is still mixed. For example, Davis and Heathcote (2005) find a contemporaneous correlation between the US nationwide house prices and output as high as 65 percent over the 1971−2001 period. Kan et al. (2004) find, however, that the contemporaneous correlation between house prices and output growth is mere 15 percent or smaller on average in about 50 major US cities.

In a recent paper, Leamer (2007) argues that housing markets are grossly understudied by macroeconomists interested in understanding business cycles. He asserts several stylized facts about the behavior of the US housing market over the business cycle, pointing out the followings: housing investment leads the business cycle, a fall in residential investment is a reliable harbinger of a recession. In particular, he claims that volumes, rather than house prices, are what matter for business cycles, and shows that eight out of ten US post−war recessions have been preceded by substantial problems in quantity variables such as housing investment and consumer durables. Similar evidence highlighting the nature of housing market cycles leading business cycles have been put forth by Alvarez et al. (2009) for the Euro area, and Alvarez and Cabrero (2010) for Spain. In those studies, the cyclical features of a variety of housing market indicators, such as housing starts, housing permits and amount of residential investment, are examined. These studies share the view, explicitly or implicitly, that the fluctuations in the housing quantity variables as a main driving force behind the business cycle. Since house prices are downward sticky, a housing market recession entails larger decreases in housing transactions such as new housing starts than in prices, which propagate toward the overall economy.

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bring forth higher borrowing capacity of homeowners and lower the real burden of their nominal debt obligation, higher aggregate demand accompanying house price increases can lead to amplified increases in output.

The aim of this paper is to further the understanding of the relationship between housing and the US economy in two ways. We first note that a substantial body of the literature on this issue focuses on the effects of house price on a single macro variable, such as GDP, employment, or consumption[2]. By examining the relationship between the movements in the housing market and the overall business cycle, we attempt to help fill the blank in the literature. We also attempt to re-examine the claim of Leamer (2007) that quantity (not price) variables in the housing market are better predictors of the US business cycle. By investigating how house price and quantities compare in their effects on the overall US economy, we can confirm whether the declines in house prices themselves played a key role in driving business cycle, or fluctuations in housing quantities is the main driving force.

In terms of methodology, we first construct a Markov-switching common factor model as the baseline, which is estimated using a set of US coincident indicators only (not including house price). To examine the importance of housing market variables, we then construct a series of extended models in which the price or quantity variables in the housing market are incorporated additionally. Two strands of extended models are considered: in the first strand, housing market variables are allowed to directly affect the individual indicators and ultimately the overall business cycle. In the second strand, housing market variables affect the probabilities that the economy moves between expansion and recession regimes. Finally, we compare the results for the extended models with those for the baseline model. If significant, the differences between the two sets of results can be interpreted as supporting that housing market variables provide additional information for describing the US business

2) A few studies, such as Iacoviello (2002), take the multivariate approach and examine the effects of house price in generating comovements among macro variables.

cycle beyond what is in the usual coincident indicators. By comparing the relative marginal importance of the housing price and quantity variables, we can also check if the claim of Leamer (2007) is valid for the overall business cycle.

We estimate the baseline and the extended models using the series of four monthly coincident indicators and the price and quantity series in the housing market. covering the five episodes of US recessions since the mid-70s. The results for the first strand of extended models corroborate the claim of Leamer (2007) emphasizing the importance of the housing quantity variables but not of the house price. In particular, the growth in housing permits and housing starts significantly affects the mean growth rates of the macro indicators and indirectly the business cycle dynamics (i.e., the duration of the recession phase). In contrast, we fail to find evidence supporting a similar role of the house price growth. For the second extension, however, the results support the relevance of house price growth in determining the transition of the economy between recession and expansion phases: the movement in house price affects the probabilities of both phases in the next period regardless of the current phase of the economy. Those in housing quantities, however, turn out useful in this regard only when the economy is currently in the expansion phase.

The remainder of the paper proceeds as follows: section 2 presents the structure of the baseline model and the extended models. Section 3 discusses the estimation results for the two models, and evaluates the importance of house price and quantity variables. Section 4 concludes.

