Linking U.S. State-level housing market returns, and the consumption-(Dis)Aggregate wealth ratio

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ABSTRACT

Using state-level data for the U.S. housing market over the period of 1975:Q1-2012:Q2, we show that the consumption-wealth ratios derived from aggregate wealth (*cay*) and disaggregate (i.e. financial and housing) wealth (*cday*) are strong predictors of real housing returns (and their volatility). Additionally, we rely on a nonparametric causality-in-quantiles test, and find that, barring the extreme ends of their respective conditional distributions, such effect is stronger for housing return volatility than housing returns. The empirical results also give support to the existence of nonlinearities in the link between housing returns and *cay* or *cday*. All in all, our findings show that state-level regressions can recover a large degree of heterogeneity that country-level exercises typically ignore. Such heterogeneity is prominent not only in terms of consumption smoothing behaviour, but also with regard to housing return predictability.

Keywords: consumption-wealth ratio, housing returns, volatility, forecasting, nonparametric causality-in-quantiles test.
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1. INTRODUCTION

Since the original study by Lettau and Ludvigson (2001), several works in the empirical finance literature have uncovered a strong predictive power of the consumption-wealth ratio (*cay*) for future stock (and bond) market returns and volatility.[1] Relying on the same assumption of the representative agent's preference for consumption smoothing, Sousa (2010) made an important contribution by formulating a forward-looking model and deriving a discounted present value equation that links the residuals of the trend relationship among consumption, financial wealth and housing wealth, and labor income (labelled by *cday*) and future stock market returns. The empirical evidence therein also showed that the predictor *cday* outperforms the original *cay* variable given its ability to track the wealth composition risk.

In the wake of the global financial crisis of 2008-2009, various pieces of research have also highlighted the role played by housing market returns and their volatility in driving aggregate and regional business cycles, besides housing investment.[2] Indeed, housing assets differ from financial assets in that they serve the dual role of investment and consumption (Henderson and Ioannides, 1987). Housing risk is also among the largest economic risks faced by individuals (Shiller, 1998) and house price volatility is an important input to housing policy (Zhou and Haurin, 2010).[3] Thus, understanding the source of housing market volatility has implications for asset portfolios, as it affects households' investment decisions regarding tenure choice and housing quantity (Miles, 2008). Not surprisingly, a few studies have extended the role of *cay* in forecasting housing returns and their volatility.[4]

In this context, we use country- and state-level data for the U.S. housing market over the period of 1975:Q1-2012:Q2 to investigate the forecasting power of the consumption-(dis)aggregate wealth ratios for real housing returns and their volatility. This is the major goal of this paper.

As housing markets may display different dynamics across states (Apergis and Payne, 2012; Montañés and Olmos, 2013; Barros *et al.*, 2014; Miles, 2015), consumption-wealth ratios constructed using data for the country as a whole may not be good predictors of regional housing returns. For this reason, the first novelty of the current work is that we use a novel state-level

[1] See, for instance, Ludvigson and Ng (2007), Afonso and Sousa (2011), Rocha Armada and Sousa (2012), Rapach and Zhou (2013), Rocha Armada *et al.* (2015), Sousa (2015), Bianchi *et al.* (2016), Sousa *et al.* (2016), Balcilar *et al.* (2017b) and Chang *et al.* (2018).
[2] See, for example, Leamer (2007, 2015), Balcilar *et al.* (2014), Nyakabawo *et al.* (2015), Emirmahmutoglu *et al.* (2016), Christidou and Fountas (2018) and Thanh *et al.* (forthcoming).
[3] For example, if house prices of low-income households are relatively volatile, then, policies that encourage low-income renters to become homeowners should carefully be evaluated on account of the house price risk that they bear.
[4] See, for instance, Caporale and Sousa (2016), Balcilar *et al.* (2017b) and Caporale *et al.* (forthcoming).

dataset to estimate consumption equations and retrieve the elasticities of consumption with respect to aggregate and (dis)aggregate wealth and labour income for all 50 U.S. states, including the District of Columbia (D.C.). We find that these elasticities differ considerably across states: the sensitivity of consumption with respect to housing wealth is significant in 43 out of 50 U.S. states (plus D.C.), and housing wealth effects are larger than financial wealth effects in all but 6 out of those 43 cases.

Our second contribution of our paper to the existing literature is that we rely on cointegration analysis to generate state-level predictors (i.e. *cay* and *cday*), and assess their forecasting power for state-level future housing returns. We show that deviations from the equilibrium relationship among state-level consumption, asset wealth and labour income are positively related with state-level future housing returns, that is, investors temporarily allow their consumption to rise above its equilibrium level when they expect real housing returns to increase in the future.

Additionally, both *cay* and *cday* display strong predictive ability: at the four quarter-ahead horizon, *cay* explains 20% (Oklahoma), 23% (Texas), 26% (Utah), 29% (Oregon), 32% (Wyoming), 33% (New Mexico) and 35% (Louisiana) of the variation in real housing returns; and *cday* predicts a fraction of 20% (Nebraska), 23% (California, Connecticut, Michigan and Washington), 30% (Rhode Island), 33% (Oregon and Texas), 45% (Louisiana and Oklahoma) and 58% (Wyoming) of the dynamics of four quarter-ahead real housing returns. In many other states, the forecasting power of both empirical proxies lies above 10%. Given that, for the U.S. as a whole, the predictive ability of *cay* or *cday* at different forecasting horizons ranges between 9% and 14% in time-series frameworks, or between 2% and 5% in panel estimations, our results corroborate the idea that country-level estimates "mask" important variation about investors' preferences and housing return predictability at the state-level.

Finally, the third element of value-added of the research included in this paper is that we evaluate the forecasting power of state-level *cay* and *cday* over the entire conditional distributions of both state-level housing returns and volatility by means of the *k*-th order nonparametric causality-in-quantiles frameworks developed by Balcilar *et al.* (2017a, 2017b, 2018). While these allow us to control for mis-specification due to missing nonlinearity, we do so in a forecasting regression setup that fully matches state-level housing returns and volatility (i.e. the predicted variables) with state-level *cay* and *cday* (i.e. the predictors) and, for comparison, we also provide evidence for the U.S. as a whole.

Our empirical findings reveal that: (i) with the exception of the tails of the corresponding distributions, the empirical proxies track particularly well housing return volatility and housing returns; (ii) the relationship between housing returns and *cay* or *cday* displays some nonlinearity; and (iii) *cday* slightly outperforms *cay*.

The research presented in this work is highly indebted to the studies of Lettau and Ludvigson (2001), Sousa (2010), Afonso and Sousa (2011) and Sousa *et al.* (2016) among others, who build on the consumption-wealth ratio to provide evidence about asset return predictability. It is also close in spirit to the works of Caporale and Sousa (2016), Balcilar *et al.* (2017b) and Caporale *et al.* (forthcoming), who extend the analysis to forecasting housing returns. Finally, it is inspired by the study of Della Corte *et al.* (2010), who re-examine the predictive ability of the consumption-wealth ratio, and exploit the *time-series* dimension by using data for the U.S., the U.K., France and Japan spanning one century. We focus on the *cross-sectional* dimension instead, by exploring unique state-level data for the U.S..

The rest of the paper is organized as follows. Section 2 briefly describes the econometric methodology. Section 3 presents the data, while Section 4 discusses the empirical results. Finally, in Section 5, we summarise the main conclusions.

2. ECONOMETRIC METHODOLOGY

We start by following Lettau and Ludvigson (2001) and obtain estimates of *cay* by recovering the residuals of the cointegrating relationship between consumption, aggregate wealth and labour income. As in Sousa (2010), we compute *cday* as the time-series of the residuals from the estimated long-run equation linking consumption with financial wealth, housing wealth and labour income. In both cases, we use the dynamic ordinary least squares (DOLS) estimator of Stock and Watson (1993), which controls for potential endogeneity of the regressors.

Next, we follow Nishiyama *et al.* (2011), Jeong *et al.* (2012) and Balcilar *et al.* (2017a, 2017b, 2018) and use a hybrid approach to test for nonlinear causality in the relationship between housing returns (or their volatility) and either *cay* or *cday*.

Let y_t denote the predicted variable and x_t represent the predictor, and assume that $Y_{t-1} \equiv (y_{t-1}, \dots, y_{t-p})$, $X_{t-1} \equiv (x_{t-1}, \dots, x_{t-p})$, $Z_t = (X_t, Y_t)$, and $F_{y_t|\bullet}(y_t| \bullet)$ corresponds to the conditional distribution of y_t given $\bullet$. If we define $Q_\theta(\bullet) \equiv Q_\theta(y_t| \bullet)$, then, $F_{y_t|Z_{t-1}}\{Q_\theta(Z_{t-1})|Z_{t-1}\} = \theta$ with probability one. Thus, we can test the (non)causality in the θ th quantile hypotheses in the *first* moment of housing market returns (y_t), i.e.:

$$H_0: \ P\{F_{y_t|Z_{t-1}}\{Q_\theta(Y_{t-1})|Z_{t-1}\} = \theta\} = 1 \tag{1}$$

$$H_1: \ P\{F_{y_t|Z_{t-1}}\{Q_\theta(Y_{t-1})|Z_{t-1}\} = \theta\} < 1 \tag{2}$$

Jeong *et al.* (2012) show that the feasible kernel-based test statistics can be expressed as:

$$\hat{J}_T = \frac{1}{T(T-1)h^{2p}} \sum_{t=p+1}^{T} \sum_{s=p+1, s\neq t}^{T} K\left(\frac{Z_{t-1}-Z_{s-1}}{h}\right) \hat{\varepsilon}_t \hat{\varepsilon}_s \quad (3)$$

where $K(\bullet)$ is the kernel function with bandwidth h, T is the sample size, p is the lag order. $\hat{\varepsilon}_t = \mathbf{1}\{y_t \leq \hat{Q}_\theta(Y_{t-1})\} - \theta$ is the estimated disturbance term from the θ^{th} conditional quantile regression of y_t on Y_{t-1}, where $\hat{Q}_\theta(Y_{t-1})$ is the estimated θ^{th} conditional quantile and $\mathbf{1}\{\bullet\}$ is an indicator function.

Using a nonparametric kernel method, we obtain the *Nadarya-Watson* kernel estimator of $\hat{Q}_\theta(Y_{t-1})$, i.e.

$$\hat{Q}_\theta(Y_{t-1}) = \frac{\sum_{s=p+1, s\neq t}^{T} L\left(\frac{Y_{t-1}-Y_{s-1}}{h}\right) \mathbf{1}\{y_s \leq y_t\}}{\sum_{s=p+1, s\neq t}^{T} L\left(\frac{Y_{t-1}-Y_{s-1}}{h}\right)} \quad (4)$$

where $L(\bullet)$ denotes the kernel function.

In addition to the setup described by equations (1)-(4), which allow us to test for causality between housing market returns and either *cay* or *cday*, we also test for causality between housing market volatility and the predictors. Therefore, based on the work of Nishiyama *et al.* (2011) and its extension by Jeong *et al.* (2012), we follow Balcilar *et al.* (2017a, 2017b, 2018) and test the (non)causality in the θ^{th} quantile hypotheses in the k^{th} moment of housing market returns (y_t^k), i.e.:

$$H_0\text{:}\ \ P\left\{F_{y_t^k|Z_{t-1}}\{Q_\theta(Y_{t-1})|Z_{t-1}\} = \theta\right\} = 1, \quad k = 1, 2, \dots, K \quad (5)$$

$$H_1\text{:}\ \ P\left\{F_{y_t^k|Z_{t-1}}\{Q_\theta(Y_{t-1})|Z_{t-1}\} = \theta\right\} < 1, \quad k = 1, 2, \dots, K \quad (6)$$

The causality-in-variance test can, thus, be computed by replacing y_t in equations (3)-(4) with y_t^2, and the rescaled version of the $\hat{J}_T$ is asymptotically normally distributed (Balcilar *et al.*, 2018).

Finally, to perform the nonparametric causality-in-quantiles test, we choose the lag order (p) in accordance with the Schwarz Information Criterion (SIC) applied to a VAR model including housing returns (or their volatility) and either *cay* or *cday*. The bandwidth (h) is determined by a leave-one-out least-squares cross-validation procedure. And we use Gaussian kernels for $K(\cdot)$ and $L(\cdot)$.

3. DATA

Our predictors, *cay* and *cday*, are computed at the state-level. Thus, we use state-level data for household consumption, financial wealth, owner-occupied housing wealth and personal income from Case *et al.* (2005, 2013). All variables are expressed in logs of per capita, real terms, with the time-series being deflated using the Consumer Price Index (CPI) - All Urban Consumers (with the base year of 1982-1984) obtained from the Bureau of Labor Statistics (BLS) via the FRED database of the Federal Reserve Bank of St. Louis.

Due to data availability, there are two main limitations of the dataset: (i) households' consumption spending is proxied by total retail sales; and (ii) households' financial wealth includes holdings of mutual funds only. Nevertheless, this is virtually the only dataset that contains unique information about aggregate wealth (and its composition) for each of the 50 U.S. states (plus D.C.) and over a relatively long period of time (i.e. 1975:Q1-2012:Q2).

Concerning house price data, we use all-transactions single-family house price indices from the Federal Housing Finance Agency (FHFA), which can be downloaded from: https://www.fhfa.gov/DataTools/Downloads/Pages/House-Price-Index-Datasets.aspx#qat. These house prices are weighted, repeat-sales indices, which track average price changes in repeated sales or refinancing of the same properties. Since January 1975, this information is gathered from repeated mortgage transactions on single-family properties whose mortgages have been purchased or securitized by either Fannie Mae or Freddie Mac. We seasonally adjust house price data using the X-13 approach of the U.S. Census Bureau.

Finally, real housing returns (*rhr*) are defined as the difference between the continuously compounded log of (nominal) housing returns and the inflation rate, which is computed using CPI data. The volatility of real housing returns (*rhv*) corresponds to the squared values of *rhr*.

Table 1 provides summary statistics of real housing returns for the 50 U.S. states (plus D.C.) and the country as a whole. With the exception of the states of Connecticut, Massachusetts, Rhode Island, Texas and Washington, normality is overwhelmingly rejected, which suggests an assessment of causality based on the whole conditional distribution instead of the conditional mean only.

4. EMPIRICAL RESULTS

4.1. THE LONG-RUN RELATIONSHIP BETWEEN U.S. STATE-LEVEL CONSUMPTION, (DIS)AGGREGATE WEALTH AND LABOUR INCOME

Our starting point is the estimation of the long-run equilibrium relationships between consumption, (dis)aggregate wealth and labour income. Thus, Table 2 summarise the point coefficient estimates associated with *cay* and *cday* after regressing state-level consumption equations using a DOLS estimator with Newey and West (1987) standard errors. The bottom panel also provides the empirical evidence for the U.S. as a whole.

In general, the elasticities of consumption with respect to aggregate wealth and labour income are positive and statistically significant, which shows that consumption displays a positive long-term relationship with the two variables. They also considerably different across states, which reinforces the idea that *cay* and *cday* measures computed for the U.S. as a whole are not able to capture such cross-state heterogeneity.

Additionally, when we disaggregate wealth into its two major components (i.e. financial and housing wealth), we find that housing wealth is significant in 43 out of 50 U.S. states (plus D.C.), with the sensitivity of consumption with respect to housing wealth being larger compared to financial wealth in all but 6 out of those 43 cases. This result is in accordance with the work of Sousa (2010), who highlights the importance of wealth composition risk and shows that fluctuations in housing wealth tend to have a stronger impact on consumption because they are very persistent and, thus, perceived as permanent. By contrast, financial wealth shocks are mainly transitory and, therefore, have a more muted effect on consumption.

The bottom panel of Table 2 shows that, for the U.S. as a whole, the long-run elasticity of consumption with respect to asset wealth is 0.11, while the long-run elasticity of consumption with respect to labour income is 0.75. Considering the disaggregation of asset wealth, it can be seen that the long-run elasticity of consumption with respect to financial wealth is less than 0.07, while the long-run elasticity of consumption with respect to housing wealth is 0.08. All in all, these empirical estimates imply that the share of asset holdings in aggregate wealth range between 12.6% and 17.3%, whereas the share of human capital is 82.7%-87.4%.

To account for potential cross-state unobserved heterogeneity, we also estimate the consumption equations using a panel fixed-effects (FE) estimator. Table 3 summarises the point coefficient estimates of the trend relationship among consumption, (dis)aggregate wealth and labour income.

Again, the elasticities of consumption with respect to asset wealth and labour income are positive and statistically significant. Moreover, the long-run elasticity of consumption with respect to housing wealth (0.094) is almost three times larger in magnitude than the long-run elasticity of consumption with respect to financial wealth (0.035). This confirms the primary role of housing wealth in shaping the dynamics of consumption, as suggested by the DOLS regressions at the state- and the country-level.

4.2. FORECASTING U.S. STATE-LEVEL HOUSING RETURNS

To assess the forecasting power of *cay* and *cday* estimated using state-level data for future real housing returns at different time horizons, we regress the following models

$$\sum_{h=1}^{H} rhr_{t+h} = \alpha + \gamma cay_{t-1} + \zeta_t \quad (6)$$

$$\sum_{h=1}^{H} rhr_{t+h} = \alpha + \gamma cday_{t-1} + \zeta_t \quad (7)$$

where the *H*-period real housing return, $rhr_{t+1} + \ldots + rhr_{t+H}$, is regressed on the lag of consumption-wealth ratio, cay_{t-1}, or the lag of consumption-(dis)aggregate wealth ratio, $cday_{t-1}$. As highlighted by Lettau and Ludvigson (2001), Sousa (2010) and Afonso and Sousa (2011), these empirical proxies track time-variation in risk premium at the country level, and we explore its predictive ability at the state level.

