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Housing and Stock Market Nexus in the US

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Abstract:

Purpose: *The research aims to study the causality between the US stock and housing markets in the period from 1890 to 2014.*
Design/Methodology/Approach: *The Granger-Causality bootstrap rolling-window test is used for studying the causality between the stock as well as real estate markets in the US.*
Findings: *The results provide robust evidence that the causality running from the housing in the stock markets has positive effects between 1918 and 1922, 1926 and 1931, 1953 and 1955 but negative effects between 1932 and 1934 and from 1971 to 1972, displaying the occurrence of a credit-price effect. In contrast, the S&P 500 stomped the housing market between 1965 and 1970, when the wealth effect dominated in the US economy. Specifically, when the negative causality of both markets happens, investors gain by allocating housing and stocks assets as various portfolios.*
Practical Implications: *This finding specifies that housing markets may be employed to predict stock markets and vice versa in the US. Studying both markets' causality offers policymakers and practitioners more situation on where the market may be going and how it works over time.*
Originality/Value: *Original research.*

Keyword: *Stock Market, housing market, bootstrap, Granger causality, rolling-window test.*

JEL classification: *C49, E32, R11.*

Paper Type: *Research article.*

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1. Introduction

Which is the best place to invest, the stock market or real estate? Investors often consider it to be a significant advantage to include both in their portfolios, as both are good but very different. Housing prices are steadier than stock prices, particularly on the downside. Hence, the housing market has been less inclined towards bubbles and crashes in the past. Stock investment portfolios can be more diversified and liquid. The housing and stock markets are interconnected in multiple ways. As the economy pulls out of a recession, investors, anticipating increased demand for real estate, begin to invest in construction-related stocks, fuelling market movement. Rising stock prices restore portfolio values, renewing the housing market. The housing sector reaches deep into the economy, impacting landscapers, plumbers, electricians and others, whose business overall increases, further confirming the lack of a relationship. Housing starts and the stock market are both leading indicators of economic activity. Conversely, a crash of the stock and housing markets will appear to threaten a collapse of the US and global economy.

Two causality transmission mechanisms of two markets include wealth as well as credit-price effects, useful for investors to forecast portfolio performance. The credit-price influence refers to the causality existing of both markets. When it acts as collateral, the real-estate value increase will decrease the borrowing expense, causing credit-constrained homes and companies to add investment and consumption and resulting in a stock-price increase. However, owing to the occurrence of the wealth effect, real estate acts as a consumption good and investment asset, while stocks don’t entail direct consumption (Benjamin *et al.*, 2004). Following the stock market booms that result in more gain, real estate consumption and prices increase. Then, a major portion of such higher consumption spending turns to the housing market, i.e., the causality running of both markets.

Furthermore, identifying the causality frequencies for two markets is important for investors to assign their assets more effectually because the diversifying gain relies on the degree and nature of markets’ co-movement. If they prefer long-term investing strategies, investors should emphasize on the causality of the two markets at inferior frequency as well as relevant motivating elements (Smith, 2001). In contrast, if they choose short-term investing strategies, investors should concentrate on the causality at upper frequency.

Via a such bootstrap rolling-window test (BRWT) between 1890 and 2014, this paper studies the causal connection for both markets in the US. This 125-year sample period encompasses recessions, bubbles, crashes and recoveries affecting the investigated markets, the causes, effects and trends are often fairly alike while future cycles will differ in their details. The stock and housing markets fluctuate in patterns that repeat themselves in predictable ways. Looking at both markets’ causality offers us more context to understand where the market may be going and how it works over time. The related literature tracks stock and housing markets recurs over a longer term. Now, whichever time period is employed will always be basically arbitrary, and various periods will often produce dramatically varied results. The main advantage of this BRWT approach is that it considers the possibility of structural change over time and can assess the temporal causal relationship of the short-term and long-run relationships for the markets. This paper finds housing markets lead stock markets, i.e., there are positive effects of both markets for the periods1918 to 1922, 1926 to 1931, and 1953 to 1955 but negative effects for 1932 to 1934 and 1971 to 1972, representing the presence of the credit-price effect. A contrary causality of both markets is found in the period 1965 to 1970, when the post-war boom peaked in 1965 and the great stock market bubble burst, leading to the remarkable housing market crash over these years. The stock market stomped the housing market, and the wealth effect dominated in the US. Such finding shows that the real estate index may be employed to predict the stock index in the US. Thus, policy makers may consider housing market development for avoiding stock-market volatility.