Ⅱ. The Models

1. Baseline Model

As the baseline model for the US business cycle, we employ a Markov-switching common factor model in the spirit of Diebold and Rudebusch (1996). We assume that macroeconomic variables Y_{it}'s move contemporaneously with overall economic conditions captured by an unobserved common component C_t, up to respective idiosyncratic components x_{it}'s. To handle the well-known integration problem of the observed series, we difference the data series and re-write the model as follows[3]:

$$\Delta y = \gamma_i(L)\Delta c_t + x_{it},\ i=1,...,N, \quad (1)$$

$$\phi(L)\Delta c_t = \mu(S_t) + \nu_t,\ \ \nu_t \sim N(0,1), \quad (2)$$

$$\psi_i(L)x_{it} = \epsilon_{it},\ \ \epsilon_{it} \sim iiN(0,\sigma_i^2),\ \ i=1,...N, \quad (3)$$

where $\Delta y_{it} = \Delta Y_{it} - \Delta\overline{Y_i}$ is the mean-deviation of the growth rate in Y_{it}. The common factor growth Δc_t and the idiosyncratic components x_{it}'s are assumed to have AR representations. The sensitivity of the macroeconomic variables Y_{it}'s to the overall business cycle is measures by the factor loadings $\gamma_i(L)$'s, and the innovations (ν_t, ϵ_{it}) are mutually independent at all leads and lags.

To incorporate the inherently asymmetric dynamics of the business cycle across expansions and recessions, we follow Hamilton (1989) and put the intercept term $\mu(S_t)$ of the common factor growth Δc_t subject to a Markov switching:

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3) The variance of ν_t is fixed at unity for the sake of identifying γ's.

$$\mu(S_t) = \mu_0 + \mu_1 S_t, \;\; \mu_0 < 0, \qquad (4)$$

where S_t is a hidden state variable that switches between 0 and 1. By restricting μ_0 to be negative, we identify the state 0 as the recession phase and the state 1 as the expansion phase. The transition between the two states are governed by the probabilities:

$$\Pr[S_t = 0 | S_{t-1} = 0] = \frac{\exp(q_0)}{1+\exp(q_0)} = q, \qquad (5a)$$

$$\Pr[S_t = 1 | S_{t-1} = 1] = \frac{\exp(p_0)}{1+\exp(p_0)} = p. \qquad (5b)$$

One concern that arises in the actual estimation stage is that, if the sample period includes the episode of the recent Subprime financial crisis, the relatively mild and short-lived recession in 2001 is not easy to detect. We address this problem by using a dummy variable D_t in the mean equation (2) for the common factor growth

$$\phi(L)\Delta c_t = \mu(S_t) + \delta(1 - S_t) + \nu_t, \;\; \nu_t \sim N(0,1), \qquad (2')$$

where D_t takes the value of one over the 2001:4 - 2001:11 and 0 elsewhere[4].To mitigate the arbitrariness of the dummy variable, we restrict the revision parameter δ for the intercept during the 2001 recession to be effective only when the phase of the economy is also identified as recession by the model.

4) The recession periods has been identified as the 'period following the peak through the trough' for the 2001 recession by the NBER business cycle dating committee.

2. Extended Models

In our first extension of the baseline model, we allow the housing market variables to directly affect the macro indicators as follows:

$$\Delta y_{it} = \gamma_i(L)\Delta c_t + \beta_i Z_t + x_{it}, \; i = 1,...,N, \qquad (1')$$

where Z_t denotes the predetermined housing market variables whose influence on business cycle is investigated. Intuitively, if the housing variables do not contribute in explaining the business cycle beyond what is done by the macro indicators, the estimated coefficients β_i's will be insignificant and the overall fits of the extended models will be identical to that by the baseline model. The equations (1'), (2'), (3), (4), and (5) constitute the first strand of extended models.

Depending on the choice the control variable Z_t in equation (1'), we construct three alternative versions of the first extension. First, we use as Z_t the one period lag of the 12 month moving average of the real house price growth, constructed as $\sum_{i=1}^{12}\Delta\log(P^H_{t-i})$, where P^H_t is the real house price at period t. This version of the extended model is dubbed HP-M henceforth, denoting that house price is included in the mean equation. The second and third choices of Z_t reflect the possible importance of the quantity variables in the housing market: for the second version, dubbed HQ-M[1] henceforth, we employ the one period lag of the 12 month moving average of the housing permit growth, constructed as $\sum_{i=1}^{12}\Delta\log(Q^1_{t-i})$, where Q^1_t is the number of new housing permits at period t. The third version, dubbed HQ-M[2], employs new housing starts denoted by Q^2_t in a similar way.