Table 4 summarises the main findings based on OLS regressions. It can be seen that the point coefficient estimates of both cay_t and $cday_t$ are positive for almost all states (except for Illinois). This result is in line with the theoretical reasoning that investors temporarily allow consumption to rise above (fall below) its equilibrium relationship with (dis-)aggregate wealth and labour income when they expect housing returns to increase (decrease) in the future. Thus, deviations in the long-term trend among state-level c_t, a_t and y_t should be positively related to state-level future housing returns.

Both empirical proxies are also statistically significant in a large number of cases. Indeed, with the exceptions of D.C., Main, Mississippi, New York and South Dakota, at least one of the two variables significantly forecast future housing returns. While there are only two states in which *cday* is not significant but *cay* displays statistical significance - Maryland and Tennessee -, the opposite holds in several states, namely: Alaska, Georgia, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Montana, Nebraska, North Carolina, North Dakota, Ohio, Pennsylvania and Vermont. This suggests that wealth composition risk - which *cday* tracks - is an important driver of state-level housing returns.

The consumption-(dis-)aggregate wealth ratio also explains an important percentage of the dynamics of future housing returns at the state-level (as described by the adjusted R-square), especially, at horizons spanning from three to four quarters. For instance, at the four quarter-ahead horizon, cay_t forecasts a fraction of 10% (Connecticut and South Carolina), 11% (Arkansas and New Jersey), 14% (Hawaii, Nevada, Rhode Island and Virginia), 20% (Oklahoma), 23% (Texas), 26% (Utah), 29% (Oregon), 32% (Wyoming), 33% (New Mexico) and 35% (Louisiana) of the variation in real housing returns. At the same horizon, $cday_t$ predicts 10% (West Virginia), 11% (Hawaii), 12% (Colorado and Iowa), 13% (Massachusetts, Nevada, Ohio and Virginia), 14% (New Jersey), 15% (Indiana and North Dakota), 16% (Kansas), 17% (South Carolina), 18% (Delaware and Idaho), 19% (New Mexico), 20% (Nebraska), 23% (California, Connecticut, Michigan and Washington), 30% (Rhode Island), 33% (Oregon and Texas), 45% (Louisiana and Oklahoma) and 58% (Wyoming). Therefore, $cday_t$ tends to over-perform cay_t and, for the other states, the predictive ability of both empirical proxies amounts to less than 10%.

Interestingly, the bottom panel of Table 4 shows that, for the U.S. as a whole, cay_t is not statistically significant, while $cday_t$ forecasts between 9% and 14% of future housing returns for horizons up to eight quarters-ahead. Thus, country-level information "masks" important variation about the dynamics of real housing returns and investors' preferences for consumption smoothing that we are able to capture with state-level data.

To investigate this issue further, we re-estimate equations (6)-(7) using a panel structure, that is, we regress:

$$\sum_{h=1}^{H} rhr_{i,t+h} = \alpha + \gamma cay_{i,t-1} + \zeta_{i,t} \quad (8)$$

$$\sum_{h=1}^{H} rhr_{i,t+h} = \alpha + \gamma cday_{i,t-1} + \zeta_{i,t} \quad (9)$$

where the H-period real housing return of state i, $rhr_{i,t+1} + \ldots + rhr_{i,t+H,}$ is regressed on the lag of consumption-wealth ratio, $cay_{i,t-1}$, or the lag of consumption-(dis)aggregate wealth ratio, $cday_{i,t-1}$ of state i. By doing so, we merge the time-series (t) and the cross-sectional dimensions (i), which enables us to benefit from the accuracy and power associated with the use of around 7,600 data points.

In Table 5, we present the main results associated with a panel fixed-effects (FE) estimator applied to equations (8)-(9). As noted before, this empirical methodology is particularly well-suited to account for cross-state unobserved heterogeneity. The Table confirms the predictive power of the consumption-wealth ratios. Both empirical proxies are statistically significant and the point coefficient estimates associated with cay_t and $cday_t$ are positive: at the one quarter-ahead horizon, both variables explain 2% of real housing returns; their forecasting power reaches a peak of predictability at the three quarter-ahead horizon (namely, 4% in the case of cay_t and 5% for $cday_t$); and, at the eight quarter-ahead horizon, the predictive ability of cay_t stands at 2%, while it is still around 4% for $cday_t$.

Summing up, time-series and panel data experiments corroborate the importance of the consumption-wealth ratios as predictors of real housing returns. However, country-level exercises typically ignore a large degree of heterogeneity that state-level regressions are able to recover.

4.3. A NONPARAMETRIC CAUSALITY-IN-QUANTILES TEST USING U.S. STATE LEVEL DATA

Albeit our key goal is to analyse the causality-in-quantiles from either *cay* or *cday* to real housing returns and their volatility, we also perform standard linear (i.e. conditional mean-based) Granger causality tests. The complete set of results is reported in Table 6 and it can be seen that the null of no causality from either *cay* or *cday* to *rhr* cannot be rejected for 28 states (namely, Arizona, Arkansas, California, Colorado, Illinois, Iowa, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Minnesota, Missouri, Montana, Nebraska, Nevada, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, Oklahoma, Rhode Island, Vermont, Virginia, Washington and West Virginia), and D.C.. In addition, for Georgia and Oregon, there is no evidence of causality from *cday* to *rhr*, and *cay* fails to predict *rhr* in Florida, Idaho, Indiana, Kansas, Michigan, Mississippi, Pennsylvania, Tennessee and Wyoming, as well as for the U.S. as a whole. Consequently, linear Granger causality tests suggest that the predictive ability of either *cay* or *cday for* housing market returns is weak, with 29 out of 52 cases showing no causality.

We now assess if the relationship between real housing returns and the two predictors is nonlinear or not, by applying the Brock *et al.* (BDS, 1996) test on the residuals of the returns equation of the VAR model involving either *cay* or *cday*. The *z*-statistics of the BDS test are reported in Table 7 and strongly reject the null hypothesis of no serial dependence. This evidence casts doubts about the validity of the linear Granger causality tests and corroborates the presence of nonlinearity between housing returns and the predictors.

In light of the previous findings, we run nonparametric causality-in-quantiles tests, which can properly account for the nonlinearity previously uncovered. Thus, instead of focusing on conditional mean-based linear Granger causality tests, we evaluate the rejection of the null of no-causality (at the 5% level of significance, i.e. for test statistic being greater than or equal to 1.96) between either *cay* or *cday* (i.e. the predictors) and either real housing returns (*rhr*) or their volatility (*rhv*) (i.e. the predicted variables) over the entire (conditional) distribution of *rhr* and *rhv* (i.e. for quantiles ranging between 0.05 and 0.95).

The empirical findings for housing market returns are summarised in Table 8, while those for housing market volatility are reported in Table 9. Besides all cases where we detected predictability from *cay* and *cday* under the linear model, nonparametric causality-in-quantiles is also observed for: *(i) cay* in five additional states (namely, Idaho, Indiana, Kentucky, Mississippi and Wyoming); *(ii) cday* in one additional state (i.e. Georgia); and both *cay* and *cday* in three additional states (that is, Illinois, Vermont and West Virginia). Therefore, compared to linear Granger causality tests, nonparametric causality-in-quantiles tests detect predictability in 9 additional states.

Additionally, *cay* and *cday* predictability seems to hold across a wide range of quantiles with the exception of the tails of the distribution, i.e. when housing market returns are abnormally very high or very low.

Concerning the volatility of housing market returns, we find that, with the exception of nine U.S. states (i.e. Connecticut, Georgia, Kentucky, Massachusetts, Minnesota, New Mexico, South Carolina, Utah and Virginia), either *cay* or *cday* are able to predict the conditional distribution at a wide range of quantiles. In addition, *cay* does not forecast housing market volatility in Kansas and Pennsylvania and *cday* does not predict the volatility of housing returns in Texas. These results are close in spirit with the evidence in Balcilar *et al.* (2017b), who show that *cay* and a Markov-Switching version of *cay* (i.e. cay^{MS}) can capture the distribution of equity and housing risk premium in the U.S. as a whole. Moreover and as with housing market returns, neither *cay*, nor *cday* appear to predict the tails of the distribution of housing market volatility.

A summary of the results from the nonparametric causality-in-quantiles tests regarding housing returns and their volatility is reported in Table 10. All in all, there are only four states (i.e. Virginia, New Mexico, Minnesota and Massachusetts) for which both *cay* and *cday* fail to cause returns and volatilities. In addition, *cay* also fails to forecast housing market returns and their volatility in the case of Pennsylvania and Kansas.

Moreover, while the performance of *cay* and *cday* is, in general, similar, it is important to highlight that: *(i)* in contrast with *cday*, *cay* fails to pick up predictability of volatility in five states (i.e. Florida, Kansas, Michigan, Pennsylvania and Tennessee); whilst *(ii)* in contrast with *cay*, *cday* fails to pick up predictability of in two states only (i.e. Kentucky and Oregon). Put it differently, *cday* marginally outperforms *cay* in predicting *rhr* and *rhv*.

In sum, given the strong evidence corroborating a nonlinear linkage between the consumption-wealth ratios and real housing returns, the nonparametric causality-in-quantile framework is particularly relevant as it allows us to study the effect of those predictors on both returns and their volatility. Indeed, we show that the ratios tend to predict volatility even more strongly than returns. In addition, the nonparametric causality-in-quantile tests make it possible to obtain further information about the predictive power of *cay* and *cday* for the conditional distributions of housing returns and their volatility. In fact, we confirm that, barring the extreme quantiles (i.e. the tails of the distribution), the consumption-wealth ratios are strong predictors of housing returns and their volatility at different quantiles. This result suggests that investors might simply be herding during such extreme episodes and, hence, do not track closely the dynamics of *cay* and *cday* at periods of stress in real estate markets (Balcilar *et al.*, 2017b).

5. CONCLUSION

In this paper, we construct consumption-(dis)aggregate wealth ratios (i.e. *cay* and *cday*) for the U.S. at the state-level, and analyse their ability to predict real housing returns and their volatility over the period of 1975:Q1-2012:Q2. We also rely on nonparametric causality-in-quantiles tests, which adequately capture the existence of a nonlinear relationship between real housing returns (and their volatility) and either *cay* or *cday*, a feature that linear Granger causality tests typically miss due to misspecification.

All in all, we show that state-level regressions can recover a large degree of heterogeneity - regarding consumption smoothing behaviour and housing return predictability - that country-level exercises typically ignore. Indeed, we find that the elasticities of consumption with respect to financial wealth and housing wealth vary considerably across states, with housing wealth effects being larger than financial wealth effects in 37 cases. Similarly, while *cay* explains 20% or more of the variation in real housing returns in states like Louisiana, New Mexico, Oklahoma, Oregon, Texas, Utah and Wyoming, it is displays no predictive ability for housing returns in Alaska, Georgia, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Montana, Nebraska, North Carolina, North Dakota, Ohio, Pennsylvania and Vermont. Likewise, the forecasting power of *cday* differs substantially across states. And, for the U.S. as a whole, the predictive ability of *cay* or *cday* lies in the range of 9%-14% in time-series estimations, or 2%-5% in panel frameworks. Finally, with the exception of extreme events (that lay at the tails of the distribution), we find that both *cay* and *cday* are strong predictors of the distribution of real housing returns and, most importantly, their volatility. In addition, *cday* slightly outperforms the forecasting power of *cay*.

Our results have important implications for investors and policymakers, as it is well-known that changes in housing prices can explain a large fraction of business cycle fluctuations, as well as recession episodes. Moreover, housing market volatility is relevant for asset portfolio management and a key driver of mortgage default and pre-payment. In this context and from a practitioner's view point, the information contained in the consumption-(dis)aggregate wealth ratios can contribute to an optimisation of asset portfolio opportunities. From a policy perspective, it can also signal the emergence of stress periods in real estate markets.

Finally, our paper sets the stage for new research avenues. Thus, a promising direction includes the investigation of nonparametric causality-in-quantiles in an out-of-sample framework (Bonaccolto *et al.*, 2018). We leave this for the future.

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List of Tables

Table 1. Summary statistics of real housing returns (*rhr*).

States	Mean	Median	Std. Dev.	Skewness	Kurtosis	JB	*p*-value
Alabama	-0.001	0.001	0.022	-0.442	9.186	242.445	0.000
Alaska	0.000	0.001	0.051	-0.099	11.198	417.482	0.000
Arizona	0.000	0.005	0.029	-0.249	4.143	9.647	0.008
Arkansas	-0.001	0.000	0.019	-1.346	10.053	353.886	0.000
California	0.005	0.004	0.026	-0.594	5.403	44.629	0.000
Colorado	0.002	0.003	0.017	0.787	5.256	46.978	0.000
Connecticut	0.002	0.004	0.024	0.309	3.125	2.475	0.290
Delaware	0.001	0.005	0.051	-3.442	38.258	8012.196	0.000
DC	0.007	0.007	0.036	-0.370	5.939	57.040	0.000
Florida	-0.001	0.001	0.028	-0.330	8.992	225.586	0.000
Georgia	-0.002	0.001	0.017	-0.342	5.243	34.144	0.000
Hawaii	0.004	0.001	0.082	3.267	54.649	16826.300	0.000
Idaho	-0.001	0.002	0.034	-0.870	13.694	728.775	0.000
Illinois	0.000	0.004	0.019	-0.546	6.980	105.763	0.000
Indiana	-0.001	0.001	0.015	-0.933	8.460	206.705	0.000
Iowa	0.000	0.002	0.024	0.263	12.879	607.563	0.000
Kansas	-0.001	0.000	0.013	-1.492	10.352	390.898	0.000
Kentucky	0.000	0.002	0.012	-0.592	4.837	29.636	0.000
Louisiana	0.001	0.001	0.017	0.418	5.023	29.743	0.000
Maine	0.004	0.007	0.063	0.626	14.714	861.667	0.000
Maryland	0.003	0.003	0.019	-0.119	4.299	10.826	0.004
Massachusetts	0.005	0.004	0.022	-0.005	2.975	0.004	0.998
Michigan	-0.001	0.003	0.020	-0.935	7.586	152.291	0.000
Minnesota	0.001	0.004	0.018	-0.747	4.369	25.501	0.000
Mississippi	-0.002	0.000	0.032	-0.109	14.295	792.397	0.000
Missouri	-0.001	0.003	0.014	-0.940	4.430	34.640	0.000
Montana	0.002	0.006	0.039	-0.671	7.777	152.854	0.000
Nebraska	-0.001	0.000	0.016	0.461	7.459	128.708	0.000
Nevada	-0.001	0.000	0.030	-0.311	5.572	43.486	0.000
New Hampshire	0.001	0.005	0.042	-0.347	9.003	226.714	0.000
New Jersey	0.003	0.003	0.022	-0.393	4.129	11.750	0.003
New Mexico	0.001	0.001	0.021	-0.216	6.117	61.481	0.000
New York	0.003	0.005	0.028	-0.060	5.139	28.485	0.000
North Carolina	0.000	0.002	0.013	-0.377	4.500	17.499	0.000
North Dakota	0.000	0.003	0.047	-0.299	10.175	321.854	0.000
Ohio	-0.001	0.002	0.013	-1.126	4.551	46.420	0.000
Oklahoma	-0.001	0.002	0.018	0.514	7.842	152.142	0.000
Oregon	0.003	0.006	0.026	-0.229	6.304	69.059	0.000
Pennsylvania	0.001	0.002	0.019	-0.973	7.407	144.050	0.000
Rhode Island	0.003	0.001	0.026	0.220	2.934	1.232	0.540
South Carolina	-0.001	0.002	0.017	-1.729	13.209	721.304	0.000
South Dakota	-0.001	0.003	0.053	1.330	18.829	1599.368	0.000
Tennessee	0.000	0.001	0.018	0.187	7.081	104.291	0.000
Texas	-0.001	0.001	0.015	-0.160	3.787	4.476	0.107
Utah	0.002	0.004	0.023	0.072	5.287	32.594	0.000
Vermont	0.002	0.004	0.500	-0.893	70.010	27897.330	0.000
Virginia	0.002	0.004	0.018	0.260	5.957	55.948	0.000
Washington	0.004	0.004	0.020	-0.197	3.681	3.845	0.146
West Virginia	0.000	0.002	0.546	0.474	72.900	30339.120	0.000
Wisconsin	0.001	0.004	0.020	-1.180	10.275	363.168	0.000
Wyoming	0.001	0.005	0.026	-0.845	5.654	61.466	0.000
U.S.	0.001	0.002	0.013	-0.855	4.191	26.962	0.000

Note: Std. Dev: stands for standard deviation; *p*-value corresponds to the Jarque-Bera (JB) test of normality.

Table 2. State- and country-level cointegrating relationships between consumption, (dis)aggregate wealth and labour income (DOLS framework).

Variable	*cay*	Variable	*cday*
		Alabama	
Wealth	0.1055***	Financial wealth	0.0634
		Housing wealth	0.3771***
Income	0.5531***	Income	1.3728***
constant	1.0674**	constant	-10.0800***
		Alaska	
Wealth	0.0009	Financial wealth	-0.0195**
		Housing wealth	0.2596***
Income	0.6751***	Income	-0.0368
constant	1.0154	constant	5.8793***
		Arizona	
Wealth	0.2029***	Financial wealth	0.1722***
		Housing wealth	0.0935***
Income	0.4993***	Income	0.4512***
constant	0.6676	constant	0.6921
		Arkansas	
Wealth	0.0319	Financial wealth	0.1713***
		Housing wealth	-0.0358
Income	0.6065***	Income	0.7097***
constant	1.3487***	constant	-0.3912
		California	
Wealth	0.0818**	Financial wealth	-0.0459*
		Housing wealth	0.1026***
Income	1.3420***	Income	0.9309***
constant	-6.6174***	constant	-2.2440*
		Colorado	
Wealth	0.0621***	Financial wealth	0.0585***
		Housing wealth	0.1393***
Income	0.9734***	Income	0.5076***
constant	-2.5206***	constant	0.7550
		Connecticut	
Wealth	0.0138	Financial wealth	-0.0021
		Housing wealth	0.1205***
Income	0.5378***	Income	0.6508***
constant	2.1862***	constant	-0.0236
		Delaware	
Wealth	0.1370**	Financial wealth	0.1540***
		Housing wealth	0.2246***
Income	0.6829***	Income	0.3872**
constant	-0.5068	constant	0.0819
		DC	
Wealth	0.1716***	Financial wealth	0.0362
		Housing wealth	0.1268***
Income	1.0779***	Income	0.7669***
constant	-5.2626***	constant	-1.9044
		Florida	
Wealth	0.0373**	Financial wealth	0.0275***
		Housing wealth	-0.0262*
Income	0.4998***	Income	1.1270***
constant	2.4552***	constant	-3.3147***
		Georgia	
Wealth	0.1548***	Financial wealth	0.1155***
		Housing wealth	0.0308
Income	1.0392***	Income	0.9287***
constant	-4.0515***	constant	-2.7121***

(cont.)