2. Literature Review

The causality characteristic and path of both markets is able to vary broadly relying on the period, the data studied and the methodology employed. Certain studies have focused on either a single market or regional data. Chen (2001) discoveries that stock values have tendency to lead housing values in Taiwan. Stock and real estate values then strengthen mutually according to the concept underlining the collateral-value and balance-sheet-position significance to credit-limited firms. However, Lin and Lin (2011) find stock-market is led by housing-market in Singapore as well as Taiwan. Lee, Chien, and Lin (2012) reveal that Taiwan Real Estate Investment Trusts go first or too slow late stock-price-index because of its capitalization size or corporate category. Ding, Chong, and Park (2014) find that quantile causality test suggests a significant causative association of China stock as well as housing markets. The occurrence for a substantial tail interdependence specifies the risk for stock-market as well as housing is unable to be evaded by investors if they happen extremely unstably. Heaney and Sriananthakumar (2012) propose the connection of Australian housing and stock-market returns is time-changing between 1986 and 2009, increasing during global crisis periods but nonsignificant of the Wall Street Crash in 1987 (Thalassinos and Thalassinos, 2006).

Despite the integral association between real estate and stocks having been broadly studied, the evidence is still indecisive. Lin and Lin (2011) review comprehensive of housing market as well as stock market in six Asian countries from 1995 to 2010. Their results display the stock-market is unified for housing market in Japan as well as partly in China, Taiwan, Hong Kong. Such indicates that both assets may be replaceable for investment strategy and provide diversified investing portfolios in Singapore and South Korea. Via the threshold-error-correction-model, Tsai and Chiang (2013) analyse association of stock as well as housing-investment-trust in Pacific-Asian fiscal markets indicate that the long-term-equilibrium between stock as well as REIT index exists in the majority of such markets. When Taiwan REITs indices become lower-higher than equilibrium, Australia and Singapore, investors are able to sell (buy) the REITs for earning exceptional profits when the REIT market increases (decreases) in Japan and Hong Kong, they can sell (buy) contrarily. Caporale and Sousa (2016) indicate that forecasting power of saying relation to stock-return is high for Korea, China, Malaysia, Brazil, Colombia, Latvia, and Israel. The housing and financial assets are as supplements in the cases of Russia, Thailand, South Africa and Chile and as replacements in Hong Kong, Taiwan, Korea, Malaysia, Indonesia, Argentina, Brazil as well as Mexico.

Examining the extent to which real-estate-market is assimilated with the global market, Hatemi-J, Roca and Al-Shayeb (2014) find Japan, US, and UK are the most unified, then US housing-market crisis made the housing-market of Australia, United Arab Emirates, and US more unified globally but caused the Japanese market turning into less worldwide unified, and the crisis did not influence the UK at all. Hui and Chan (2014) study inference over the equity as well as securitized housing-market of the US, the UK and Hong Kong in world financial crisis find the effect between the US housing-market as well as equity become crucial, indicating US become global-financial-crisis core.

Most studies have examined real-estate-as well as-stock-market wealth effects (Hanias *et al.*, 2007). Cho (2006) shows proof for this stock-market-wealth effect for households in the uppermost payment category, normally embracing a big share of company stock in Korea. Peltonen, Sousa, and Vansteenkiste (2012) investigate the size of wealth influences on consumption for 14 emerging countries find that the housing-and-stock-market wealth influence is less for Latin American developing markets. Moreover, real-estate-wealth influences have considerably grown for Asian developing markets recently are more vital at an inferior fiscal growth or in inferior payment countries, as fiscal- wealth influences are sturdier in nations for upper stock-market capitalization. Su (2011) finds asymmetric value transmission exists in the long term from the housing and stock-market of Western European nations, both overhead and under the threshold shows one direction causation being executed between the housing and the Germany stock-market, the Netherlands as well as the U.K., and one direction causation being executed between the Italy and Belgium stock as well as housing market, in addition to the feedback effects in France, Switzerland and Spain.