One problem with the first strand of extended models described above is

that the phase of the economy is not directly related with housing market movements in those models, since the transition probabilities are assumed to be invariant across the whole sample period. In the second extension, therefore, we follow Filardo (1994) and allow the transition probabilities of the Markov state variable to depend upon the housing market variables:

$$\Pr[S_t = 0 | S_{t-1} = 0, Z_t] = \frac{\exp(q_0 + q_1 Z_t)}{1 + \exp(q_0 + q_1 Z_t)} = q(t), \qquad (5a)$$

$$\Pr[S_t = 1 | S_{t-1} = 1, Z_t] = \frac{\exp(p_0 + p_1 Z_t)}{1 + \exp(p_0 + p_1 Z_t)} = p(t). \qquad (5b)$$

If the estimates for (q_1, p_1) turn out to be significant, it directly follows that house price variables are important factors in explaining the expansion/recession episodes of the business cycle and the switches between the two regimes. The equations (1), (2'), (3), (4), and (5') constitute the second strand of extended models, and the three choices of housing market variables discussed above are considered again. The resulting three versions are dubbed HP-TP, HQ-TP[1], and HQ-TP[2], reflecting the use of hosing price or quantity variables in the transition probabilities.

To estimate the parameters of the baseline and the extended models, we cast them into state space forms and apply the method of Kim (1994). Based on the estimation results, inferences can be drawn on the unobserved common factor and its latent phases. We also expect that the comparison of the estimated recession probabilities for the baseline and the extended models will help reveal which of the historical recessions are likely to have been affected by the housing market movements.

III. Empirical Results

1. Data

We set off estimating the baseline model with four monthly coincident indicators for Y_{it}'s in the following order: (i) industrial production index; (ii) total personal income net of transfer payments (in 2005 dollars); (iii) total manufacturing and trade sales (in 2005 dollars); and (iv) total employees on nonfarm payrolls. All these four series are available as seasonally adjusted monthly series from the Federal Reserve Economic Data (FRED) and Bureau of Economic Analysis (BEA) database. They are transformed into logs, and then tested for their integration properties. The ADF and Phillip-Perron tests cannot reject the hypothesis that each of the series is integrated, and the Johansen test fails to reject the null of no cointegration among them. Therefore, we use as Δy_{it} the first log-differences of the four coincident indicators (multiplied by 100), spanning Feb:1976 to Sep:2011[5].

As measures of housing market quantities, we use nationwide new housing permits and housing starts measured in units[6]. The two series are available from the US Census Bureau at monthly frequency in seasonally adjusted form. The house price we use is the nationwide Freddie Mac House Price Index (FMHPI) available from the January of 1975 on[7]. This

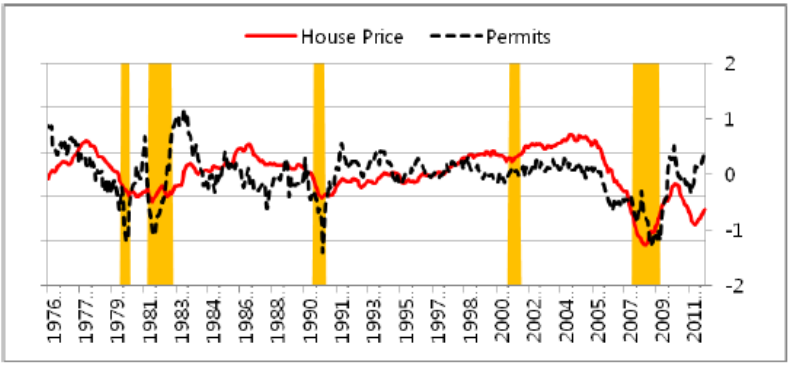
5) Although the four indicators are available from earlier than Jan:1975 on, the span of the demeaned series is shortened to match the availability of the control variable Z_t in the extended models.

6) The full names of the series are 'New Privately Owned Housing Units Authorized by Building Permits in Permit-Issuing Places' and 'New Privately Owned Housing Units Started'.