Variable	***cay***	**Variable**	***cday***
		Hawaii	
Wealth	0.1797***	Financial wealth	0.1204***
		Housing wealth	0.0111
Income	0.7149***	Income	0.9111***
constant	-1.2533	constant	-2.5684***
		Idaho	
Wealth	0.0008	Financial wealth	-0.0239***
		Housing wealth	0.2716***
Income	0.8213***	Income	0.8020***
constant	-0.3802	constant	-2.7512***
		Illinois	
Wealth	0.0653***	Financial wealth	-0.0069
		Housing wealth	0.1619***
Income	1.6627***	Income	1.1642***
constant	-9.6040***	constant	-5.5010***
		Indiana	
Wealth	0.1317***	Financial wealth	0.0100
		Housing wealth	0.2683***
Income	1.7339***	Income	1.3677***
constant	-10.7411***	constant	-8.6066***
		Iowa	
Wealth	0.2219***	Financial wealth	0.0770***
		Housing wealth	0.3731***
Income	1.1969***	Income	0.3261***
constant	-6.4241***	constant	-0.0188
		Kansas	
Wealth	0.2258***	Financial wealth	0.0941***
		Housing wealth	0.3408***
Income	0.8675***	Income	0.1802**
constant	-3.3184	constant	1.4955***
		Kentucky	
Wealth	0.0471**	Financial wealth	-0.0353***
		Housing wealth	0.4925***
Income	2.1366***	Income	1.0956***
constant	-13.6167***	constant	-7.6504***
		Louisiana	
Wealth	0.3792***	Financial wealth	0.1322***
		Housing wealth	0.3643***
Income	0.4746***	Income	0.1967
constant	-0.8757	constant	0.8954
		Maine	
Wealth	0.2150***	Financial wealth	0.1264***
		Housing wealth	0.1148***
Income	1.0057***	Income	0.9001***
constant	-4.3085***	constant	-3.3751***
		Maryland	
Wealth	0.9026***	Financial wealth	0.5585***
		Housing wealth	-0.0122
Income	-0.2557	Income	0.0983
constant	0.6321	constant	1.5854
		Massachusetts	
Wealth	-0.0992***	Financial wealth	-0.0260***
		Housing wealth	0.1498***
Income	1.3851***	Income	0.4200***
constant	-4.9577***	constant	2.3323***

(cont.)

Variable	***cay***	**Variable**	***cday***
		Michigan	
Wealth	0.1018***	Financial wealth	0.0309
		Housing wealth	0.1066***
Income	1.5568***	Income	1.0762***
constant	-8.8327***	constant	-4.3569***
		Minnesota	
Wealth	0.1224***	Financial wealth	0.0805***
		Housing wealth	0.1199***
Income	1.0961***	Income	0.5307***
constant	-4.4268***	constant	0.4538
		Mississippi	
Wealth	0.0626***	Financial wealth	-0.0093
		Housing wealth	0.2845***
Income	0.5261***	Income	1.6219***
constant	1.7569***	constant	-10.8166***
		Missouri	
Wealth	0.0822***	Financial wealth	0.0479***
		Housing wealth	0.4636***
Income	0.6143***	Income	0.3821***
constant	0.7386**	constant	-1.2772***
		Montana	
Wealth	0.2407***	Financial wealth	0.0943***
		Housing wealth	0.2319***
Income	1.8285***	Income	1.3095***
constant	-12.6659***	constant	-8.2965***
		Nebraska	
Wealth	0.1625***	Financial wealth	0.0142
		Housing wealth	0.5812***
Income	0.5721***	Income	0.5368***
constant	0.2968	constant	-3.6291***
		Nevada	
Wealth	0.3517***	Financial wealth	0.1387***
		Housing wealth	0.1765***
Income	0.4440***	Income	0.1068
constant	-0.2214	constant	3.7765***
		New Hampshire	
Wealth	0.2088***	Financial wealth	0.2080***
		Housing wealth	0.1003***
Income	0.4423***	Income	0.7215***
constant	1.2867***	constant	-2.2651***
		New Jersey	
Wealth	0.0019	Financial wealth	-0.1049***
		Housing wealth	0.0843***
Income	0.6235***	Income	1.1347***
constant	1.4417***	constant	-3.4543**
		New Mexico	
Wealth	0.3990***	Financial wealth	0.1891***
		Housing wealth	0.0230
Income	1.0019***	Income	1.2320***
constant	-6.2314***	constant	-6.2329***
		New York	
Wealth	-0.0884***	Financial wealth	-0.0638***
		Housing wealth	0.0859**
Income	0.6537***	Income	0.3427**
constant	1.9329	constant	3.8845***

(cont.)

Variable	*cay*	Variable	*cday*
		North Carolina	
Wealth	0.2949***	Financial wealth	0.0800**
		Housing wealth	0.2013**
Income	1.0669***	Income	0.8161***
constant	-5.7933***	constant	-3.0683***
		North Dakota	
Wealth	0.1080***	Financial wealth	0.1337***
		Housing wealth	0.5321***
Income	0.5263***	Income	0.0512
constant	1.4872***	constant	0.7119***
		Ohio	
Wealth	0.4721***	Financial wealth	-0.0032
		Housing wealth	0.4807***
Income	0.4904***	Income	0.5157**
constant	-2.1485*	constant	-2.3250
		Oklahoma	
Wealth	0.5056***	Financial wealth	0.1409***
		Housing wealth	0.3441***
Income	-0.3660**	Income	-0.0251
constant	5.9854***	constant	3.1129***
		Oregon	
Wealth	0.0784**	Financial wealth	0.0711**
		Housing wealth	0.0684***
Income	1.3541***	Income	0.9263***
constant	-6.4124***	constant	-2.7278***
		Pennsylvania	
Wealth	0.1123*	Financial wealth	-0.0369
		Housing wealth	-0.0064
Income	0.5416***	Income	0.9472***
constant	1.0625	constant	-1.3517
		Rhode Island	
Wealth	0.3799***	Financial wealth	0.0510**
		Housing wealth	0.2469***
Income	0.5704***	Income	0.0853
constant	-2.0018	constant	3.7925***
		South Carolina	
Wealth	0.1459***	Financial wealth	0.1102***
		Housing wealth	0.0013
Income	1.4941***	Income	1.2029***
constant	-8.3572***	constant	-5.0247***
		South Dakota	
Wealth	1.0696***	Financial wealth	0.6784***
		Housing wealth	0.8867***
Income	-0.2475	Income	-0.7652
constant	-0.9090	constant	0.0147
		Tennessee	
Wealth	0.3039**	Financial wealth	0.7910***
		Housing wealth	-1.1732***
Income	1.3574***	Income	-1.4810***
constant	-10.3893***	constant	25.5063***
		Texas	
Wealth	0.1344***	Financial wealth	0.0454*
		Housing wealth	0.1236***
Income	0.7887***	Income	0.5058***
constant	-1.3782	constant	1.1329

(cont.)

Variable	*cay*	Variable	*cday*
		Utah	
Wealth	0.5123***	Financial wealth	0.3626***
		Housing wealth	0.3515***
Income	0.1779	Income	-0.0365
constant	0.4586	constant	1.0567
		Vermont	
Wealth	0.0101	Financial wealth	-0.0304
		Housing wealth	0.1627***
Income	0.5968***	Income	0.4467***
constant	1.8225***	constant	2.0256***
		Virginia	
Wealth	0.1717***	Financial wealth	0.2444***
		Housing wealth	0.0318
Income	0.9247***	Income	0.6935***
constant	-3.2782***	constant	-1.7897*
		Washington	
Wealth	0.3027***	Financial wealth	0.0588
		Housing wealth	0.2100***
Income	0.4284*	Income	-0.0418
constant	0.3110	constant	5.4790***
		West Virginia	
Wealth	0.0681**	Financial wealth	0.0486
		Housing wealth	0.3219***
Income	1.9578***	Income	0.4034**
constant	-12.0824***	constant	-0.0594
		Wisconsin	
Wealth	0.1552***	Financial wealth	0.1141***
		Housing wealth	0.1315***
Income	1.1355***	Income	0.6647***
constant	-5.1788***	constant	-1.3027
		Wyoming	
Wealth	0.0086	Financial wealth	0.0542**
		Housing wealth	0.2243***
Income	1.1483***	Income	0.6590***
constant	-3.6314***	constant	-1.5119**
		U.S.	
Wealth	0.1086***	Financial wealth	0.0651***
		Housing wealth	0.0825***
Income	0.7511***	Income	0.7032***
constant	-0.8767***	constant	-0.7091***

Note: *** p<0.01, ** p<0.05, * p<0.1.

Table 3. Country-level cointegrating relationship between consumption, (dis)aggregate wealth and labour income (Panel FE framework).

Variable	*cay*	Variable	*cday*
Wealth	0.075***	Financial wealth	0.035***
		Housing wealth	0.094***
Income	0.481***	Income	0.429***

Note: *** p<0.01, ** p<0.05, * p<0.1.

Table 4. Forecasting real housing returns using state- and country-level data (Time-series framework).

		Forecast horizon H				
State	**Predictor**	**1**	**2**	**3**	**4**	**8**
Alabama	*cay*	0.0671*	0.1250***	0.1615***	0.1952***	0.2335**
		(0.037)	(0.045)	(0.051)	(0.063)	(0.103)
		[0.0215]	[0.0494]	[0.0639]	[0.0618]	[0.0341]
	cday	0.0899	0.1359*	0.1943**	0.2566***	0.5324***
		(0.057)	(0.070)	(0.079)	(0.097)	(0.154)
		[0.0165]	[0.0249]	[0.0395]	[0.0456]	[0.0756]
Alaska	*cay*	0.0685	0.1099	0.1412	0.1472	0.3039*
		(0.072)	(0.097)	(0.120)	(0.143)	(0.176)
		[0.00613]	[0.00866]	[0.00938]	[0.00713]	[0.0198]
	cday	0.1781**	0.2880***	0.4314***	0.4971***	0.6419***
		(0.070)	(0.094)	(0.114)	(0.137)	(0.169)
		[0.0419]	[0.0600]	[0.0883]	[0.0821]	[0.0890]
Arizona	*cay*	0.1858**	0.3585***	0.4796***	0.5856***	0.8170**
		(0.076)	(0.127)	(0.173)	(0.223)	(0.404)
		[0.0394]	[0.0515]	[0.0497]	[0.0448]	[0.0271]
	cday	0.1693**	0.3115**	0.3980**	0.4947*	0.5911
		(0.085)	(0.143)	(0.195)	(0.251)	(0.454)
		[0.0263]	[0.0312]	[0.0275]	[0.0257]	[0.0114]
Arkansas	*cay*	0.0812***	0.1621***	0.2190***	0.2790***	0.4766***
		(0.031)	(0.044)	(0.055)	(0.065)	(0.100)
		[0.0457]	[0.0848]	[0.0978]	[0.110]	[0.133]
	cday	0.0899**	0.1671***	0.2253***	0.2913***	0.4776***
		(0.036)	(0.053)	(0.066)	(0.079)	(0.121)
		[0.0399]	[0.0641]	[0.0735]	[0.0853]	[0.0952]
California	*cay*	0.1641***	0.3256***	0.4914***	0.6694***	1.2046***
		(0.056)	(0.106)	(0.154)	(0.200)	(0.368)
		[0.0554]	[0.0599]	[0.0648]	[0.0708]	[0.0681]
	cday	0.2843***	0.5676***	0.8460***	1.1250***	2.0872***
		(0.049)	(0.092)	(0.133)	(0.172)	(0.315)
		[0.187]	[0.205]	[0.216]	[0.225]	[0.230]
Colorado	*cay*	0.0968*	0.2262***	0.3439***	0.4746***	0.9884***
		(0.050)	(0.081)	(0.108)	(0.137)	(0.243)
		[0.0248]	[0.0506]	[0.0640]	[0.0751]	[0.101]
	cday	0.1438***	0.3316***	0.4936***	0.6571***	1.2398***
		(0.055)	(0.088)	(0.117)	(0.148)	(0.264)
		[0.0447]	[0.0888]	[0.108]	[0.118]	[0.130]
Connecticut	*cay*	0.1931***	0.3478***	0.4612***	0.5491***	0.6121**
		(0.042)	(0.073)	(0.103)	(0.135)	(0.251)
		[0.124]	[0.134]	[0.120]	[0.101]	[0.0388]
	cday	0.3007***	0.5701***	0.8053***	1.0192***	1.5954***
		(0.050)	(0.085)	(0.119)	(0.155)	(0.289)
		[0.196]	[0.234]	[0.237]	[0.227]	[0.171]

(cont.)

		Forecast horizon H				
State	**Predictor**	**1**	**2**	**3**	**4**	**8**
Delaware	*cay*	0.2091*	0.3697***	0.5068***	0.6284***	0.8407***
		(0.110)	(0.111)	(0.120)	(0.160)	(0.244)
		[0.0242]	[0.0703]	[0.108]	[0.0949]	[0.0748]
	cday	0.3572***	0.5156***	0.7455***	0.9247***	1.4059***
		(0.114)	(0.114)	(0.120)	(0.161)	(0.242)
		[0.0631]	[0.122]	[0.208]	[0.184]	[0.187]
DC	*cay*	-0.0517	-0.0515	-0.0732	-0.0396	0.1104
		(0.055)	(0.067)	(0.093)	(0.118)	(0.211)
		[0.00607]	[0.00403]	[0.00419]	[0.000768]	[0.00185]
	cday	-0.0077	0.0392	0.0591	0.1393	0.4605**
		(0.058)	(0.071)	(0.099)	(0.124)	(0.221)
		[0.000121]	[0.00208]	[0.00244]	[0.00846]	[0.0288]
Florida	*cay*	0.1556**	0.3261***	0.4509***	0.5430***	0.5709*
		(0.063)	(0.103)	(0.143)	(0.182)	(0.344)
		[0.0399]	[0.0642]	[0.0634]	[0.0569]	[0.0184]
	cday	0.2014**	0.4736***	0.6871***	0.8638***	1.1088**
		(0.090)	(0.146)	(0.202)	(0.257)	(0.484)
		[0.0331]	[0.0670]	[0.0729]	[0.0713]	[0.0344]
Georgia	*cay*	0.0313	0.0730	0.1248	0.1736	0.5120**
		(0.050)	(0.076)	(0.096)	(0.118)	(0.207)
		[0.00261]	[0.00626]	[0.0113]	[0.0146]	[0.0400]
	cday	0.0517	0.1163	0.1861**	0.2508**	0.5843***
		(0.049)	(0.073)	(0.093)	(0.113)	(0.200)
		[0.00756]	[0.0168]	[0.0265]	[0.0322]	[0.0551]
Hawaii	*cay*	0.3021*	0.5645***	0.8532***	1.1357***	1.7177***
		(0.173)	(0.194)	(0.218)	(0.234)	(0.345)
		[0.0203]	[0.0544]	[0.0941]	[0.138]	[0.144]
	cday	0.3568*	0.6181***	0.8615***	1.0893***	1.3851***
		(0.185)	(0.208)	(0.236)	(0.255)	(0.384)
		[0.0247]	[0.0567]	[0.0834]	[0.110]	[0.0814]
Idaho	*cay*	0.0685	0.1341**	0.1677**	0.1836**	0.0879
		(0.046)	(0.052)	(0.067)	(0.083)	(0.143)
		[0.0150]	[0.0441]	[0.0408]	[0.0319]	[0.00258]
	cday	0.1042**	0.2340***	0.3500***	0.4378***	0.7497***
		(0.046)	(0.050)	(0.063)	(0.078)	(0.131)
		[0.0336]	[0.130]	[0.172]	[0.176]	[0.182]
Illinois	*cay*	-0.0542	-0.1150*	-0.1893**	-0.2744**	-0.6859***
		(0.039)	(0.061)	(0.084)	(0.106)	(0.180)
		[0.0130]	[0.0237]	[0.0335]	[0.0438]	[0.0901]
	cday	-0.0710	-0.1473**	-0.2399**	-0.3511***	-0.8095***
		(0.044)	(0.068)	(0.094)	(0.118)	(0.201)
		[0.0178]	[0.0309]	[0.0427]	[0.0570]	[0.0996]

(cont.)