Using pooled mean set estimators for a thirty-industrialized-and-developing-economy dynamic heterogeneous panel data, Ahec Sˇonje, Cˇeh Cˇasni, and Vizek (2014) investigate the short- and long-term connection among stock-market, housing-wealth, private consumption and payment. Their findings reinforce the presence of short- and long-term stock-market-wealth influences in two industrialized market-based and bank-based nations. A modest long-term housing-wealth influence is proved merely for the industrialized bank-based nations but a especially sturdy short-term housing-wealth influence is shown in the industrialized market-based nations. Ashley and Li (2014) study the differential influence of two stock as well as housing-wealth volatilities on national class retail sales through various classes of perseverance in wealth volatilities for the US. Retail sales react extreme sturdily to housing-wealth volatilities persisting between 1 year to 4 years but the reaction to stock-wealth volatilities is less with a either-less-than- 1-year-or-more-than-4-year persistence.

3. Methodology and Data Selection

3.1 Methodology

The Granger non-causality test in the bivariate VAR framework (Balcilar *et al.*, 2010) is used for studying the causality between the stock as well as real estate markets in the US in this study. The Wald Likelihood Ratio (LR) as well as Lagrange Multiplier (LM) statistics are commonly used for the standard causality hypothesis to examine mutual restraint and normal asymptotic characteristics. However, if the time series data in levels calculation of VAR-model is non-stationary (Sims *et al.*, 1990; Toda and Phillips 1993; 1994), the relevant simulation statistic has not standard asymptotic distribution (SAD). An augmented VAR-model with I(1) variable (Toda and Yamamoto, 1995) is employed to get a SAD for a modified Wald test (MWT).

Moreover, Monte Carlo simulations (MCS) display the MWT eradicates exact size in small and medium size data (Shukur and Mantolos, 1997). Nevertheless, upgrading by name of power and scale is able to be accomplished via the residual-bootstrap-method (RBM) critical values (Shukur and Mantalos, 2004). Additionally, many MCS researches (Mantalos and Shukur, 1998; Shukur and Mantalos, 2000; Mantalos, 2000; Hacker and Hatemi-J, 2006; Balcilar *et al.*, 2010) indicate the remarkable execution of the RBM of SADs despite cointegration. Some adjusted LR tests, even in little data (Shukur and Mantalos, 2000), show significantly superior power as well as scale characteristics. Thus, the RBM based on adjusted-LR statistic in this research is employed to check causal connection of the stock as well as housing markets in the US. The RBM via an adjusted-LR causality simulation is indicated as follows:

$$z_t=\psi_0 + \psi_1 z_{t-1} + \cdots\cdots + \psi_p z_{t-p} + \epsilon_t \text{ , } t=1,2,\cdots,T \tag{1}$$

In which $\varepsilon_t=(\varepsilon_{1t},\varepsilon_{2t})'$ defines as a covariance matrix $\sum$ and white noise procedure for nil mean. Schwarz Criteria (*SC*) are used to choose the optimum lag length *p*. If $z_t=(z_{hm,t}, z_{sm,t})'$ is divided into 2 sub-vectors, $z_{hm,t}$ (housing market) and $z_{sm,t}$ (stock market), equation (1) can accordingly be shown as:

$$\begin{bmatrix} z_{hm,t} \\ z_{sm,t} \end{bmatrix} = \begin{bmatrix} \psi_{hm} \\ \psi_{sm} \end{bmatrix} + \begin{bmatrix} \psi_{hm,hm} & \psi_{hm,sm} \\ \psi z_{sm,hm} & \psi_{sm,sm} \end{bmatrix} \begin{bmatrix} z_{hm,t} \\ z_{sm,t} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \tag{2}$$

where $z_{hm,t}$ and $z_{sm,t}$ indicate the housing and stock markets, respectively. $\psi_{ij}(L) = \sum_{k=1}^{p+1} \psi_{ij,k} L^k$ for i, j = 1,2 ; L defines as lag operator in term of $L^k x_t = x_{t-k}$.

The constraint $\psi_{12,k} = 0$ for $k = 1,2,\ldots,p$ is imposed on Equation (2) to examine this null hypothesis i.e., housing market is indeed not Granger cause (GC) stock market. Correspondingly, the constraint $\psi_{21,k} = 0$ for $k = 1,2,\ldots,p$ is also adopted to analyse such null hypothesis that the stock market doesn't GC the housing market. RBM according to p-values and adjusted-*LR* statistics are used for the full-sample causality tests. There's a significant nexus of being executed between real estate as well as stock market in the US if the 1st null hypothesis, $\psi_{12,k} = 0$ for $k = 1,2,\ldots,p$, is refused. This implies real-estate-market can influence stock-market in the US. Similarly, the stock-market can forward the housing-market in the US if 2st null hypothesis, $\psi_{21,k} = 0$ for $k = 1,2,\ldots,p$, is discarded.