7) Another house price index with comparable frequency and length is the median sales prices of new homes available from the US Census Bureau. We did not use

index is constructed using a repeat transaction methodology, which controls for the changing composition of homes sold, and does not include transactions of new homes by construction. The FMHPI series is deflated by the CPI, and the resulting real house price series (in logs) is seasonally adjusted by the X-12 routine in Eviews 6.0.

[Figure 1] Housing Variables and Recession Periods



Note: House price and permits are measured in year-on-year growth. For the ease of visual inspection, the growth rate of the housing permits is re-scaled to match the standard deviation of the house price growth.

Figure 1 plots the real house price (in solid line) and the housing permits (in dashed line) series, along with the NBER recession dates in shades. Both series have difficulty predicting the 2001 recession caused by the burst of the IT bubble without accompanying conspicuous housing market slowdown. While house price growth over the past years show sharp decline prior to or at the early stage of each recession, it also fails to distinguish between the first two early recessions. In contrast, the movements in housing permits show sharp declines at the early stage of

this index because it shows too much noise and seasonal variations even after seasonal adjustment.

those two recessions separately. Although the correspondence between housing variables and recession/expansion phases is not perfect, we believe the plots in Figure 1 provides enough motivation for delving into the housing – business cycle relationship, especially between housing permits and business cycle.

2. Estimation Results

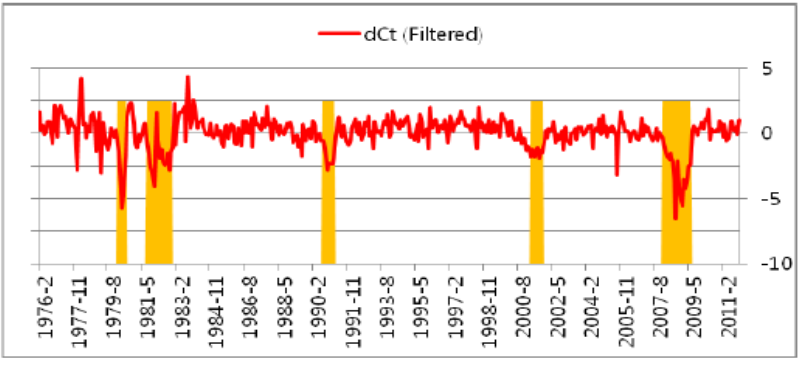
The estimation results for the baseline model turn out successful in extracting information about fluctuations in overall economic activity, and support the presence of two distinctive phase in the US business cycle. Since the detailed results are not of the main interest of the paper, we only provide the graphical summary in Figure 2[8].

In panel (a), the filtered estimates of the common factor growth are plotted (in solid line) along with the NBER recession dates (in shades). Except for a few spikes during the early period of the sample, the movement of the estimated common factor shows sharp downturns in the U.S. business cycle during the NBER-determined expansion/recession chronology. Panel (b) plots the filtered and smoothed estimates of the recession probability for each period, which give further support for the fit of the baseline model. While the filtered probabilities based on information up to each period give a few false alarms for recessions in some isolated periods (e.g., Jan:1978, Apr:1979, and Sep:2005), the smoothed probabilities based on the full sample information coincide almost perfectly with the official NBER business cycle chronology.

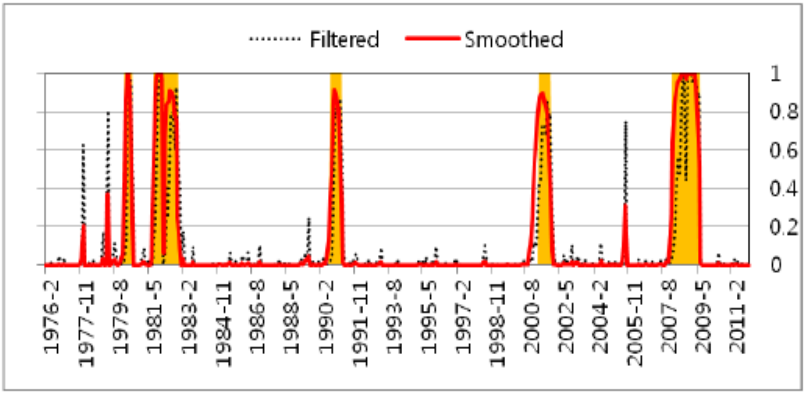
8) The whole estimation results for the baseline model are available from the author upon request.