		Forecast horizon H				
State	**Predictor**	**1**	**2**	**3**	**4**	**8**
Indiana	*cay*	0.0019	0.0306	0.0781	0.1309	0.3665**
		(0.040)	(0.061)	(0.079)	(0.096)	(0.163)
		[1.51e-05]	[0.00169]	[0.00664]	[0.0124]	[0.0333]
	cday	0.0873**	0.2071***	0.3331***	0.4401***	0.8915***
		(0.038)	(0.057)	(0.072)	(0.087)	(0.143)
		[0.0342]	[0.0824]	[0.128]	[0.149]	[0.209]
Iowa	*cay*	0.0352	0.0579	0.0592	0.0415	0.1061
		(0.058)	(0.076)	(0.100)	(0.118)	(0.200)
		[0.00253]	[0.00392]	[0.00239]	[0.000837]	[0.00192]
	cday	0.0342	0.4535***	0.5660***	0.6161***	0.9589***
		(0.069)	(0.086)	(0.113)	(0.136)	(0.232)
		[0.0598]	[0.160]	[0.145]	[0.123]	[0.104]
Kansas	*cay*	0.0254	0.0502	0.0602	0.0754	0.0360
		(0.025)	(0.039)	(0.053)	(0.066)	(0.116)
		[0.00677]	[0.0111]	[0.00883]	[0.00884]	[0.000656]
	cday	0.1013***	0.2209***	0.3077***	0.3874***	0.6038***
		(0.030)	(0.044)	(0.059)	(0.074)	(0.132)
		[0.0732]	[0.146]	[0.156]	[0.158]	[0.125]
Kentucky	*cay*	0.0056	-0.0087	-0.0222	-0.0441	-0.0717
		(0.028)	(0.045)	(0.059)	(0.072)	(0.119)
		[0.000273]	[0.000255]	[0.000953]	[0.00252]	[0.00248]
	cday	0.0882**	0.1679***	0.2268***	0.2621***	0.3366**
		(0.035)	(0.056)	(0.073)	(0.090)	(0.149)
		[0.0420]	[0.0582]	[0.0609]	[0.0546]	[0.0335]
Louisiana	*cay*	0.2237***	0.4193***	0.6144***	0.8105***	1.4913***
		(0.038)	(0.056)	(0.074)	(0.091)	(0.154)
		[0.194]	[0.274]	[0.317]	[0.348]	[0.391]
	cday	0.2322***	0.4380***	0.6377***	0.8316***	1.4609***
		(0.033)	(0.048)	(0.062)	(0.076)	(0.131)
		[0.256]	[0.366]	[0.417]	[0.449]	[0.459]
Maine	*cay*	-0.1702	-0.1280	-0.1361	-0.3733*	-0.3701
		(0.156)	(0.169)	(0.178)	(0.219)	(0.333)
		[0.00803]	[0.00390]	[0.00394]	[0.0195]	[0.00834]
	cday	-0.1785	-0.1323	-0.1612	-0.3936*	-0.4489
		(0.154)	(0.167)	(0.176)	(0.216)	(0.328)
		[0.00904]	[0.00427]	[0.00567]	[0.0222]	[0.0126]
Maryland	*cay*	0.0312	0.0865**	0.1743***	0.2686***	0.7289***
		(0.024)	(0.042)	(0.059)	(0.075)	(0.132)
		[0.0112]	[0.0279]	[0.0566]	[0.0805]	[0.172]
	cday	0.0149	0.0334	0.0787	0.1183	0.2437*
		(0.025)	(0.043)	(0.061)	(0.079)	(0.146)
		[0.00245]	[0.00402]	[0.0111]	[0.0151]	[0.0186]

(cont.)

		Forecast horizon H				
State	**Predictor**	**1**	**2**	**3**	**4**	**8**
Massachusetts	*cay*	0.1394***	0.2561***	0.3316***	0.3976***	0.5452**
		(0.043)	(0.075)	(0.110)	(0.143)	(0.271)
		[0.0678]	[0.0726]	[0.0586]	[0.0497]	[0.0268]
	cday	0.2189***	0.4301***	0.5857***	0.7267***	1.0961***
		(0.047)	(0.082)	(0.119)	(0.157)	(0.300)
		[0.129]	[0.158]	[0.141]	[0.128]	[0.0833]
Michigan	*cay*	-0.0063	0.0014	0.0426	0.0861	0.4391*
		(0.049)	(0.083)	(0.113)	(0.141)	(0.252)
		[0.000110]	[2.08e-06]	[0.000966]	[0.00253]	[0.0202]
	cday	0.1908***	0.3858***	0.5832***	0.7626***	1.4652***
		(0.043)	(0.070)	(0.094)	(0.116)	(0.205)
		[0.116]	[0.170]	[0.208]	[0.227]	[0.258]
Minnesota	*cay*	0.0190	0.0230	-0.0055	-0.0476	-0.1577
		(0.046)	(0.079)	(0.104)	(0.128)	(0.231)
		[0.00115]	[0.000579]	[1.92e-05]	[0.000946]	[0.00317]
	cday	0.1424***	0.2645***	0.3427***	0.3878***	0.5739**
		(0.046)	(0.078)	(0.103)	(0.128)	(0.233)
		[0.0611]	[0.0724]	[0.0700]	[0.0590]	[0.0396]
Mississippi	*cay*	0.0540*	0.0892*	0.1021	0.0883	-0.0085
		(0.028)	(0.047)	(0.064)	(0.079)	(0.141)
		[0.0244]	[0.0244]	[0.0172]	[0.00839]	[2.52e-05]
	cday	0.0381	0.0446	0.0446	-0.0046	0.2933
		(0.042)	(0.070)	(0.096)	(0.119)	(0.209)
		[0.00544]	[0.00273]	[0.00147]	[1.03e-05]	[0.0133]
Missouri	*cay*	-0.0050	0.0280	0.0180	0.0293	-0.0344
		(0.057)	(0.064)	(0.072)	(0.085)	(0.123)
		[5.29e-05]	[0.00131]	[0.000430]	[0.000817]	[0.000529]
	cday	0.0157	0.1667**	0.1783*	0.2974***	0.4285***
		(0.074)	(0.082)	(0.092)	(0.107)	(0.156)
		[0.000308]	[0.0275]	[0.0250]	[0.0500]	[0.0487]
Montana	*cay*	-0.0401	-0.0319	0.0077	0.0623	0.2350
		(0.076)	(0.088)	(0.103)	(0.128)	(0.199)
		[0.00189]	[0.000897]	[3.83e-05]	[0.00160]	[0.00939]
	cday	0.0456	0.1405	0.2744**	0.3830**	0.8132***
		(0.090)	(0.104)	(0.120)	(0.149)	(0.228)
		[0.00173]	[0.0123]	[0.0343]	[0.0428]	[0.0796]
Nebraska	*cay*	0.0190	0.0194	0.0135	0.0110	-0.0556
		(0.022)	(0.030)	(0.037)	(0.045)	(0.074)
		[0.00513]	[0.00279]	[0.000908]	[0.000408]	[0.00378]
	cday	0.1127***	0.1989***	0.2784***	0.3644***	0.6995***
		(0.032)	(0.043)	(0.051)	(0.061)	(0.096)
		[0.0799]	[0.129]	[0.169]	[0.197]	[0.264]

(cont.)

State	Predictor	Forecast horizon H 1	2	3	4	8
Nevada	*cay*	0.1097**	0.2687***	0.4773***	0.7336***	1.8555***
		(0.049)	(0.084)	(0.117)	(0.149)	(0.254)
		0.0334	0.0644	0.102	0.141	0.266
	cday	0.1313***	0.2902***	0.4694***	0.6763***	1.4966***
		(0.046)	(0.079)	(0.110)	(0.142)	(0.252)
		0.0533	0.0839	0.110	0.134	0.193
New Hampshire	*cay*	0.1501**	0.2737***	0.3912***	0.4362***	0.4381
		(0.075)	(0.088)	(0.116)	(0.151)	(0.269)
		0.0267	0.0612	0.0713	0.0540	0.0178
	cday	0.1022	0.1771	0.2760*	0.2766	0.1923
		(0.090)	(0.108)	(0.143)	(0.184)	(0.324)
		0.00868	0.0179	0.0248	0.0152	0.00240
New Jersey	*cay*	0.1883***	0.3507***	0.4867***	0.5708***	0.6452**
		(0.040)	(0.070)	(0.100)	(0.132)	(0.252)
		0.133	0.146	0.139	0.113	0.0426
	cday	0.1975***	0.3840***	0.5645***	0.7018***	1.1404***
		(0.044)	(0.078)	(0.110)	(0.144)	(0.270)
		0.118	0.142	0.152	0.139	0.108
New Mexico	*cay*	0.1638***	0.3510***	0.5440***	0.7485***	1.4397***
		(0.046)	(0.059)	(0.072)	(0.088)	(0.134)
		0.0804	0.196	0.282	0.331	0.441
	cday	0.1618***	0.3184***	0.4594***	0.6336***	1.1825***
		(0.052)	(0.068)	(0.087)	(0.108)	(0.175)
		0.0623	0.128	0.160	0.189	0.236
New York	*cay*	0.0611	0.1103	0.1353	0.1284	-0.0333
		(0.044)	(0.068)	(0.088)	(0.109)	(0.190)
		0.0127	0.0176	0.0160	0.00943	0.000207
	cday	0.0760	0.1409*	0.1851*	0.1872	0.1303
		(0.049)	(0.074)	(0.095)	(0.118)	(0.208)
		0.0164	0.0239	0.0250	0.0167	0.00266
North Carolina	*cay*	0.0179	0.0622	0.0883	0.1204	0.1538
		(0.035)	(0.055)	(0.071)	(0.088)	(0.153)
		0.00172	0.00864	0.0105	0.0125	0.00686
	cday	0.0638*	0.1483***	0.2043***	0.2551***	0.3053**
		(0.035)	(0.053)	(0.068)	(0.085)	(0.149)
		0.0225	0.0504	0.0578	0.0576	0.0277
North Dakota	*cay*	0.0266	0.1228	0.0862	0.0071	-0.2223
		(0.076)	(0.101)	(0.122)	(0.129)	(0.165)
		0.000839	0.00995	0.00341	2.10e-05	0.0123
	cday	0.3460***	0.6218***	0.7213***	0.7057***	1.1175***
		(0.085)	(0.108)	(0.131)	(0.140)	(0.172)
		0.102	0.183	0.171	0.147	0.222

(cont.)

		Forecast horizon H				
State	**Predictor**	**1**	**2**	**3**	**4**	**8**
Ohio	*cay*	0.0201	0.0296	0.0380	0.0290	-0.1301
		(0.030)	(0.052)	(0.069)	(0.086)	(0.150)
		[0.00301]	[0.00223]	[0.00206]	[0.000771]	[0.00511]
	cday	0.0973***	0.2000***	0.2894***	0.3555***	0.5999***
		(0.027)	(0.046)	(0.060)	(0.076)	(0.132)
		[0.0798]	[0.115]	[0.136]	[0.131]	[0.123]
Oklahoma	*cay*	0.1921***	0.3642***	0.4887***	0.6001***	0.7333***
		(0.040)	(0.059)	(0.080)	(0.100)	(0.180)
		[0.133]	[0.205]	[0.201]	[0.196]	[0.101]
	cday	0.2421***	0.4703***	0.6600***	0.8226***	1.2805***
		(0.034)	(0.045)	(0.060)	(0.074)	(0.134)
		[0.261]	[0.423]	[0.453]	[0.454]	[0.382]
Oregon	*cay*	0.3521***	0.7086***	1.0335***	1.2915***	1.8852***
		(0.069)	(0.097)	(0.127)	(0.169)	(0.319)
		[0.152]	[0.267]	[0.311]	[0.285]	[0.192]
	cday	0.3678***	0.7142***	1.0310***	1.2797***	1.7796***
		(0.061)	(0.086)	(0.112)	(0.150)	(0.292)
		[0.196]	[0.320]	[0.366]	[0.331]	[0.202]
Pennsylvania	*cay*	0.0362	0.0647	0.0805	0.0656	-0.0888
		(0.038)	(0.060)	(0.078)	(0.099)	(0.178)
		[0.00612]	[0.00787]	[0.00714]	[0.00297]	[0.00170]
	cday	0.0730**	0.1357**	0.1870***	0.2103**	0.1930
		(0.034)	(0.054)	(0.070)	(0.089)	(0.161)
		[0.0301]	[0.0417]	[0.0464]	[0.0369]	[0.00966]
Rhode Island	*cay*	0.1995***	0.3725***	0.5655***	0.7566***	1.2185***
		(0.049)	(0.086)	(0.119)	(0.154)	(0.290)
		[0.100]	[0.112]	[0.133]	[0.141]	[0.107]
	cday	0.2990***	0.5628***	0.8282***	1.0889***	1.8852***
		(0.045)	(0.078)	(0.106)	(0.137)	(0.260)
		[0.232]	[0.263]	[0.294]	[0.300]	[0.263]
South Carolina	*cay*	0.0935*	0.1758***	0.2593***	0.3709***	0.7532***
		(0.048)	(0.066)	(0.076)	(0.090)	(0.149)
		[0.0253]	[0.0466]	[0.0738]	[0.103]	[0.149]
	cday	0.1268***	0.2359***	0.3339***	0.4702***	0.8584***
		(0.046)	(0.063)	(0.072)	(0.085)	(0.141)
		[0.0483]	[0.0870]	[0.127]	[0.172]	[0.201]
South Dakota	*cay*	0.0061	0.0421	0.0255	0.0484	0.0050
		(0.041)	(0.045)	(0.054)	(0.055)	(0.069)
		[0.000149]	[0.00595]	[0.00154]	[0.00530]	[3.51e-05]
	cday	0.0136	0.0607	0.0443	0.0686	0.0327
		(0.036)	(0.039)	(0.047)	(0.048)	(0.061)
		[0.000947]	[0.0159]	[0.00598]	[0.0136]	[0.00196]

(cont.)

		Forecast horizon H				
State	**Predictor**	**1**	**2**	**3**	**4**	**8**
Tennessee	*cay*	0.0127	0.0267	0.0424*	0.0594**	0.1260***
		(0.014)	(0.017)	(0.022)	(0.026)	(0.042)
		[0.00588]	[0.0157]	[0.0255]	[0.0342]	[0.0569]
	cday	0.0078	0.0193	0.0220	0.0280	0.0121
		(0.011)	(0.014)	(0.017)	(0.021)	(0.035)
		[0.00346]	[0.0130]	[0.0108]	[0.0120]	[0.000835]
Texas	*cay*	0.1625***	0.3396***	0.4935***	0.6602***	1.3511***
		(0.042)	(0.064)	(0.082)	(0.100)	(0.161)
		[0.0924]	[0.159]	[0.199]	[0.227]	[0.324]
	cday	0.1924***	0.3950***	0.5648***	0.7318***	1.3587***
		(0.038)	(0.056)	(0.070)	(0.087)	(0.142)
		[0.151]	[0.251]	[0.304]	[0.326]	[0.382]
Utah	*cay*	0.1824***	0.3387***	0.5082***	0.6728***	1.2252***
		(0.036)	(0.055)	(0.074)	(0.093)	(0.163)
		[0.149]	[0.205]	[0.243]	[0.262]	[0.278]
	cday	0.0987**	0.1892***	0.2983***	0.4057***	0.7653***
		(0.040)	(0.063)	(0.086)	(0.108)	(0.191)
		[0.0398]	[0.0581]	[0.0761]	[0.0870]	[0.0988]
Vermont	*cay*	0.0413	0.2178	0.3949*	0.4314*	0.4165
		(0.182)	(0.202)	(0.215)	(0.221)	(0.256)
		[0.000351]	[0.00783]	[0.0225]	[0.0253]	[0.0177]
	cday	0.0858	0.3602*	0.5666***	0.5427**	0.8476***
		(0.180)	(0.199)	(0.210)	(0.218)	(0.246)
		[0.00154]	[0.0217]	[0.0471]	[0.0406]	[0.0746]
Virginia	*cay*	0.1475***	0.2841***	0.4504***	0.6159***	1.1389***
		(0.046)	(0.075)	(0.102)	(0.127)	(0.231)
		[0.0661]	[0.0895]	[0.117]	[0.137]	[0.142]
	cday	0.1407***	0.2687***	0.4330***	0.5978***	1.0046***
		(0.046)	(0.075)	(0.102)	(0.128)	(0.235)
		[0.0602]	[0.0802]	[0.108]	[0.130]	[0.110]
Washington	*cay*	0.1506***	0.2992***	0.4224***	0.5336***	0.7712***
		(0.045)	(0.078)	(0.108)	(0.138)	(0.251)
		[0.0716]	[0.0911]	[0.0942]	[0.0921]	[0.0603]
	cday	0.2077***	0.4158***	0.5855***	0.7256***	1.0521***
		(0.037)	(0.062)	(0.086)	(0.111)	(0.208)
		[0.180]	[0.233]	[0.240]	[0.226]	[0.149]
West Virginia	*cay*	0.0917	0.2004**	0.3083***	0.2546**	0.5587***
		(0.093)	(0.099)	(0.088)	(0.119)	(0.136)
		[0.00661]	[0.0269]	[0.0775]	[0.0300]	[0.103]
	cday	0.1204	0.1883**	0.4091***	0.4237***	0.7990***
		(0.085)	(0.092)	(0.077)	(0.106)	(0.115)
		[0.0134]	[0.0279]	[0.160]	[0.0977]	[0.248]

(cont.)

State	Predictor	Forecast horizon H 1	2	3	4	8
Wisconsin	*cay*	0.1189*	0.1914**	0.3246**	0.4667***	0.7760***
		(0.062)	(0.096)	(0.124)	(0.152)	(0.243)
		[0.0246]	[0.0262]	[0.0442]	[0.0606]	[0.0647]
	cday	0.1355**	0.2481**	0.3882***	0.5139***	0.6252**
		(0.065)	(0.101)	(0.130)	(0.159)	(0.260)
		[0.0287]	[0.0395]	[0.0568]	[0.0660]	[0.0377]
Wyoming	*cay*	0.2150***	0.4089***	0.5981***	0.8339***	1.4494***
		(0.046)	(0.064)	(0.083)	(0.100)	(0.170)
		[0.129]	[0.216]	[0.262]	[0.319]	[0.331]
	cday	0.3120***	0.5886***	0.8508***	1.1281***	1.8546***
		(0.042)	(0.054)	(0.067)	(0.079)	(0.142)
		[0.269]	[0.444]	[0.526]	[0.578]	[0.536]
U.S.	*cay*	0.0481	0.0928	0.1213	0.1387	0.0775
		(0.040)	(0.070)	(0.096)	(0.122)	(0.223)
		[0.00986]	[0.0118]	[0.0108]	[0.00871]	[0.000817]
	cday	0.1535***	0.3047***	0.4286***	0.5304***	0.7908***
		(0.038)	(0.065)	(0.089)	(0.113)	(0.212)
		[0.102]	[0.129]	[0.137]	[0.130]	[0.0868]

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors appear in parenthesis. Adjusted R-square is reported in square brackets.