Owing to lacking stock and housing market nexus in US, a VAR (p) model in difference parameters is made use of studying stock and housing market nexus in the US. A VAR (2) model is used to test models via Schwartz criteria (SC). The full-data causality outcomes via the RBM via adjusted -*LR* causality simulations are shown in Table 3.

3.2 Stability Test

The full-data causality tests generally assume VAR-model variables are constant over time. The causality tests would be void if the fundamental full-data time series have structural variations; accordingly, the series causality is possibly unsteady (Balcilar and Ozdemir, 2013). Therefore, steadiness simulations for long and short-term parameters are required.

It's essential to examine variable stability as well as whether its structure varies; *Exp-F*, *Mean-F* and the *Sup-F* tests (Andrews, 1993; Andrews and Ploberger, 1994) are applied to analyse the sequential-parameter steadiness in the VAR-model. The L_c test (Nyblom, 1989; Hansen, 1992) is likewise employed to simulate for all variable s in the inclusive VAR structure. However, except that it allows error-correction, the VAR-model in first differences is misspecified if the underlying parameters in levels are cointegrated. By way of the *FM-OLS* (fully modified ordinary least squares) estimator (Phillips and Hansen, 1990), various physical variations and variable steadiness simulations are employed for the long-term association. The L_c test (Nyblom, 1989; Hansen, 1992) is employed for testing the long-run parameters' stability.

3.3 Rolling-Window Test

Structural variations through sample splitting as well as dummy variables can be specified in advance and added into the estimation. Nevertheless, the disadvantage of a pre-test bias appears. The sub-samples rolling-window test (RWT) is used according to the adjusted bootstrap calculation to prevent variable non-steadiness and pre-analysis bias. There are two main reasons to use the rolling calculation: I. The RWT is proper because the causality between parameter varies for time. II. The RWT is to specify unsteadiness through various sub-samples because of the structural-change existence.

The RWT is applied for stationary-size sub-sample rolling consecutively from the start to the end full-sample (Balcilar *et al*., 2010). Particularly, offered a stationary-size rolling-window with *l* observations, the full-data is transferred to a series of *T-l* sub-data, i.e., *τ-l*+1, *τ-l*,...,T for *τ* = *l*, *l*+1, ..., T. The *RB* via adjusted *-LR* causality simulation is used for every sub-data, in place of evaluation a unit causality simulation for the full data. The bootstrap *p*-values of detected *LR*-statistic rolling over T-*l* sub-data are employed to capture possible variations in nexus of housing and stock markets in US. The effect magnitude of housing-market on stock market and that of stock on housing-market is also analysed. The impact of housing market on stock-market is evaluated using the expression $N_b^{-1}\sum_{k-1}^{p}\psi_{21,k}^{\wedge *}$ for the average of the whole bootstrap, where N_b is defined as the bootstrap-repetition number, and vice versa, using the formula a $N_b^{-1}\sum_{k-1}^{p}\psi_{12,k}^{\wedge *}$. These $\psi_{21,k}^{\wedge *}$ and $\psi_{12,k}^{\wedge *}$ are bootstrap evaluation via the VAR-model in Equation (2). The 90% confidence intervals are evaluated, i.e. the lower as well as higher intervals equal 5 and 95 quintiles of $\psi_{21,k}^{\wedge *}$ and $\psi_{12,k}^{\wedge *}$, individually (Balcilar *et al*., 2010).

The BRWT correctness and execution rely on the increase interval of every regression as well as the window scale *l*. Minor intervals, e.g., *1*, are suggested, as they offer an additionally specified alteration owing to their maximizing the total rolling-regression number. The window scale *l* is the variable in charge of the observation number included in ever sub-data as well as the estimation accuracy. A big window scale possibly upgrades the estimation precision but lessens the representation, particularly in the heterogenous occurrence. Furthermore, a minor window scale decreases heterogeneity and upgrades the parameter representation; however, possibly decrease variable precision via growing the estimation standard errors. Hence, the applied window scale is required to match the trade-off of accuracy as well as representativeness.