[Figure 2] Estimation Results for the Baseline Model

(a) Common Factor Growth(%) and the NBER Recessions



(b) Estimated Recession Probabilities and the NBER Recessions



Having confirmed the decent fit of the baseline model, we proceed to estimate the extended models and examine the effect of housing market variables on the business cycle. Table 1 shows the key estimates of the three versions of the first extension, in which the housing market variables are incorporated in the modified mean equation (1)'.

<Table 1> Key Estimates for the Extended Models (1)

papameter	Baseline	HP-M	HQ-M[1]	HQ-M[2]
μ_0	-2.203	-2.060	-2.283	-2.141
	(0.138)*	(0.226)*	(0.287)*	(0.314)*
μ_1	0.258	0.257	0.238	0.279
	(0.036)*	(0.071)*	(0.070)*	(0.071)*
q	0.852	0.849	0.811	0.830
	(0.040)*	(0.048)*	(0.063)*	(0.065)*
p	0.980	0.981	0.981	0.980
	(0.005)*	(0.005)*	(0.005)*	(0.009)*
β_1	n.a	0.025	0.490	0.350
		(0.098)	(0.097)*	(0.093)*
β_2	n.a	0.136	0.327	0.243
		(0.069)	(0.077)*	(0.067)*
β_3	n.a	0.097	0.386	0.228
		(0.095)	(0.099)*	(0.095)*
β_4	n.a	0.098	0.181	0.139
		(0.044)*	(0.003)*	(0.029)*
log-LKHD	614.487	619.113	636.575	628.529
		[0.055]	[0.000]	[0.000]

Note: Standard Errors are in parentheses, and p-values are in square brackets. Asterisks denote significance are the 5% level.

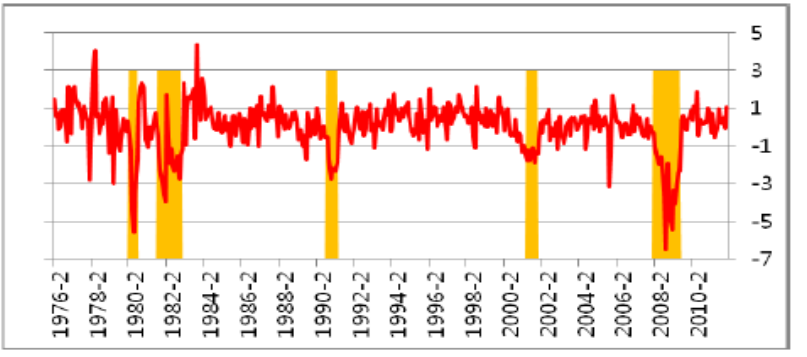
The results for the HP-M model are reported in the third column, where we fail to find strong evidence for the importance of the past house price growth for the US business cycle. The estimated coefficients β's on the house price growth are not significant for the production, income, and sales, and that for employment is only marginally significant. The maximized likelihood values convey the same picture: relative to the baseline model, the HP-M model yields the likelihood ratio statistic of $2 \times (619.113 - 614.487) = 9.252$ with the p-value of 5.51%, and therefore is not supported as an alternative to the baseline model. One may suspect that the reason for overall insignificance of the estimated β's

is that house price growth contains more of the variations common across the four series than of their idiosyncratic variations. Since the baseline model and HP-M models yield qualitatively and quantitatively similar estimates of the regime-specific intercepts (μ_0,μ_1) and the transition probabilities (q, p), however, we discard this conjecture as well.