Table 5. Forecasting real housing returns using state-level data (Panel framework).

U.S.	Predictor	Forecast horizon H 1	2	3	4	8
FE estimator	*cay*	0.0664***	0.1264***	0.1728***	0.2073***	0.2573***
		(0.006)	(0.008)	(0.010)	(0.012)	(0.020)
		[0.0162]	[0.0342]	[0.0408]	[0.0395]	[0.0223]
	Cday	0.0721***	0.1399***	0.1960***	0.2404***	0.3457***
		(0.006)	(0.008)	(0.010)	(0.012)	(0.020)
		[0.0187]	[0.0411]	[0.0516]	[0.0522]	[0.0396]

Note: *** p<0.01, ** p<0.05, * p<0.1. Standard errors appear in parenthesis. Adjusted R-square is reported in square brackets.

Table 6. Linear Granger causality tests.

State	Predictor	*F*-statistic	*p*-value
Alabama	*cay*	**7.69959**	0.0063
	cday	**8.27831**	0.0046
Alaska	*cay*	**3.98756**	0.0477
	cday	**8.81339**	0.0035
Arizona	*cay*	1.96698	0.1629
	cday	1.61448	0.2059
Arkansas	*cay*	**10.9973**	0.0012
	cday	**7.92822**	0.0055
California	*cay*	0.51241	0.4752
	cday	**4.57874**	0.0340
Colorado	*cay*	2.29201	0.1322
	cday	**4.33215**	0.0392
Connecticut	*cay*	**7.96991**	0.0054
	cday	**15.3677**	0.0001
Delaware	*cay*	**3.92423**	0.0495
	cday	**8.72632**	0.0037
DC	*cay*	1.46946	0.2274
	cday	3.57449	0.0607
Florida	*cay*	3.89226	0.0504
	cday	**5.20315**	0.0240
Georgia	*cay*	**8.43872**	0.0042
	cday	3.41009	0.0668
Hawaii	*cay*	**6.34128**	0.0129
	cday	**7.38503**	0.0074
Idaho	*cay*	3.08962	0.0809
	cday	**9.25165**	0.0028
Illinois	*cay*	0.48394	0.4878
	cday	0.09492	0.7585
Indiana	*cay*	0.89694	0.3452
	cday	**11.7123**	0.0008
Iowa	*cay*	2.24437	0.1363
	cday	**25.0072**	0.0000
Kansas	*cay*	2.42905	0.1213
	cday	**13.1333**	0.0004
Kentucky	*cay*	1.29486	0.2570
	cday	**11.6637**	0.0008
Louisiana	*cay*	**28.3428**	0.0000
	cday	**41.0227**	0.0000
Maine	*cay*	3.35975	0.0689
	cday	**5.90197**	0.0163
Maryland	*cay*	**4.98701**	0.0271
	cday	2.80367	0.0962
Massachusetts	*cay*	**4.41493**	0.0374
	cday	**9.62708**	0.0023
Michigan	*cay*	**12.8717**	0.0005
	cday	**32.9554**	0.0000
Minnesota	*cay*	1.85851	0.1749
	cday	**6.20934**	0.013
Mississippi	*cay*	2.32478	0.1295
	cday	**6.40571**	0.0124
Missouri	*cay*	0.74362	0.3899
	cday	**10.2147**	0.0017
Montana	*cay*	**10.6331**	0.0014
	cday	**27.6439**	0.0000
Nebraska	*cay*	0.56101	0.4551
	cday	**9.98083**	0.0019

(cont.)

State	Predictor	*F*-statistic	*p*-value
Nevada	*cay*	**6.31028**	0.0131
	cday	3.78123	0.0538
New Hampshire	*cay*	**8.96478**	0.0032
	cday	**7.06181**	0.0088
New Jersey	*cay*	**9.93078**	0.0020
	cday	**15.2590**	0.0001
New Mexico	*cay*	**17.1789**	0.0000
	cday	**14.6346**	0.0002
New York	*cay*	1.43500	0.2329
	cday	2.10937	0.1486
North Carolina	*cay*	3.85651	0.0515
	cday	**6.61561**	0.0111
North Dakota	*cay*	0.26775	0.6056
	cday	**16.6381**	0.0000
Ohio	*cay*	**4.22727**	0.0416
	cday	**4.06486**	0.0456
Oklahoma	*cay*	**16.5749**	0.0000
	cday	**37.2699**	0.0000
Oregon	*cay*	**20.4009**	0.0000
	cday	**25.6132**	0.0000
Pennsylvania	*cay*	1.10363	0.2952
	cday	**5.52574**	0.0201
Rhode Island	*cay*	**14.2885**	0.0002
	cday	**25.7105**	0.0000
South Carolina	*cay*	**9.37286**	0.0026
	cday	**11.4463**	0.0009
South Dakota	*cay*	**4.45062**	0.0366
	cday	**11.1114**	0.0011
Tennessee	*cay*	**4.34856**	0.0388
	cday	**7.66195**	0.0064
Texas	*cay*	**22.8707**	0.0000
	cday	**26.1145**	0.0000
Utah	*cay*	**20.5567**	0.0000
	cday	**15.1686**	0.0001
Vermont	*cay*	0.01411	0.9056
	cday	1.02957	0.3119
Virginia	*cay*	**8.73052**	0.0037
	cday	**8.63854**	0.0038
Washington	*cay*	**6.07516**	0.0149
	cday	**10.8470**	0.0012
West Virginia	*cay*	0.06845	0.7940
	cday	0.33985	0.5608
Wisconsin	*cay*	**5.73577**	0.0179
	cday	**7.49198**	0.0070
Wyoming	*cay*	3.52069	0.0626
	cday	**42.6126**	0.0001
U.S.	*cay*	1.92287	0.1677
	cday	**5.41316**	0.0214

Note: Entries in bold indicate significance at the 5% level, i.e. rejection of the null hypothesis of no-causality.

Table 7. BDS (Brock *et al.*, 1996) test of nonlinearity.

State	**Predictor**	**Dimension**				
		2	**3**	**4**	**5**	**6**
Alabama	*cay*	5.808***	6.695***	7.909***	9.151***	10.276***
	cday	5.130***	6.103***	7.495***	8.727***	9.759***
Alaska	*cay*	7.728***	8.968***	9.975***	11.295***	12.715***
	cday	7.289***	8.558***	9.572***	10.659***	12.018***
Arizona	*cay*	8.187***	9.344***	10.313***	10.957***	11.898***
	cday	8.153***	9.302***	10.254***	10.912***	11.876***
Arkansas	*cay*	5.360***	5.835***	6.205***	7.073***	8.184***
	cday	6.157***	6.495***	6.788***	7.753***	8.899***
California	*cay*	5.036***	6.269***	6.427***	6.192***	6.120***
	cday	6.359***	7.477***	7.639***	7.506***	7.490***
Colorado	*cay*	6.854***	7.568***	8.845***	9.877***	10.766***
	cday	6.951***	7.765***	9.132***	10.218***	11.133***
Connecticut	*cay*	4.888***	5.276***	6.304***	7.104***	7.583***
	cday	4.721***	4.804***	5.906***	6.750***	7.227***
Delaware	*cay*	9.023***	10.141***	10.936***	11.473***	12.288***
	cday	8.928***	9.731***	10.383***	10.776***	11.318***
DC	*cay*	8.590***	10.737***	12.090***	13.163***	14.603***
	cday	9.271***	11.216***	12.416***	13.373***	14.686***
Florida	*cay*	8.890***	10.054***	10.757***	11.713***	12.806***
	cday	8.955***	10.102***	10.754***	11.659***	12.751***
Georgia	*cay*	4.775***	5.587***	7.889***	10.113***	11.702***
	cday	5.419***	5.892***	8.040***	10.338***	12.009***
Hawaii	*cay*	10.852***	11.739***	12.806***	13.549***	14.642***
	cday	10.163***	11.084***	12.068***	12.724***	13.672***
Idaho	*cay*	7.505***	8.037***	8.484***	9.107***	9.676***
	cday	7.935***	8.526***	8.758***	9.052***	9.227***
Illinois	*cay*	7.207***	9.098***	11.057***	12.803***	14.940***
	cday	7.088***	8.924***	10.888***	12.603***	14.678***
Indiana	*cay*	7.144***	9.373***	10.743***	12.039***	13.619***
	cday	6.416***	8.526***	9.847***	11.015***	12.385***
Iowa	*cay*	8.177***	9.435***	10.153***	10.805***	11.672***
	cday	8.214***	9.038***	9.607***	10.004***	10.496***
Kansas	*cay*	5.739***	6.844***	8.057***	8.702***	9.392***
	cday	6.724***	7.309***	8.338***	8.959***	9.231***
Kentucky	*cay*	4.810***	5.712***	6.028***	7.047***	8.287***
	cday	4.007***	4.834***	5.284***	6.227***	7.235***
Louisiana	*cay*	6.657***	8.001***	9.304***	10.186***	10.954***
	cday	7.040***	8.267***	9.420***	9.959***	10.423***
Maine	*cay*	9.214***	12.087***	13.881***	15.377***	17.088***
	cday	8.906***	11.781***	13.593***	15.050***	16.672***
Maryland	*cay*	5.957***	7.034***	7.707***	8.229***	8.837***
	cday	5.773***	6.902***	7.575***	7.973***	8.528***
Massachusetts	*cay*	4.470***	5.903***	7.098***	7.734***	8.391***
	cday	4.377***	5.650***	6.936***	7.620***	8.284***
Michigan	*cay*	6.554***	7.819***	9.207***	10.164***	11.800***
	cday	6.936***	8.332***	9.494***	10.306***	11.413***
Minnesota	*cay*	5.076***	5.381***	6.180***	6.925***	8.191***
	cday	5.168***	5.228***	5.932***	6.851***	8.097***
Mississippi	*cay*	6.223***	7.358***	8.257***	9.247***	10.434***
	cday	6.478***	7.379***	8.512***	9.507***	10.544***
Missouri	*cay*	6.847***	8.315***	9.840***	11.200***	12.840***
	cday	7.322***	8.308***	9.511***	11.072***	12.462***
Montana	*cay*	5.388***	6.979***	7.790***	9.036***	10.299***
	cday	4.602***	6.752***	7.781***	8.795***	9.983***
Nebraska	*cay*	8.063***	10.039***	11.298***	12.321***	13.482***
	cday	8.094***	8.094***	8.094***	8.094***	8.094***

(cont.)

State	Predictor	Dimension				
		2	3	4	5	6
Nevada	*cay*	8.445***	9.590***	10.530***	11.036***	11.867***
	cday	8.577***	9.726***	10.671***	11.260***	12.132***
New Hampshire	*cay*	10.618***	12.168***	13.182***	14.178***	15.483***
	cday	10.521***	12.150***	13.216***	14.267***	15.637***
New Jersey	*cay*	5.651***	5.971***	6.942***	7.667***	7.929***
	cday	4.939***	5.370***	6.363***	7.113***	7.274***
New Mexico	*cay*	5.807***	6.157***	6.890***	7.354***	7.466***
	cday	5.673***	6.241***	6.983***	7.420***	7.652***
New York	*cay*	3.993***	6.756***	9.276***	11.264***	12.993***
	cday	4.077***	6.929***	9.404***	11.438***	13.164***
North Carolina	*cay*	4.740***	6.115***	7.830***	9.467***	10.993***
	cday	4.623***	6.124***	7.783***	9.320***	10.720***
North Dakota	*cay*	8.966***	9.070***	10.187***	11.249***	12.566***
	cday	8.356***	8.789***	10.153***	11.614***	13.140***
Ohio	*cay*	7.747***	9.224***	10.019***	10.640***	11.861***
	cday	7.775***	8.852***	9.671***	10.662***	11.974***
Oklahoma	*cay*	5.928***	6.528***	7.608***	8.609***	9.458***
	cday	5.678***	6.275***	7.235***	7.855***	8.586***
Oregon	*cay*	9.526***	11.254***	12.251***	13.100***	13.886***
	cday	9.544***	11.361***	12.211***	12.997***	13.683***
Pennsylvania	*cay*	9.012***	9.528***	10.430***	11.607***	12.604***
	cday	9.008***	9.483***	10.318***	11.485***	12.488***
Rhode Island	*cay*	2.901***	4.286***	5.964***	6.975***	7.716***
	cday	3.195***	4.478***	6.286***	7.591***	8.512***
South Carolina	*cay*	4.400***	6.419***	7.704***	9.059***	10.214***
	cday	4.318***	6.269***	7.438***	8.640***	9.681***
South Dakota	*cay*	8.053***	10.513***	11.963***	13.260***	14.998***
	cday	7.639***	9.495***	10.656***	11.510***	12.894***
Tennessee	*cay*	9.783***	10.663***	11.049***	11.872***	12.944***
	cday	9.483***	10.575***	11.024***	12.023***	13.386***
Texas	*cay*	3.649***	5.434***	6.570***	7.580***	9.145***
	cday	4.491***	5.837***	6.774***	7.700***	9.045***
Utah	*cay*	8.257***	7.962***	7.767***	7.673***	7.484***
	cday	8.288***	8.167***	7.956***	8.039***	8.068***
Vermont	*cay*	8.287***	7.529***	8.078***	8.062***	7.907***
	cday	8.287***	7.529***	8.078***	8.062***	7.907***
Virginia	*cay*	3.162***	5.140***	6.573***	7.307***	7.888***
	cday	3.121***	5.134***	6.564***	7.250***	7.806***
Washington	*cay*	7.226***	8.070***	9.027***	9.645***	10.228***
	cday	7.137***	8.044***	8.989***	9.736***	10.313***
West Virginia	*cay*	8.263***	7.493***	6.798***	6.261***	5.841***
	cday	8.263***	7.493***	6.798***	6.261***	5.841***
Wisconsin	*cay*	6.240***	7.840***	8.532***	9.382***	10.138***
	cday	5.796***	7.377***	8.180***	9.075***	9.678***
Wyoming	*cay*	8.139***	9.788***	10.951***	12.138***	13.504***
	cday	6.486***	7.870***	8.639***	9.305***	10.179***
U.S.	*cay*	5.423***	6.094***	7.000***	7.434***	8.083***
	cday	5.799***	6.187***	6.923***	7.351***	7.904***

Note: Entries correspond to the BDS (Brock *et al.*, 1996) *z*-statistic, with the test applied to the residuals recovered from housing return (*rhr*) equations of the VAR model with either *cay* or *cday*. *** indicates rejection of null hypothesis at the 1% significance level.

Table 8. Causality-in-quantiles tests (housing market returns).