No reliable standard is obtainable in our choice of the window scale in rolling-window evaluation (Balcilar *et al*., 2010). Window scale under structural change is assessed by the root-mean-square error (Pesaran and Timmerman, 2005), showing best window-scale relies on break size as well as perseverance and arguing bias in autoregressive (AR) variables resulting from the MCS is diminished with a window scale as less as twenty when there are recurrent breaks. Both argument demands are considered if the appropriate window size is selected. First, the freedom extent regarding the parameter-estimation accuracy needs a bigger window scale; second, the multiple-physical-change occurrence, increasing the risk including certain of such several changes in windows samples, calls for a lesser window scale. Hence, a minor 17-year window scale is selected (without the observations necessary for lags, the real observation number in the VAR). The BRWT used for evaluation of well accuracy can prove the incorrect-estimation problem results of the minor window scale selected.

Long- as well as short-run variables for VAR-model assessed via full-data specify unsteadiness on account of physical alterations the feedback outcome of the full data of the stock as well as housing markets in the US might then be ambiguous and valueless. The VAR models can be employed for a basis framework fulfilling the causality RWT using sub-data. The RWT deliberates physical alterations and permits the causality between parameters to be time-changing over diverse sub-data. The *RB* via adjusted-*LR* causality analyses with null hypotheses are employed in the housing market without Granger-caused stock market and in reverse order, the bootstrap *LR*-statistic *p*-values are assessed via VAR-model in Equation (2) employing rolling sub-data, counting 17-year observations. Moreover, the effect extent of housing market on stock-market and in reverse order are similarly assessed for the US. Wholly the rolling evaluations for every sub-data are drawn in Figures 1 to 4. Such rolling evaluations transfer between 1907 and 2014 in the US after truncating 17-year observations of the full data.

3.4 Data Selection

The annual indices of the stock and housing markets from 1890 to 2014 were collected according to the online data segment of Robert J. Shiller's website.[4] The S&P 500 is used because the index follows the market-value of the 500-foremost-corporation stocks. To obtain the real estate and stock prices, Robert J. Shiller devalues the relating nominal values with the Consumer Price Index. The index values are deflated using the 1890 index as the original year to get yearly growth rates of house prices. Entirely the initial data are dealt with via using the natural logarithm to modify for probable heteroskedasticity and measurement differences between series.

4. Empirical Results

To select whether the housing as well as stock values in US are stationary, the MZa unit-root test (URT) of Ng-Perron (2001) and the KPSS test of Kwiatowski *et al.* (1992) are performed. Panels A as well as B of Table 1 disply outcomes for URTs MZa as well as KPSS, separately. This MZa statistics cannot discard the null

[4]http://www.econ.yale.edu/~shiller/data.htm.

hypothesis if all series in all levels are non-stationary but refuse this null hypothesis if these series happen in 1st differences. The KPSS tests refuse such null hypothesis if all series in whole levels are stationary but can't refuse this null hypothesis if the series are in 1st differences.

Table 1. *Unit root test results*

Panel A. Ng-Perron unit root test (MZ_a)				
Series	Level		First Differences	
	Constant	Constant with Trend	Constant	Constant with Trend
Real House Price	-5.3876	-12.6407	-22.8463***	-47.9296***
Real Stock Price	0.2212	-8.03845	-18.7717***	-36.5231***
Panel B. KPSS unit root test results				
Series	Level		First Differences	
	Constant	Constant with Trend	Constant	Constant with Trend
Real House Price	1.0016***	0.0860	0.1508	0.0673
Real Stock Price	0.9943***	0.1095	0.0958	0.0341

Notes: ****, ** and * indicate significance at the 1, 5 and 10 % levels, separately.*
a. This is a one-sided test with the null hypothesis that the series is stationary; 1, 5 and 10 % significance critical values equal 0.7390, 0.4630 and 0.3470, individually. b. This is a one-sided test with the null hypothesis that the series is stationary; 1, 5 and 10 % significance critical values equal 0.2160, 0.1460 and 0.1190, respectively.
Source: *Authors' calculations.*

Briefly, this MZa and KPSS analysis outcomes show real house and stock prices are in non-stationary levels, but stationary in 1st differences, conforming to I(1) processes. Therefore, these cointegration test of Johansen and Juselius (1990) is carried out to determine whether the 1st differences VAR models are wrongly defined. Table 2 shows that the extreme as well as trace Eigenvalue statistics fail to refuse this null hypothesis without nexus of house-price as well as stock-price, i.e., r = 0; thus, we used variable difference series based on VAR(2) test in the model.