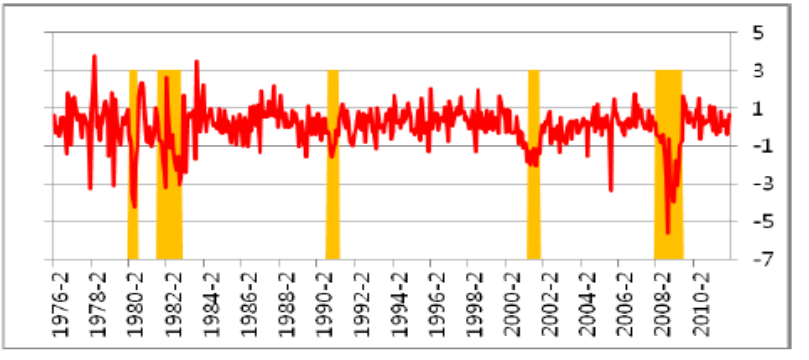
Turning to the two HQ-M type models, we note the housing permits and housing starts have significant effects on the business cycle: all β's are sharply estimated with expected signs, so higher rate of housing quantity growth over the previous year leads to higher growth in all individual series, with the largest effect of the housing quantities falling on industrial production. The likelihood ratio statistics for the HQ-M models have the p-value of virtually zero and clearly rejects the baseline model practically at any significance level. It is also worth noting that the housing quantity variables in the mean equation (1') affect the estimated of transition probabilities as well: unlike the house price increase, higher growth in housing permits and housing starts tend to lower the probability of continued recession. For example, the expected duration of the recession phase is estimated to be 1/(1-0.852)=6.76 months, but the duration under the HQ-M[1] model is 1/(1-0.811)=5.29 months. This in turn implies that, had it not been for the historical fluctuations in the housing permits, the span of the recession phase would have been shorter by one month an half on average. All in all, the results in Table 1 corroborate the claim of Leamer (2007) emphasizing the role of the housing quantity variables (but not the house price) in the US business cycle. In particular, the housing permits and housing starts affect the mean growth rates of the macro indicators, and the duration of the recessions as well.

[Figure 3] Common Factor Growth: Baseline vs. HQ-M[1]

(a) Baseline Model



(b) HQ-M[1] Model



Having confirmed the importance of housing quantities in the overall U.S. business cycle, we now turn to the question "which of the historical recessions is affected by those variables? To the extent that the estimation results for the extended models are net of the movement in housing variables, one way to address the question is to compare the estimated evolution of Δc_t across the baseline and extended models. We therefore plot the estimated common factor growth from the baseline and

the HQ-M[1] model in panel (a) and panel (b), respectively, of Figure 3. We note that the decline in the common growth is much more dampened in the HQ-M[1] model during all of the NBER recession periods except for the 2001 recession. More specifically, while the average common growth over the recession periods as low as −0.287 for the baseline model, that number from HQ-M[1] is −0.188. This finding strongly suggest that one reason for the historical downturns, except for the 2001 recession, was decline in housing permits prior to them.

We now turn to Table 2 where the results for the second strand of extended models are reported. One conspicuous feature is found in the third column for the HP-TP model: the house price growth turns out to significantly affect the transition probabilities (q(t), p(t)) of the common growth factor with the correct signs. For example, regarding the probability q(t) of continued recession, the coefficient q_1 on the house price growth is sharply estimated to be −3.174. This estimate implies that, given that the economy was in recession in the last period, higher house price growth rate over the previous year significantly lowers the probability of a back-to-back recession (or equivalently, significantly raises the probability of switching to expansion) in the current period. The coefficient p_1=2.663 for the probability of continued expansion is also sharply estimated with a correct sign, implying that higher house price growth rate over the previous year significantly raises the probability of a back-to-back expansion (or equivalently, significantly lowers the probability of switching to recession) in the current period. The significance of the house price growth for the time-varying transition probabilities is also exhibited by the likelihood ratio test statistic: with the p-value of 0.019, the null of the baseline model is clearly rejected in favor of the HP-TP model.

<Table 2> Key Estimates for the Extended Models (2)

parameter	Baseline	HP-TP	HQ-TP[1]	HQ-TP[2]
μ_0	-2.203 (0.138)*	-2.173 (0.226)*	-2.196 (0.269)*	-2.157 (0.261)*
μ_1	0.258 (0.036)*	0.215 (0.071)*	0.204 (0.061)*	0.193 (0.062)*
q_0	-1.007 (0.456)	-0.050 (0.098)	1.043 (0.838)	1.264 (0.855)
p_0	3.976 (0.293)*	4.205 (0.069)*	10.209 (0.516)*	10.791 (0.167)*
q_1	n.a	-3.174 (0.842)*	-0.560 (0.959)	-0.203 (0.997)
p_1	n.a	2.663 (1.109)*	14.117 (0.430)*	13.656 (0.203)*
log-LKHD	614.487	618.446 [0.019]	625.964 [0.000]	621.225 [0.001]

Note: Standard Errors are in parentheses, and p-values are in square brackets. Asterisks denote significance at the 5% level.