		Quantiles of housing market *returns (rhr)*																		
State	**Predictor**	**0.05**	**0.10**	**0.15**	**0.20**	**0.25**	**0.30**	**0.35**	**0.40**	**0.45**	**0.50**	**0.55**	**0.60**	**0.65**	**0.70**	**0.75**	**0.80**	**0.85**	**0.90**	**0.95**
Alabama	*cay*	0.44	1.51	1.87	**2.48**	**3.13**	**2.82**	**2.65**	**2.56**	1.73	1.49	1.25	0.96	0.56	0.71	0.62	0.38	0.62	0.69	0.77
	cday	0.36	0.97	1.22	**2.18**	**3.00**	**3.38**	**3.46**	**3.05**	**2.38**	**2.22**	1.62	1.30	0.86	1.13	1.26	0.87	0.59	0.66	0.71
Alaska	*cay*	0.50	0.62	1.19	1.54	**2.23**	**2.90**	**2.32**	1.53	1.46	1.45	1.21	1.00	1.16	0.75	0.59	0.68	0.80	0.96	0.65
	cday	0.67	0.73	1.28	1.74	**2.08**	**2.44**	1.92	1.21	1.37	1.30	1.17	0.93	1.16	1.03	0.89	0.65	0.83	0.95	0.67
Arizona	*cay*	0.06	0.02	0.01	0.00	0.01	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.03	0.00	0.01	0.00	0.02	0.01	0.04
	cday	0.06	0.02	0.01	0.00	0.01	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.03	0.00	0.01	0.00	0.02	0.01	0.04
Arkansas	*cay*	0.05	0.31	0.43	0.74	0.95	0.77	0.71	0.50	0.35	0.53	0.46	0.34	0.16	0.14	0.11	0.10	0.12	0.23	0.02
	cday	0.04	0.24	0.40	0.85	1.19	0.86	0.89	0.65	0.51	0.63	0.49	0.38	0.18	0.13	0.09	0.07	0.09	0.23	0.02
California	*cay*	0.01	0.02	0.01	0.00	0.00	0.03	0.01	0.01	0.00	0.01	0.02	0.00	0.03	0.02	0.01	0.00	0.02	0.01	0.00
	cday	0.01	0.02	0.01	0.00	0.00	0.03	0.01	0.01	0.00	0.01	0.02	0.00	0.03	0.02	0.01	0.00	0.02	0.01	0.00
Colorado	*cay*	0.36	0.58	0.44	0.53	0.62	0.55	0.61	0.52	0.49	0.42	0.32	0.32	0.18	0.14	0.27	0.24	0.19	0.41	0.27
	cday	0.41	0.85	0.49	0.45	0.49	0.43	0.42	0.45	0.51	0.37	0.30	0.26	0.15	0.12	0.23	0.20	0.22	0.53	0.32
Connecticut	*cay*	1.38	1.82	**2.07**	**2.68**	**2.81**	**3.45**	**3.42**	**3.86**	**3.49**	**2.75**	**2.45**	**2.19**	**2.37**	**2.25**	**2.38**	**2.42**	**2.10**	1.89	0.83
	cday	1.53	1.91	**2.16**	**2.65**	**2.80**	**3.24**	**2.98**	**3.37**	**3.34**	**3.02**	**2.63**	**2.61**	**2.89**	**2.36**	**2.33**	**2.02**	1.89	1.65	0.78
Delaware	*cay*	0.39	0.92	1.60	1.71	**2.13**	**2.86**	**3.04**	**4.40**	**4.54**	**5.45**	**4.73**	**5.11**	**4.63**	**4.18**	**3.44**	**2.68**	1.91	1.08	0.45
	cday	0.45	1.17	**2.13**	**2.36**	**2.44**	**2.90**	**3.46**	**5.18**	**4.62**	**5.65**	**4.95**	**5.24**	**3.85**	**3.50**	**2.49**	**2.19**	1.35	0.81	0.46
DC	*cay*	0.23	0.38	0.44	0.69	0.78	1.35	1.37	1.78	1.59	1.76	1.74	1.74	1.42	1.14	1.17	1.04	0.51	0.42	0.17
	cday	0.15	0.46	0.39	0.58	0.64	1.31	1.28	1.78	1.44	1.65	1.63	1.67	1.38	1.19	1.18	1.11	0.57	0.40	0.16
Florida	*cay*	0.91	0.96	0.95	0.61	0.47	0.55	0.48	0.64	0.68	0.52	0.39	0.77	0.49	0.52	0.59	0.70	0.75	0.64	0.57
	cday	0.68	0.75	0.90	0.65	0.76	0.75	0.38	0.46	0.46	0.45	0.40	0.80	0.57	0.68	0.77	1.27	**1.98**	1.35	0.68
Georgia	*cay*	1.17	1.60	1.85	**2.06**	**2.55**	**2.80**	**2.76**	**2.73**	**2.99**	**3.18**	**3.38**	**3.53**	**3.26**	**3.54**	**3.22**	**2.49**	1.74	1.46	0.89
	cday	1.14	1.48	1.73	1.83	**2.12**	**2.50**	**2.68**	**2.50**	**2.95**	**3.15**	**3.48**	**3.62**	**3.32**	**4.05**	**3.85**	**2.66**	1.86	1.76	0.91
Hawaii	*cay*	1.17	1.66	**2.51**	**2.59**	**2.69**	**3.14**	**3.67**	**3.76**	**4.21**	**4.60**	**5.82**	**5.60**	**5.17**	**4.51**	**3.82**	**3.92**	**3.64**	**2.06**	1.02
	cday	1.04	1.30	**2.05**	**2.26**	**2.36**	**2.69**	**2.96**	**3.48**	**3.82**	**4.49**	**4.85**	**4.06**	**4.04**	**3.75**	**3.45**	**3.49**	**3.48**	1.81	0.90
Idaho	*cay*	0.44	1.18	1.64	1.47	**2.20**	**3.00**	**2.72**	**2.35**	**2.76**	**2.94**	**2.96**	**2.48**	**2.70**	**2.26**	**2.50**	**2.61**	**1.98**	**2.04**	0.96
	cday	0.51	1.32	**1.97**	1.81	**2.58**	**4.41**	**4.15**	**3.37**	**3.52**	**3.28**	**2.43**	**2.40**	**2.86**	**2.44**	**2.33**	**2.46**	**2.00**	**2.13**	0.93
Illinois	*cay*	1.13	1.84	**2.40**	**2.64**	**2.54**	**3.00**	**2.83**	**2.93**	**2.48**	**2.57**	**2.65**	**2.91**	**3.05**	**3.04**	**2.95**	**2.38**	**2.09**	**2.06**	1.16
	cday	1.08	1.82	**2.45**	**2.46**	**2.45**	**3.13**	**2.88**	**3.12**	**2.98**	**3.19**	**3.19**	**3.19**	**3.08**	**2.46**	**2.18**	1.89	1.86	1.82	0.89
Indiana	*cay*	1.75	**2.45**	**2.84**	**3.31**	**3.58**	**3.80**	**3.93**	**4.09**	**3.87**	**4.02**	**3.92**	**3.81**	**3.90**	**3.84**	**3.23**	**2.88**	**2.56**	**2.07**	1.55
	cday	1.73	**2.36**	**2.72**	**3.08**	**3.41**	**3.50**	**3.69**	**3.45**	**3.44**	**3.59**	**3.66**	**3.40**	**3.39**	**3.15**	**3.02**	**2.78**	**2.37**	**2.03**	1.46
Iowa	*cay*	0.27	0.39	0.42	0.39	0.54	0.43	0.30	0.25	0.22	0.28	0.32	0.28	0.21	0.32	0.64	0.51	0.42	0.23	0.13
	cday	0.49	0.69	0.76	1.09	1.37	1.00	0.93	0.81	0.44	0.43	0.48	0.27	0.33	0.29	0.46	0.43	0.49	0.37	0.22
Kansas	*cay*	0.37	0.71	0.86	1.28	1.16	1.36	1.53	1.32	1.35	1.23	1.09	0.91	0.99	0.92	0.85	0.84	0.53	1.02	0.65
	cday	0.55	1.12	1.34	**2.05**	1.82	**2.12**	**2.22**	1.92	1.69	1.44	1.30	1.13	0.92	0.87	0.58	0.91	0.65	1.00	0.72

(cont.)

		Quantiles of housing market ***returns (rhr)***																		
State	**Predictor**	**0.05**	**0.10**	**0.15**	**0.20**	**0.25**	**0.30**	**0.35**	**0.40**	**0.45**	**0.50**	**0.55**	**0.60**	**0.65**	**0.70**	**0.75**	**0.80**	**0.85**	**0.90**	**0.95**
Kentucky	*cay*	0.61	0.94	1.47	1.41	1.88	1.80	**1.99**	1.79	1.64	1.67	1.44	1.17	1.04	0.84	0.78	0.59	0.72	0.62	0.43
	cday	0.97	1.36	1.58	1.42	1.84	1.48	1.73	1.56	1.17	1.41	1.16	1.09	0.83	0.59	0.79	0.74	0.87	0.68	0.57
Louisiana	*cay*	0.01	0.02	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.02	0.00	0.00	0.02	0.01	0.00	0.02	0.01	0.04
	cday	0.01	0.02	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.02	0.00	0.00	0.02	0.01	0.00	0.02	0.01	0.04
Maine	*cay*	0.20	0.29	0.27	0.26	0.27	0.23	0.18	0.16	0.16	0.14	0.13	0.11	0.09	0.07	0.05	0.04	0.03	0.02	0.01
	cday	0.21	0.30	0.26	0.26	0.27	0.22	0.19	0.16	0.17	0.14	0.13	0.11	0.08	0.06	0.04	0.04	0.04	0.02	0.02
Maryland	*cay*	0.41	0.94	0.93	0.70	0.67	0.55	0.54	0.47	0.53	0.51	0.46	0.82	1.29	1.41	0.97	0.70	0.64	0.70	0.46
	cday	0.18	0.62	0.69	0.32	0.47	0.54	0.83	0.75	0.75	0.66	0.57	0.87	1.17	1.22	0.85	0.64	0.73	0.71	0.48
Massachusetts	*cay*	0.12	0.16	0.05	0.10	0.26	0.32	0.24	0.31	0.19	0.20	0.31	0.25	0.39	0.57	0.52	0.80	0.63	0.49	0.24
	cday	0.16	0.13	0.14	0.09	0.10	0.18	0.14	0.24	0.24	0.29	0.41	0.41	0.49	0.58	0.56	0.82	0.70	0.50	0.22
Michigan	*cay*	0.95	1.57	1.86	1.43	1.48	1.77	1.85	1.93	1.86	1.45	1.25	1.15	1.18	1.51	1.42	1.84	1.37	1.26	0.75
	cday	1.20	1.63	1.85	1.65	**2.07**	**2.81**	**2.64**	**2.53**	**2.59**	**2.16**	1.68	1.72	1.27	1.26	1.05	1.54	1.73	1.27	0.77
Minnesota	*cay*	0.01	0.02	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.02	0.01	0.01	0.00	0.01	0.00	0.02	0.01	0.00
	cday	0.01	0.02	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.02	0.01	0.01	0.00	0.01	0.00	0.02	0.01	0.00
Mississippi	*cay*	**1.98**	**2.65**	**3.03**	**3.54**	**4.00**	**4.12**	**4.16**	**4.26**	**4.26**	**4.31**	**4.25**	**4.31**	**3.98**	**3.67**	**3.58**	**3.28**	**2.97**	**2.57**	1.47
	cday	1.92	**2.66**	**3.04**	**3.35**	**3.76**	**3.87**	**4.00**	**4.11**	**4.15**	**4.28**	**4.10**	**4.01**	**4.01**	**3.92**	**3.86**	**3.36**	**3.06**	**2.63**	1.46
Missouri	*cay*	0.10	0.23	0.25	0.18	0.37	0.32	0.29	0.27	0.21	0.22	0.32	0.25	0.23	0.44	0.33	0.72	0.64	0.93	0.53
	cday	0.13	0.23	0.33	0.33	0.30	0.41	0.62	0.81	0.38	0.32	0.37	0.26	0.23	0.38	0.22	0.40	0.25	0.41	0.44
Montana	*cay*	0.36	0.50	0.85	1.07	1.01	0.98	1.08	0.92	1.05	0.91	0.96	1.06	1.03	0.85	0.97	1.26	1.20	0.99	0.34
	cday	0.46	0.81	1.33	1.46	1.56	1.58	1.64	1.19	1.22	1.09	1.06	1.07	1.06	0.84	0.95	1.12	1.09	0.93	0.37
Nebraska	*cay*	0.06	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.03	0.00	0.01	0.00	0.00	0.01	0.00
	cday	0.06	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.03	0.00	0.01	0.00	0.00	0.01	0.00
Nevada	*cay*	0.01	0.02	0.04	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.03	0.02	0.00	0.00
	cday	0.01	0.02	0.04	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.03	0.02	0.00	0.00
New Hampshire	*cay*	0.41	1.15	**2.12**	**2.62**	**3.41**	**3.20**	**3.23**	**3.42**	**3.58**	**3.19**	**3.52**	**2.99**	**2.93**	**2.38**	**2.18**	**2.23**	1.78	1.68	0.63
	cday	0.35	0.93	1.87	1.82	1.91	1.53	1.52	1.65	1.77	1.81	1.79	1.54	1.85	1.85	1.74	**2.01**	1.64	1.65	0.60
New Jersey	*cay*	0.09	0.11	0.14	0.15	0.08	0.06	0.10	0.23	0.28	0.26	0.21	0.37	0.65	0.66	0.88	1.27	1.23	0.83	0.41
	cday	0.10	0.17	0.35	0.23	0.11	0.20	0.24	0.33	0.44	0.35	0.20	0.40	0.49	0.59	0.55	0.83	0.84	0.63	0.35
New Mexico	*cay*	0.13	0.39	0.74	1.11	1.08	1.26	1.31	1.39	1.47	1.40	1.25	1.12	0.72	0.75	0.64	0.61	0.67	0.46	0.26
	cday	0.06	0.12	0.32	0.73	0.64	0.78	0.98	1.19	1.26	1.33	1.19	1.19	0.91	1.06	1.01	0.98	0.90	0.53	0.23
New York	*cay*	0.06	0.11	0.15	0.29	0.57	0.58	0.58	0.57	0.71	0.80	0.75	1.02	1.07	0.92	0.44	0.38	0.34	0.17	0.03
	cday	0.07	0.14	0.23	0.42	0.78	0.80	0.81	0.75	0.80	0.87	0.77	0.87	0.82	0.69	0.37	0.31	0.30	0.15	0.04
North Carolina	*cay*	0.15	0.27	0.60	0.67	0.73	0.70	0.63	0.79	0.54	0.60	0.67	0.74	0.41	0.42	0.19	0.09	0.09	0.13	0.05
	cday	0.26	0.54	0.90	1.03	0.91	0.86	0.65	0.90	0.57	0.65	0.72	0.65	0.39	0.34	0.14	0.08	0.10	0.17	0.05

(cont.)

		Quantiles of housing market *returns (rhr)*																		
State	**Predictor**	**0.05**	**0.10**	**0.15**	**0.20**	**0.25**	**0.30**	**0.35**	**0.40**	**0.45**	**0.50**	**0.55**	**0.60**	**0.65**	**0.70**	**0.75**	**0.80**	**0.85**	**0.90**	**0.95**
North Dakota	*cay*	0.01	0.02	0.01	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.00	0.00	0.00	0.01	0.00	0.02	0.01	0.04
	cday	0.01	0.02	0.01	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.00	0.00	0.00	0.01	0.00	0.02	0.01	0.04
Ohio	*cay*	0.36	0.39	0.51	0.55	0.37	0.41	0.35	0.49	0.35	0.58	0.58	0.58	0.82	0.71	0.84	0.91	1.29	1.28	0.50
	cday	0.24	0.31	0.88	1.03	1.28	1.68	1.35	1.74	0.93	0.95	0.84	0.54	0.56	0.41	0.42	0.50	0.74	0.82	0.52
Oklahoma	*cay*	0.03	0.07	0.05	0.07	0.08	0.10	0.10	0.09	0.09	0.10	0.06	0.08	0.07	0.06	0.05	0.04	0.05	0.03	0.01
	cday	0.02	0.06	0.06	0.10	0.11	0.15	0.14	0.13	0.13	0.12	0.09	0.09	0.06	0.07	0.07	0.05	0.06	0.04	0.02
Oregon	*cay*	0.44	1.06	1.09	0.74	0.96	1.29	1.57	1.51	1.31	1.61	**2.03**	1.46	1.29	1.20	1.52	1.31	1.29	0.80	0.46
	cday	0.48	1.32	1.52	1.10	1.29	1.77	1.79	1.53	1.35	1.63	1.75	1.51	1.43	1.37	1.57	1.71	1.52	1.07	0.53
Pennsylvania	*cay*	0.99	0.98	1.08	1.61	1.38	**2.05**	**2.04**	1.89	**2.50**	**2.33**	**2.73**	**2.81**	**2.14**	1.95	**2.21**	**2.70**	**2.67**	**2.11**	1.19
	cday	0.96	1.16	1.36	1.52	1.50	**2.23**	1.93	1.74	**2.09**	**2.15**	**2.54**	**2.73**	**2.36**	**2.14**	**2.73**	**2.90**	**3.03**	**2.31**	1.08
Rhode Island	*cay*	0.01	0.02	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.02	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00
	cday	0.01	0.02	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.02	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00
South Carolina	*cay*	1.49	**2.00**	**2.38**	**2.78**	**2.89**	**2.96**	**3.47**	**3.60**	**3.55**	**3.34**	**3.23**	**3.49**	**3.49**	**3.50**	**3.27**	**2.53**	**2.11**	1.59	1.03
	cday	1.43	1.93	**2.34**	**3.02**	**2.96**	**3.18**	**3.62**	**3.65**	**3.81**	**3.95**	**3.60**	**3.38**	**3.66**	**3.81**	**3.58**	**2.41**	**1.99**	1.78	1.10
South Dakota	*cay*	0.98	1.40	1.71	**2.23**	**2.74**	**3.19**	**2.94**	**2.60**	**2.30**	**2.11**	1.94	1.72	1.53	1.55	1.42	1.35	1.33	1.11	0.73
	cday	0.95	1.41	1.83	**2.21**	**2.63**	**2.72**	**2.36**	1.86	1.67	1.46	1.62	1.37	1.53	1.64	1.72	1.57	1.36	1.11	0.68
Tennessee	*cay*	0.37	0.84	1.14	1.18	1.28	1.62	1.70	1.62	1.57	1.34	1.33	1.04	0.72	0.43	0.54	0.58	0.61	0.79	0.39
	cday	0.38	0.55	1.02	1.40	1.93	**2.71**	**2.59**	**2.44**	**2.21**	**2.38**	1.90	1.76	1.42	0.60	0.79	0.62	0.63	0.83	0.43
Texas	*cay*	0.50	1.09	1.80	**2.99**	**2.57**	**3.62**	**3.35**	**2.86**	**2.13**	1.57	1.43	1.07	0.89	0.95	0.73	0.81	0.90	1.12	0.71
	cday	0.52	1.15	**2.04**	**3.04**	**2.93**	**4.31**	**4.18**	**3.14**	**2.64**	1.67	1.41	1.04	0.75	0.69	0.54	0.73	0.87	1.17	0.76
Utah	*cay*	0.77	1.33	1.82	**2.00**	**2.20**	**2.01**	**2.00**	**2.26**	**2.19**	**2.32**	**2.50**	1.71	1.51	1.68	**2.12**	1.64	0.99	1.18	0.69
	cday	0.53	0.60	0.62	0.92	1.21	1.25	1.10	1.44	1.70	1.84	**2.18**	1.47	1.24	1.33	1.53	1.28	0.83	1.08	0.70
Vermont	*cay*	**1.99**	**2.72**	**3.11**	**3.47**	**3.75**	**3.98**	**4.03**	**4.16**	**4.20**	**4.36**	**4.34**	**4.23**	**4.21**	**3.86**	**3.63**	**3.26**	**2.93**	**2.29**	1.52
	cday	**1.98**	**2.74**	**3.06**	**3.60**	**3.96**	**4.16**	**4.28**	**4.31**	**4.35**	**4.44**	**4.33**	**4.26**	**4.24**	**3.87**	**3.69**	**3.30**	**2.93**	**2.28**	1.51
Virginia	*cay*	0.27	0.68	0.79	1.18	1.09	1.29	1.31	1.17	0.93	0.63	0.78	0.42	0.37	0.45	0.54	0.28	0.25	0.20	0.21
	cday	0.19	0.35	0.48	0.72	0.56	0.62	0.61	0.49	0.57	0.35	0.44	0.39	0.43	0.53	0.67	0.50	0.38	0.24	0.25
Washington	*cay*	0.31	0.58	0.83	0.42	0.35	0.39	0.72	0.81	1.13	1.08	1.08	1.06	0.99	1.11	1.12	1.31	1.36	1.41	0.79
	cday	0.62	1.14	1.47	0.92	1.06	0.76	0.38	0.46	0.61	0.93	1.00	0.91	0.85	0.84	1.00	1.37	1.53	1.57	0.82
West Virginia	*cay*	**2.26**	**2.78**	**3.17**	**3.58**	**3.81**	**4.04**	**4.17**	**4.28**	**4.29**	**4.30**	**4.26**	**4.18**	**4.07**	**3.87**	**3.65**	**3.31**	**2.95**	**2.46**	1.54
	cday	**2.26**	**2.77**	**3.17**	**3.57**	**3.77**	**4.00**	**4.12**	**4.21**	**4.32**	**4.32**	**4.28**	**4.20**	**4.08**	**3.87**	**3.65**	**3.31**	**2.94**	**2.46**	1.54
Wisconsin	*cay*	1.82	**2.37**	**2.87**	**3.17**	**3.43**	**3.44**	**3.55**	**3.60**	**3.58**	**3.39**	**3.39**	**3.32**	**3.44**	**3.00**	**2.76**	**2.61**	**2.42**	**1.96**	1.42
	cday	1.72	**2.28**	**3.24**	**3.16**	**3.33**	**3.63**	**4.00**	**3.82**	**3.68**	**3.77**	**3.74**	**3.58**	**3.33**	**2.96**	**2.70**	**2.45**	**2.35**	1.92	1.37
Wyoming	*cay*	0.21	0.59	1.05	**2.11**	**2.35**	1.80	1.67	1.82	1.57	1.59	1.50	1.07	0.97	0.88	0.68	0.44	0.56	0.35	0.10
	cday	0.27	0.69	1.34	**2.37**	**2.79**	**2.09**	**2.29**	**2.41**	**2.21**	**2.56**	**2.54**	**2.06**	**1.96**	1.84	1.31	0.80	0.84	0.41	0.10
U.S.	*cay*	0.01	0.02	0.01	0.02	0.01	0.00	0.01	0.01	0.02	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.02	0.01	0.04
	cday	0.01	0.02	0.01	0.02	0.01	0.00	0.01	0.01	0.02	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.02	0.01	0.04

Note: Entries in bold indicate significance at the 5% level, i.e. rejection of the null hypothesis of no-causality. Thus, the test statistic for a given quantile is greater than or equal to 1.96.