Table 2. *Johansen cointegration test with unrestricted intercepts and no trends*

Series	Null Hypothesis	Alternative Hypothesis	Trace Test	95% critical value	90% critical value
House Price and Stock Price	$r = 0$	$r \geq 1$	9.8017	17.86	15.75
	$r \leq 1$	$r = 2$	0.1722	8.07	6.50
	Null Hypothesis	Alternative Hypothesis	Maximum Eigen value test	95% critical value	90% critical value
	$r = 0$	$r = 1$	9.6295	14.88	12.98
	$r \leq 1$	$r = 2$	0.1722	8.07	6.50

Source: *Authors' calculations.*

Via simulating the null hypothesis which the house-price doesn't GC the stock-price and the stock-price doesn't Granger cause the real estate value, we evaluate the full-data bootstrap Likelihood Ratio (*LR*) statistics, the Wald, as well as these relevant p-values having lag-length equivalent to 2. Via the Schwartz information criteria *(SIC*), a VAR(2) model was selected for the models. Table 3 displays the outcomes. These results exhibit neither of these null hypotheses are able to be refused based on the bootstrap *p*-values. Thus, the outcomes designate the house- price does not temporally cause the stock-price, and stock-price does not temporally cause the house price. We, thus, make conclusion that there is no bi-directional causal relationship. The result is uneven with the current research, i.e., Hui and Chan (2014). This conflicting result might have something to do with the methodology applied and the data adopted, in addition to the effect of structural changes. Further, structural changes may vary parameter values and affect temporal (Granger) causality effects over time.

Table 3. *Full-Sample Granger Causality Tests*

	H0: House Price does not Granger cause Stock Price		H0: Stock Price does not Granger cause House Price	
	Statistics	p-value	Statistics	p-value
Bootstrap LR Test	3.1264	0.197	0.5713	0.745
Bootstrap Wald Test	3.1713	0.197	0.5728	0.745

Source: *Authors' calculations.*

If structural changes happen, the causality of stock-price as well as house-price will be unstable. Therefore, when the parameter is estimated in an unstable relationship, the subsequent outcomes show up to be worthless (Zeileis *et al.*, 2005). The Sup-F, Mean-F and Exp-F assessments suggested via Andrews (1993) as well as Andrews and Ploberger (1994) are adopted for testing variable steadiness and determining whether structural changes occur, which allow testing of the time-based steadiness of variable s of the VAR-model consisting of the house-price as well as stock- prices. This Lc simulation established by Nyblom (1989) and Hansen (1992) is likewise employed via testing whole variables in such total VAR-system.

Table 4 displays the *Sup-F, Mean-F* as well as *Exp-F* simulations refuse this null hypothesis of variables steadiness at the 1% level of both the stock-price as well as the house-price equation. These *Sup-F* tests propose a 1-time shrill change occurs between house price as well as stock price equation. These *Mean-F* as well as *Exp-F* simulations refuse this null hypothesis of variable constancy in VAR (2) system. These outcomes demonstrate that parameters in the stock-price and house-price and the VAR (2) system evolve steadily temporally time. This system Lc statistics simulation is in contrary to the substitute which the variables keep on the random-walk procedure used via Gardner (1969), symptomatic of variables non-constancy in the total VAR-model. Hence, we conclude that the VAR-model via full-data shows unstable short-term parameters, implying that structural changes exist.

Table 4. *Short-Run Parameter Stability Tests*

	House Price Equation		Stock Price Equation		VAR(2) System	
	Statistics	Bootstrap p-value	Statistics	Bootstrap p-value	Statistics	Bootstrap p-value
Sup-F	41.83***	<0.01	28.67***	<0.01	27.10***	<0.01
Mean-F	9.49***	<0.01	7.78***	0.01	10.27**	0.05
Exp-F	17.65***	<0.01	10.17***	<0.01	10.52***	<0.01
L_c					2.14***	0.01

Notes: *p-values are calculated via 2,000 bootstrap repetitions. ***, ** and * show significance at the 1, 5 and 10 % levels, individually.*
Source: *Authors' calculations.*