When we look at the last two columns for the two HQ-TP type models, the importance of housing quantity variables is also supported strongly. The likelihood ratio statistics reject the null of baseline for the two extended models HQ-TP[1] and HQ-TP[2] virtually at any level of significance. One key difference is found, however, from the results for the HP-TP model: while the house price growth affects both of the two transition probabilities (q, p) via the significant coefficients (q1, p1), the housing permits and housing starts affects only the probability p(t) of continued expansion (or the probability 1-p(t) of switching from current expansion to recession). Put differently, the movement in house prices contains useful information on the phase in the next period regardless of the current phase of the economy, but those in housing quantities are useful mainly when the economy is currently in expansion.

In summary, both the house price and quantities turn out to be nontrivial

in the transition of the overall economy between expansion and recession phases. Moreover, when the economy is in recession, house price provide additional piece of information on the phase of the economy in the future, which is not the case for housing quantity variables.

Ⅳ. Conclusion

In this paper, we assess the relationship between housing and the overall business cycle in the US. The conventional wisdom regarding this relationship has viewed housing prices as a potential driving force of the business cycles, as witnessed over the global economic boom and bust in the past decade. In a recent paper, however, Leamer (2007) put the conventional wisdom into question by arguing that it is fluctuations in housing market quantities (such as residential investments) not in prices that have affected the overall postwar US economy. By evaluating and comparing the importance of the price and quantity variables from the housing markets in the evolution of the business cycle, this paper attempts to further our understanding of the housing-business cycle relationship in the US.

When the housing market variables are specified as directly affecting the key macroeconomic variables such as GDP, consumption, and investment, the results are at odds with the conventional wisdom and square with the finding of Leamer: the increase in new housing permits and housing starts turn out to affect the average growth rates of the three macroeconomic variables, but we fail to find similar evidence for housing price increase.

When we allow the housing variables to affect the probabilities that governs the switching of the US economy between expansions and recessions, the results are quite different and in line with the conventional

wisdom: the larger the increase in house prices is over the past year, the more likely the economy continues to be in expansion or switched from recession to expansion. Therefore, the movements in house prices contain important information about the phase of the economy in the future, whether the economy is currently in expansion of recession. In contrast, the movements housing permits and starts turn out to be informative only when the economy is currently in expansion.

It should be stressed that our results are based on a particular form of model and data series used for the US. As such, the findings in the current paper should be examined further for the robustness using data with different frequencies (such as quarterly series) or at different levels (such as city-level data). Also, extending the analysis of the paper to other advanced countries that have experienced a conspicuous boom-bust in the housing and the overall economy is an interesting topic of future research.Overall, our results support the importance of house variables at the current juncture of the US economy experiencing a weak recovery and sluggishness in housing market. According to our empirical results, a further slowdown in house price or quantities may drag the economy with it, turning the weak recovery into another recession. At the same time, improvements in housing market conditions would render a continued expansion more likely. Examining which scenario is more plausible is another topic in our future research agenda.

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Abstract

Housing and the US Business Cycle: Price or Quantity?

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This paper analyzes the relationship between housing and the business cycle in the US. We start with constructing and estimating a baseline Markov-switching common factor model, and the importance of housing variables is then evaluated by comparing the results for the baseline model with those for the extended models augmented with the housing market variables. Two strands of extended models are considered: one in which housing variables directly affect the individual macroeconomic series and thereby the business cycle, and the other in which they affect the probabilities of transitions between expansion/recession phases.

Results for the first extension support the importance of the housing quantity variables as argued by Leamer (2007): the growth in housing permits and housing new housing starts exert significant effects on the macroeconomic indicators and consequently the business cycle, but house price growth does not. For the second extension, however, we find that house price growth contains useful information beyond what is in the housing quantity variables. More specifically, while higher quantity growth affects which phase will prevail in the next period only when the economy is currently in the expansion, higher house price growth is informative whether the economy is currently in recession or expansion.

Key words: House Price, Hosing Quantity Variables, Business Cycle, Markov Switching, Transition Probabilities
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