Table 9. Causality-in-quantiles tests (housing market volatility).

State	Predictor	**Quantiles of housing market *volatility (rhv)***																		
State	**Predictor**	**0.05**	**0.10**	**0.15**	**0.20**	**0.25**	**0.30**	**0.35**	**0.40**	**0.45**	**0.50**	**0.55**	**0.60**	**0.65**	**0.70**	**0.75**	**0.80**	**0.85**	**0.90**	**0.95**
Alabama	*cay*	**2.22**	**2.74**	**3.25**	**3.55**	**3.77**	**3.93**	**4.07**	**4.15**	**4.13**	**4.13**	**4.14**	**4.08**	**3.99**	**3.91**	**3.68**	**3.30**	**2.92**	**2.44**	1.52
	cday	**2.25**	**2.76**	**3.27**	**3.56**	**3.79**	**3.98**	**4.13**	**4.25**	**4.30**	**4.31**	**4.27**	**4.19**	**4.11**	**3.89**	**3.68**	**3.32**	**2.95**	**2.46**	1.54
Alaska	*cay*	0.99	1.26	1.82	**2.00**	**2.21**	**2.04**	**1.65**	**1.78**	**1.91**	**2.76**	**2.69**	**2.22**	**2.40**	**3.05**	**2.82**	**2.09**	1.49	1.22	1.02
	cday	1.28	1.46	1.43	1.64	**2.39**	**2.34**	**2.84**	**2.38**	**2.41**	**2.91**	**2.87**	**2.59**	**2.65**	**2.68**	**2.58**	**2.09**	1.48	1.32	1.08
Arizona	*cay*	1.91	**2.29**	**2.70**	**2.57**	**3.03**	**3.34**	**3.55**	**3.53**	**3.61**	**3.54**	**3.84**	**3.89**	**3.69**	**3.38**	**3.31**	**2.84**	**2.50**	**2.18**	1.52
	cday	**2.27**	**2.49**	**2.83**	**2.90**	**3.31**	**3.61**	**3.78**	**3.87**	**4.01**	**4.00**	**3.83**	**3.96**	**3.52**	**3.56**	**3.49**	**2.97**	**2.59**	**2.23**	1.56
Arkansas	*cay*	0.73	1.31	1.45	1.61	1.82	1.70	**2.30**	**2.44**	**2.05**	**3.54**	**3.60**	**3.33**	**2.91**	**2.30**	**2.09**	1.93	1.57	1.32	0.78
	cday	0.92	1.43	**2.07**	**2.00**	**2.26**	**2.17**	**2.88**	**2.51**	**2.15**	**3.31**	**3.34**	**3.37**	**3.15**	**2.90**	**2.48**	**2.05**	1.76	1.35	0.81
California	*cay*	1.91	**2.48**	**2.97**	**3.44**	**3.80**	**3.87**	**4.23**	**4.25**	**4.21**	**4.24**	**4.12**	**4.01**	**3.90**	**3.76**	**3.47**	**3.09**	**2.81**	**2.14**	1.63
	cday	**2.23**	**2.60**	**3.06**	**3.34**	**3.77**	**3.86**	**4.16**	**4.20**	**4.17**	**4.05**	**3.93**	**3.84**	**3.86**	**3.65**	**3.36**	**3.06**	**2.79**	**2.15**	1.66
Colorado	*cay*	1.64	**2.21**	**2.78**	**3.26**	**3.63**	**4.12**	**4.32**	**4.46**	**4.26**	**4.17**	**3.97**	**4.19**	**3.76**	**3.50**	**3.51**	**2.93**	**2.86**	**2.29**	1.29
	cday	1.64	**2.15**	**2.64**	**3.35**	**3.70**	**4.00**	**3.98**	**4.18**	**4.10**	**4.01**	**3.79**	**3.71**	**3.75**	**3.41**	**3.45**	**3.01**	**2.85**	**2.13**	1.27
Connecticut	*cay*	0.37	0.52	0.90	0.68	0.68	0.73	0.64	0.68	0.54	0.45	0.40	0.62	0.70	0.99	1.17	0.94	0.76	0.77	0.14
	cday	0.31	0.32	0.24	0.58	0.70	0.89	0.82	1.00	0.64	0.66	0.46	0.79	0.80	0.76	0.71	0.67	0.76	0.78	0.18
Delaware	*cay*	1.43	**2.02**	**2.04**	**2.36**	**2.92**	**2.84**	**3.21**	**3.22**	**3.58**	**4.13**	**3.89**	**3.55**	**3.10**	**2.99**	**2.40**	**2.74**	**2.26**	1.58	1.07
	cday	1.53	1.88	**2.12**	**2.24**	**2.81**	**3.06**	**3.05**	**2.83**	**2.76**	**2.89**	**3.04**	**2.93**	**3.04**	**2.72**	**2.51**	**2.39**	1.88	1.45	1.36
DC	*cay*	1.06	1.73	**2.03**	**2.31**	**2.79**	**2.84**	**3.08**	**2.78**	**2.39**	**2.59**	**2.33**	**2.31**	**2.35**	**2.03**	1.70	1.81	1.59	1.32	1.00
	cday	1.34	1.59	1.86	**2.09**	**2.30**	**2.25**	**2.34**	**2.55**	**2.47**	**2.41**	**2.39**	**2.42**	**2.46**	**2.13**	**2.08**	**2.09**	1.91	1.58	1.10
Florida	*cay*	**1.99**	**2.43**	**2.88**	**3.22**	**3.39**	**3.70**	**3.96**	**3.97**	**3.83**	**3.74**	**3.74**	**3.71**	**3.64**	**3.41**	**3.23**	**2.90**	**2.55**	**1.96**	1.52
	cday	**2.10**	**2.50**	**2.86**	**3.08**	**3.18**	**3.39**	**3.84**	**3.80**	**3.98**	**3.99**	**3.92**	**3.91**	**3.73**	**3.59**	**3.45**	**3.21**	**2.76**	**2.25**	1.61
Georgia	*cay*	0.01	0.00	0.01	0.02	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.02	0.01	0.00	0.02	0.01	0.00
	cday	0.01	0.00	0.01	0.02	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.02	0.01	0.00	0.02	0.01	0.00
Hawaii	*cay*	1.95	**2.63**	**3.13**	**3.36**	**3.46**	**3.67**	**3.88**	**4.02**	**4.18**	**4.18**	**4.15**	**4.19**	**4.01**	**3.66**	**3.37**	**3.09**	**2.89**	**2.31**	1.72
	cday	**2.01**	**2.75**	**3.38**	**3.59**	**3.73**	**3.95**	**4.13**	**4.20**	**4.29**	**4.29**	**4.32**	**4.27**	**4.11**	**3.98**	**3.63**	**3.31**	**3.04**	**2.45**	1.77
Idaho	*cay*	1.75	**2.40**	**2.68**	**3.12**	**3.37**	**3.78**	**3.76**	**3.75**	**3.99**	**3.94**	**3.91**	**3.91**	**3.67**	**3.89**	**3.69**	**3.50**	**2.71**	**1.99**	1.54
	cday	1.52	**2.28**	**2.72**	**3.22**	**3.52**	**3.75**	**3.57**	**3.59**	**3.66**	**3.65**	**3.61**	**3.44**	**3.36**	**3.38**	**3.17**	**2.99**	**2.70**	1.90	1.45
Illinois	*cay*	0.22	0.29	0.31	0.55	0.67	1.26	1.32	1.76	1.44	1.27	1.42	**1.99**	**3.07**	1.88	**2.06**	**2.86**	**2.15**	1.69	0.47
	cday	0.15	0.29	0.31	0.46	0.67	1.25	1.33	1.48	1.23	1.02	1.19	1.66	**2.38**	1.57	**2.14**	**2.57**	**2.23**	**2.09**	0.80
Indiana	*cay*	1.02	1.55	1.92	**2.24**	**2.29**	**2.22**	**2.32**	**2.71**	**3.15**	**3.37**	**2.99**	**2.97**	**2.80**	**2.68**	**2.53**	**2.00**	1.88	1.68	0.98
	cday	1.04	1.40	1.81	1.76	1.49	1.81	1.75	1.82	1.89	**2.06**	**2.36**	**2.54**	**2.47**	**2.17**	**2.09**	1.93	1.84	1.70	1.01
Iowa	*cay*	1.93	**2.12**	**2.67**	**2.80**	**3.26**	**3.04**	**3.59**	**3.55**	**3.97**	**4.24**	**3.99**	**3.87**	**3.67**	**3.66**	**3.77**	**3.09**	**2.79**	**2.04**	1.26
	cday	**2.00**	**2.60**	**2.92**	**3.08**	**3.21**	**3.45**	**3.52**	**3.72**	**3.71**	**3.77**	**3.58**	**3.49**	**3.34**	**3.31**	**3.35**	**2.79**	**2.58**	**2.19**	1.42
Kansas	*cay*	0.23	0.70	0.93	1.03	1.34	1.17	1.31	1.45	1.06	1.66	1.20	1.17	1.31	1.11	1.26	1.01	1.10	0.95	0.44
	cday	0.32	0.58	0.58	0.47	0.76	0.67	0.83	0.97	1.26	1.79	1.67	**2.39**	**2.27**	1.93	1.75	1.25	1.52	1.22	0.60

(cont.)

State	Predictor	Quantiles of housing market *volatility (rhv)*																		
State	**Predictor**	**0.05**	**0.10**	**0.15**	**0.20**	**0.25**	**0.30**	**0.35**	**0.40**	**0.45**	**0.50**	**0.55**	**0.60**	**0.65**	**0.70**	**0.75**	**0.80**	**0.85**	**0.90**	**0.95**
Kentucky	*cay*	0.06	0.02	0.02	0.00	0.00	0.03	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.01	0.01
	cday	0.06	0.02	0.02	0.00	0.00	0.03	0.01	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.01	0.01
Louisiana	*cay*	1.09	1.44	1.49	**2.08**	**3.21**	**3.38**	**3.01**	**3.16**	**3.00**	**2.99**	**2.63**	**3.27**	**3.01**	**3.12**	**2.97**	**2.18**	1.72	1.62	1.36
	cday	1.12	1.31	1.43	1.57	1.83	**2.70**	**2.77**	**2.91**	**3.22**	**3.15**	**3.22**	**3.12**	**3.01**	**3.35**	**3.35**	**3.04**	**2.45**	1.78	1.28
Maine	*cay*	1.22	1.73	**2.41**	**2.78**	**3.08**	**3.54**	**3.20**	**3.51**	**3.25**	**3.54**	**3.42**	**3.41**	**3.05**	**2.86**	**2.76**	**2.55**	**2.54**	1.74	1.57
	cday	1.21	1.83	**2.13**	**2.31**	**2.30**	**2.77**	**2.51**	**2.98**	**2.70**	**2.71**	**2.45**	**2.58**	**2.59**	**2.64**	**2.56**	**2.53**	**2.36**	1.86	1.47
Maryland	*cay*	**2.01**	**2.39**	**2.58**	**2.65**	**2.74**	**2.96**	**3.15**	**3.77**	**4.10**	**3.91**	**3.92**	**3.80**	**3.99**	**3.93**	**3.50**	**3.06**	**2.42**	1.88	1.30
	cday	1.59	**2.10**	**2.72**	**2.86**	**3.50**	**3.50**	**3.88**	**3.85**	**4.12**	**3.84**	**3.93**	**4.01**	**3.77**	**3.97**	**3.42**	**3.12**	**2.49**	**2.12**	1.48
Massachusetts	*cay*	0.05	0.15	0.06	0.10	0.07	0.19	0.12	0.07	0.10	0.05	0.11	0.11	0.13	0.16	0.09	0.13	0.06	0.08	0.04
	cday	0.02	0.10	0.07	0.07	0.08	0.06	0.20	0.20	0.11	0.13	0.08	0.15	0.13	0.19	0.21	0.15	0.05	0.08	0.01
Michigan	*cay*	1.40	**2.25**	**2.28**	**3.09**	**2.92**	**3.04**	**3.15**	**3.63**	**3.79**	**3.53**	**3.33**	**3.55**	**3.42**	**3.58**	**3.06**	**2.99**	**2.88**	**2.06**	1.13
	cday	1.27	1.90	**2.02**	**2.19**	**2.16**	**2.24**	**2.24**	**2.68**	**2.98**	**2.92**	**2.88**	**2.87**	**2.81**	**3.27**	**3.25**	**2.75**	**2.60**	1.95	1.10
Minnesota	*cay*	0.03	0.02	0.02	0.00	0.02	0.02	0.05	0.07	0.07	0.05	0.04	0.07	0.07	0.09	0.06	0.02	0.02	0.02	0.03
	cday	0.06	0.05	0.06	0.05	0.04	0.09	0.18	0.19	0.05	0.05	0.04	0.05	0.07	0.08	0.18	0.13	0.10	0.03	0.04
Mississippi	*cay*	0.87	1.44	1.71	1.77	1.94	**2.30**	**2.70**	**2.56**	**2.52**	**2.52**	**2.94**	**2.62**	**2.72**	**2.47**	**2.29**	**2.08**	**2.07**	1.65	1.18
	cday	1.00	1.45	1.85	2.40	**2.42**	**2.58**	**2.59**	**2.69**	**2.54**	**2.47**	**2.61**	**2.40**	**2.46**	**2.42**	**2.60**	**2.37**	1.81	1.30	1.04
Missouri	*cay*	0.83	0.97	1.16	1.04	1.35	1.72	**1.97**	**2.06**	1.60	1.78	**1.96**	1.77	**2.01**	**2.22**	**2.20**	**2.13**	1.80	1.28	0.85
	cday	0.70	0.69	1.18	1.80	1.58	**2.18**	**2.02**	**2.08**	**2.36**	1.82	1.66	1.78	1.69	1.92	1.37	1.31	1.02	0.98	0.70
Montana	*cay*	1.00	1.76	**2.05**	**2.59**	**2.78**	**2.61**	**2.99**	**2.95**	**3.12**	**2.85**	**2.63**	**2.45**	**2.51**	**2.19**	**2.45**	**2.45**	**2.23**	1.76	1.17
	cday	1.45	1.73	**2.09**	**2.43**	**2.69**	**2.94**	**3.14**	**3.52**	**3.37**	**3.07**	**2.58**	**2.39**	**2.57**	**2.70**	**2.06**	**2.12**	**2.16**	1.77	0.99
Nebraska	*cay*	1.90	**2.33**	**2.48**	**2.93**	**3.25**	**3.44**	**3.68**	**3.91**	**3.76**	**3.62**	**3.66**	**3.82**	**3.88**	**3.54**	**3.32**	**3.00**	**2.71**	**2.21**	1.54
	cday	1.69	**2.50**	**2.71**	**2.98**	**3.72**	**3.89**	**3.76**	**4.19**	**4.00**	**3.67**	**3.76**	**3.67**	**3.47**	**3.23**	**3.19**	**2.87**	**2.62**	**2.07**	1.43
Nevada	*cay*	1.28	1.74	**2.04**	**2.58**	**2.95**	**2.88**	**3.99**	**3.95**	**4.22**	**4.20**	**3.82**	**3.78**	**3.31**	**3.31**	**3.11**	**2.92**	**2.65**	1.94	1.24
	cday	1.30	1.87	**2.09**	**2.74**	**3.13**	**3.18**	**4.13**	**3.98**	**3.99**	**3.80**	**3.43**	**3.43**	**2.97**	**2.93**	**2.62**	**2.71**	**2.45**	1.89	1.06
New Hampshire	*cay*	1.45	1.92	**2.26**	**2.57**	**2.99**	**3.46**	**3.29**	**3.73**	**3.78**	**4.06**	**3.39**	**3.18**	**2.99**	**3.00**	**3.16**	**2.67**	**2.24**	1.95	1.22
	cday	1.65	**1.98**	**2.80**	**2.88**	**2.91**	**2.85**	**3.17**	**3.46**	**3.62**	**3.90**	**3.73**	**3.47**	**3.48**	**3.29**	**3.24**	**3.03**	**2.31**	**2.01**	1.26
New Jersey	*cay*	1.17	1.74	**2.49**	**3.31**	**3.49**	**3.50**	**3.66**	**3.92**	**3.34**	**3.20**	**3.00**	**3.08**	**2.85**	**2.51**	**2.19**	**2.46**	**2.00**	1.68	0.96
	cday	1.09	1.64	1.92	**2.68**	**2.99**	**3.32**	**3.75**	**3.43**	**3.37**	**3.28**	**3.14**	**3.01**	**3.14**	**2.88**	**2.76**	**2.90**	**2.38**	1.52	1.06
New Mexico	*cay*	0.02	0.02	0.04	0.05	0.07	0.04	0.07	0.05	0.07	0.04	0.06	0.10	0.06	0.07	0.16	0.16	0.15	0.06	0.06
	cday	0.02	0.04	0.11	0.20	0.11	0.14	0.17	0.20	0.16	0.18	0.23	0.26	0.13	0.11	0.04	0.01	0.04	0.03	0.07
New York	*cay*	**2.07**	**2.32**	**2.92**	**3.33**	**3.63**	**4.03**	**4.02**	**4.14**	**4.08**	**3.91**	**4.11**	**4.05**	**3.87**	**3.92**	**3.55**	**3.34**	**2.84**	**2.24**	1.54
	cday	**2.05**	**2.40**	**3.03**	**3.19**	**3.53**	**3.75**	**3.85**	**3.82**	**3.88**	**3.84**	**3.76**	**3.86**	**3.67**	**3.55**	**3.29**	**3.17**	**2.81**	**2.21**	1.64
North Carolina	*cay*	1.36	1.87	**2.19**	**2.37**	**2.53**	**2.66**	**2.83**	**2.96**	**2.92**	**3.20**	**2.98**	**2.78**	**2.95**	**2.65**	**2.76**	**2.55**	**2.13**	1.57	1.06
	cday	1.10	1.83	**2.09**	**2.51**	**2.79**	**2.64**	**3.12**	**3.27**	**3.44**	**3.56**	**3.05**	**2.86**	**3.08**	**2.77**	**2.81**	**2.75**	**2.13**	1.69	0.94

(cont.)

		Quantiles of housing market *volatility (rhv)*																		
State	**Predictor**	**0.05**	**0.10**	**0.15**	**0.20**	**0.25**	**0.30**	**0.35**	**0.40**	**0.45**	**0.50**	**0.55**	**0.60**	**0.65**	**0.70**	**0.75**	**0.80**	**0.85**	**0.90**	**0.95**
North Dakota	*cay*	**2.32**	**2.79**	**3.13**	**3.53**	**3.70**	**4.00**	**4.07**	**4.12**	**4.26**	**4.27**	**4.25**	**4.17**	**4.07**	**3.89**	**3.75**	**3.41**	**3.04**	**2.45**	1.52
	cday	**2.20**	**2.72**	**3.06**	**3.54**	**3.69**	**4.00**	**4.12**	**4.17**	**4.29**	**4.33**	**4.37**	**4.13**	**4.11**	**3.86**	**3.69**	**3.38**	**3.03**	**2.43**	1.51
Ohio	*cay*	1.00	1.21	1.15	1.53	1.59	1.91	**2.12**	**2.09**	**2.19**	1.92	1.87	1.75	1.79	1.57	1.61	1.37	1.55	1.13	0.66
	cday	0.79	1.30	1.25	1.85	1.92	**2.14**	**1.96**	1.70	1.57	1.49	1.45	1.37	1.34	1.51	1.27	1.62	1.36	1.36	0.77
Oklahoma	*cay*	0.49	0.68	0.88	0.85	1.19	1.43	**2.48**	1.92	1.72	1.92	**2.03**	1.50	1.59	1.68	1.33	0.91	0.92	0.82	0.55
	cday	0.34	0.76	0.85	0.87	1.38	1.19	**2.20**	**3.34**	**3.56**	**3.48**	**3.08**	**2.50**	**2.48**	**2.80**	**2.86**	**2.12**	1.89	0.93	0.70
Oregon	*cay*	1.40	**2.12**	**2.44**	**2.75**	**2.95**	**3.29**	**3.42**	**3.45**	**3.63**	**3.53**	**3.60**	**3.55**	**3.29**	**3.33**	**3.15**	**2.86**	**2.58**	**2.12**	1.69
	cday	1.32	**2.10**	**2.42**	**2.97**	**3.39**	**3.51**	**3.61**	**3.76**	**3.94**	**4.13**	**4.10**	**4.08**	**3.73**	**3.39**	**3.28**	**2.92**	**2.81**	**2.26**	1.71
Pennsylvania	*cay*	0.80	1.34	1.13	0.94	1.24	1.29	1.08	1.42	1.37	1.74	**2.02**	1.93	1.73	1.31	1.51	1.65	1.61	1.42	0.86
	cday	0.73	1.12	0.98	0.82	1.08	1.30	1.33	1.60	1.51	1.63	**2.11**	1.82	1.69	1.91	1.76	**1.97**	1.45	1.19	0.78
Rhode Island	*cay*	0.51	0.81	0.88	0.75	0.73	1.21	1.68	**2.11**	**2.05**	1.81	**3.01**	**2.32**	**2.27**	**2.08**	**2.82**	**2.53**	**2.05**	0.98	0.46
	cday	0.78	0.83	0.94	1.60	1.32	**2.02**	1.86	**2.11**	**2.16**	1.82	1.75	1.51	1.54	1.03	1.20	1.33	0.73	0.79	0.35
South Carolina	*cay*	0.35	0.58	0.90	0.84	0.71	0.73	0.94	1.02	1.01	1.00	1.12	1.42	1.37	1.04	1.12	0.96	0.69	0.48	0.31
	cday	0.42	0.97	1.33	1.24	0.94	0.80	0.91	1.10	1.15	0.84	0.87	1.02	1.14	0.94	1.02	0.96	0.80	0.86	0.33
South Dakota	*cay*	1.75	**2.39**	**2.78**	**3.26**	**3.38**	**3.69**	**3.86**	**3.65**	**3.68**	**3.80**	**3.72**	**3.89**	**3.75**	**3.60**	**3.36**	**2.98**	**2.67**	**2.26**	1.58
	cday	1.78	**2.39**	**2.97**	**3.41**	**3.53**	**3.56**	**3.67**	**3.99**	**4.13**	**4.05**	**3.84**	**3.68**	**3.78**	**3.56**	**3.54**	**3.37**	**2.85**	**2.33**	1.60
Tennessee	*cay*	1.69	**2.08**	**2.89**	**2.90**	**3.05**	**3.28**	**3.43**	**3.42**	**3.53**	**3.40**	**3.52**	**3.55**	**3.46**	**3.51**	**3.19**	**2.95**	**2.65**	**2.11**	1.33
	cday	1.64	1.90	**2.53**	**2.74**	**3.03**	**3.39**	**3.55**	**3.53**	**3.36**	**3.28**	**3.18**	**3.27**	**3.28**	**3.43**	**3.26**	**2.98**	**2.74**	**2.18**	1.35
Texas	*cay*	0.56	0.76	0.82	0.69	0.96	1.06	1.93	**2.37**	1.61	1.39	1.85	1.76	1.87	1.46	1.63	1.21	0.74	0.46	0.39
	cday	0.57	0.75	0.61	0.42	0.49	0.58	1.04	1.37	1.01	1.09	1.39	1.53	1.56	1.34	1.26	1.17	0.62	0.33	0.34
Utah	*cay*	0.42	0.49	0.52	0.73	0.82	0.91	0.92	1.13	1.15	1.11	1.00	1.00	1.15	1.50	1.22	1.24	1.20	0.61	0.49
	cday	0.40	0.37	0.29	0.31	0.38	0.44	0.59	0.83	0.73	0.68	0.86	0.86	0.90	0.92	0.62	0.41	0.35	0.36	0.15
Vermont	*cay*	**2.03**	**2.62**	**3.17**	**3.58**	**3.74**	**3.99**	**4.16**	**4.25**	**4.30**	**4.32**	**4.28**	**4.22**	**4.09**	**3.94**	**3.67**	**3.49**	**2.94**	**2.47**	1.78
	cday	**2.03**	**2.62**	**3.17**	**3.58**	**3.74**	**3.99**	**4.16**	**4.25**	**4.30**	**4.32**	**4.28**	**4.22**	**4.09**	**3.94**	**3.67**	**3.49**	**2.94**	**2.47**	1.78
Virginia	*cay*	0.27	0.23	0.29	0.35	0.22	0.14	0.27	0.41	0.67	0.55	0.66	0.87	0.63	0.41	0.54	0.50	0.61	0.34	0.11
	cday	0.55	0.16	0.28	0.43	0.35	0.27	0.70	0.64	0.55	0.83	1.14	0.63	0.59	0.51	0.44	0.43	0.53	0.33	0.31
Washington	*cay*	0.74	1.64	1.86	**2.01**	1.83	1.80	**2.03**	**2.56**	**2.28**	**2.21**	1.22	1.12	1.36	1.43	1.48	1.41	1.36	0.96	0.61
	cday	0.75	1.21	1.19	1.15	1.48	1.59	1.69	1.89	1.70	1.58	1.38	1.41	1.64	**2.54**	**2.56**	**2.08**	1.81	1.27	0.71
West Virginia	*cay*	**2.27**	**2.78**	**3.17**	**3.58**	**3.80**	**3.99**	**4.16**	**4.25**	**4.30**	**4.32**	**4.28**	**4.20**	**4.09**	**3.88**	**3.74**	**3.40**	**2.94**	**2.47**	1.78
	cday	**2.26**	**2.77**	**3.17**	**3.57**	**3.80**	**3.98**	**4.15**	**4.24**	**4.29**	**4.31**	**4.27**	**4.19**	**4.08**	**3.88**	**3.73**	**3.39**	**2.95**	**2.47**	1.78
Wisconsin	*cay*	1.34	1.69	**2.25**	**2.42**	**2.61**	**2.58**	**2.67**	**2.67**	**2.97**	**3.24**	**3.13**	**2.88**	**2.65**	**2.44**	**2.31**	**2.08**	**2.31**	1.81	1.41
	cday	1.59	1.61	1.75	**2.45**	**2.51**	**2.78**	**2.80**	**2.80**	**2.64**	**2.72**	**2.83**	**2.53**	**2.43**	**2.45**	**2.36**	**2.31**	**2.07**	1.56	1.19
Wyoming	*cay*	**2.38**	**2.47**	**2.83**	**3.34**	**3.27**	**3.67**	**3.69**	**3.99**	**3.79**	**3.76**	**3.75**	**3.79**	**3.73**	**3.61**	**3.45**	**3.22**	**2.88**	**2.12**	1.48
	cday	1.89	**2.11**	**2.59**	**3.03**	**3.26**	**3.32**	**3.54**	**3.61**	**3.56**	**3.66**	**3.64**	**3.68**	**3.54**	**3.31**	**3.13**	**2.89**	**2.74**	**2.16**	1.51
U.S.	*cay*	1.08	1.57	**2.26**	**2.34**	**2.30**	**2.40**	**2.56**	**2.96**	**2.71**	**2.77**	**3.06**	**3.16**	**3.29**	**3.05**	**2.63**	**2.61**	**2.36**	1.92	1.19
	cday	1.03	1.49	**2.11**	**2.36**	**2.47**	**2.62**	**2.75**	**3.06**	**2.82**	**2.90**	**3.23**	**2.99**	**3.08**	**3.14**	**2.97**	**2.85**	**2.58**	**2.09**	1.31

Note: Entries in bold indicate significance at the 5% level, i.e. rejection of the null hypothesis of no-causality. Thus, the test statistic for a given quantile is greater than or equal to 1.96.

Table 10. Summary of causality tests.

State	Variable	Housing market returns (*rhr*)	Housing market volatility (*rhv*)
Alabama	*cay*	GC; 0.20 – 0.40	0.05 – 0.90
	cday	GC; 0.20 – 0.50	0.05 – 0.90
Alaska	*cay*	GC; 0.25 – 0.35	0.20 – 0.30; 0.5 – 0.80
	cday	GC; 0.25 – 0.30	0.25 – 0.80
Arizona	*cay*	--	0.10 – 0.90
	cday	--	0.05 – 0.90
Arkansas	*cay*	--	0.35 – 0.75
	cday	--	0.20 – 0.80
California	*cay*	--	0.10 – 0.90
	cday	--	0.05 – 0.90
Colorado	*cay*	--	0.10 – 0.90
	cday	--	0.10 – 0.90
Connecticut	*cay*	GC; 0.15 – 0.85	--
	cday	GC; 0.15 – 0.80	--
Delaware	*cay*	GC; 0.25 – 0.80	0.10 – 0.85
	cday	GC; 0.15 – 0.80	0.15 – 0.80
DC	*cay*	--	0.15 – 0.70
	cday	--	0.20 – 0.80
Florida	*cay*	--	0.05 – 0.90
	cday	GC; 0.85	0.05 – 0.90
Georgia	*cay*	GC; 0.20 – 0.80	--
	cday	0.25 – 0.80	--
Hawaii	*cay*	GC; 0.15 – 0.85	0.10 – 0.90
	cday	GC; 0.15 – 0.80	0.05 – 0.90
Idaho	*cay*	0.25 – 0.90	0.10 – 0.90
	cday	GC; 0.15; 0.25 – 0.90	0.10 – 0.85
Illinois	*cay*	0.15 – 0.90	0.60 – 0.65; 0.75 – 0.85
	cday	0.15 – 0.75	0.65; 0.75 – 0.90
Indiana	*cay*	0.10 – 0.90	0.20 – 0.80
	cday	GC; 0.10 – 0.90	0.50 – 0.75
Iowa	*cay*	--	0.10 – 0.90
	cday	--	0.05 – 0.90
Kansas	*cay*	--	--
	cday	GC; 0.20; 0.30 – 0.35	0.5
Kentucky	*cay*	0.35	--
	cday	--	--
Louisiana	*cay*	--	0.20 – 0.80
	cday	--	0.30 – 0.85
Maine	*cay*	--	0.15 – 0.85
	cday	--	0.15 – 0.85
Maryland	*cay*	--	0.05 – 0.85
	cday	--	0.10 – 0.90
Massachusetts	*cay*	--	--
	cday	--	--
Michigan	*cay*	--	0.10 – 0.90
	cday	GC; 0.25 – 0.50	0.15 – 0.85
Minnesota	*cay*	--	--
	cday	--	--
Mississippi	*cay*	0.05 – 0.90	0.30 – 0.85
	cday	GC; 0.10 – 0.90	0.20 – 0.80
Missouri	*cay*	--	0.35 – 0.40; 0.55; 0.65 – 0.80
	cday	--	0.30 – 0.45
Montana	*cay*	--	0.15 – 0.85
	cday	--	0.15 – 0.85
Nebraska	*cay*	--	0.10 – 0.90
	cday	--	0.10 – 0.90

(cont.)

State	Variable	Housing market returns (*rhr*)	Housing market volatility (*rhv*)
Nevada	*cay*	--	0.15 – 0.85
	cday	--	0.15 – 0.85
New Hampshire	*cay*	GC; 0.15 – 0.80	0.15 – 0.85
	cday	GC; 0.80	0.10 – 0.90
New Jersey	*cay*	--	0.15 – 0.85
	cday	--	0.20 – 0.85
New Mexico	*cay*	--	--
	cday	--	--
New York	*cay*	--	0.05 – 0.90
	cday	--	0.05 – 0.90
North Carolina	*cay*	--	0.15 – 0.85
	cday	--	0.15 – 0.85
North Dakota	*cay*	--	0.05 – 0.90
	cday	--	0.05 – 0.90
Ohio	*cay*	--	0.35 – 0.45
	cday	--	0.30 – 0.35
Oklahoma	*cay*	--	0.35; 0.55
	cday	--	0.35 – 0.80
Oregon	*cay*	GC; 0.55	0.10 – 0.90
	cday	--	0.10 – 0.90
Pennsylvania	*cay*	--	--
	cday	GC; 0.3; 0.45 – 0.90	0.55; 0.80
Rhode Island	*cay*	--	0.40 – 0.45; 0.55 – 0.85
	cday	--	0.3; 0.40 – 0.45
South Carolina	*cay*	GC; 0.10 – 0.85	--
	cday	GC; 0.15 – 0.85	--
South Dakota	*cay*	GC; 0.20 – 0.50	0.10 – 0.90
	cday	GC; 0.20 – 0.35	0.10 – 0.90
Tennessee	*cay*	--	0.10 – 0.90
	cday	GC; 0.30 – 0.50	0.15 – 0.90
Texas	*cay*	GC; 0.20 – 0.45	0.4
	cday	GC; 0.15 – 0.45	--
Utah	*cay*	GC; 0.20 – 0.55; 0.74	--
	cday	GC; 0.55	--
Vermont	*cay*	0.05 – 0.90	0.05 – 0.90
	cday	0.05 – 0.90	0.05 – 0.90
Virginia	*cay*	--	--
	cday	--	--
Washington	*cay*	--	0.2; 0.35 – 0.50
	cday	--	0.70 – 0.80
West Virginia	*cay*	0.05 – 0.90	0.05 – 0.90
	cday	0.05 – 0.90	0.05 – 0.90
Wisconsin	*cay*	GC; 0.10 – 0.90	0.15 – 0.85
	cday	GC; 0.10 – 0.85	0.20 – 0.85
Wyoming	*cay*	0.20 – 0.25	0.05 – 0.90
	cday	GC; 0.20 – 0.65	0.10 – 0.90
U.S.	*cay*	--	0.15 – 0.85
	cday	--	0.15 – 0.90

Note: GC indicates the existence of linear Granger causality. Entries denote the quantile ranges over which causality-in-quantiles exists for housing market returns and volatility.