The results of MZ_a as well as *KPSS* URTs specify the house price as well as the stock price are both I(1) procedures. This suggests the VAR-model estimated via these parameters in 1st differences are wrongly specified if nexus happens. Testing nexus and variables steadiness in the long-term connection, the FM-OLS estimator is to evaluate nexus, the *Sup-F, Mean-F* and *Exp-F* tests in addition to the *Lc* test are employed to evaluate the long-run stability of parameters. Table 5 shows that the *Lc* statistics refuse this null hypothesis of nexus at the 1% level. These *Mean-F* and *Exp-F* simulations are unable to refuse the null hypothesis of gradual shifting of variables in the nexus formula. However, the *Sup-F* statistics refuse this null hypothesis of parameter steadiness at the 1 percent level, implying a *1-time* change in the long-term association. Both short-term and long-term variables in these VAR models assessed show instability due to structural changes, and consequently, every full-data causal nexus of house price as well as stock price is meaningless. Thus, the BRWT with sub-data is to be performed.

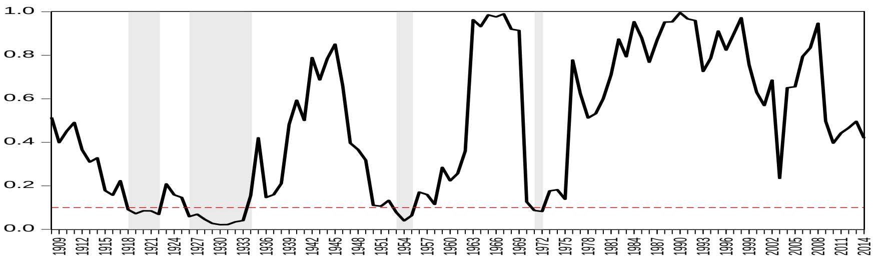
Table 5. *Parameter Stability Tests of the Long-Run Relationship*

	Sup-F	Mean-F	Exp-F	L_c
$LHP = \alpha + \beta * LSP$	135.26***	65.55	63.41	10.46***
Bootstrap p-value	<0.01	1.00	1.00	<0.01

Notes: *p-values are calculated via 2,000 bootstrap repetitions. *** and** indicate significance at the 1 and 5 % levels, individually.*
Source: *Authors' calculations.*

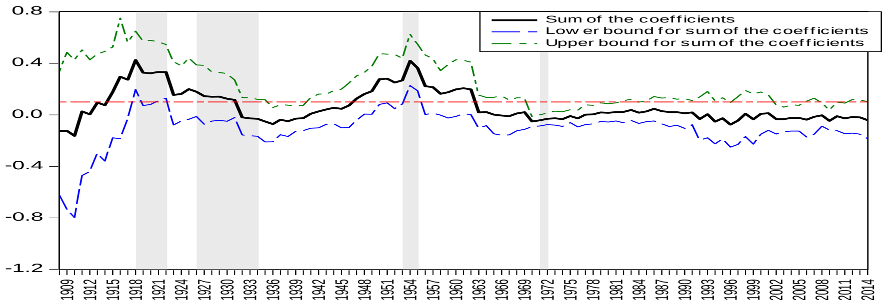
Figures 1 to 4 present the BRWM p-values of *LR*-statistics estimated via a sub-data and the extent of the effect that house-price has on stock-price and vice versa. Figure 1 specifies this null hypothesis i.e., house-price does not GC stock-price enables to be refused at this 10% significance level in five terms, i.e., between 1918 and 1922, 1926 and 1931, 1932 and 1934, 1953 and 1955, 1971 and 1972. Figure 2 plots the amount of the rolling-window coefficients of the house price, significantly affecting stock-price in these five periods. There are positive effects in the three periods, i.e., from 1918 to 1922, 1926 to 1931, and 1953 to 1955 and negative effects from 1932 to 1934 and from 1971 to 1972. Figure 3 presents that the null hypothesis that stock-price doesn't GC house-price enables to be refused at 10 % significance level between 1965 and 1970. Figure 4 plots the sum stock-price-coefficients of the, showing that it has significantly positive housing-price effects between 1965 and 1970. This shows that the stock price has predictive capability for the house price only from 1965 to 1970.

***Figure 1**. Bootstrap p value of LR test statistic testing the null hypothesis that house price does not Granger cause stock price.*



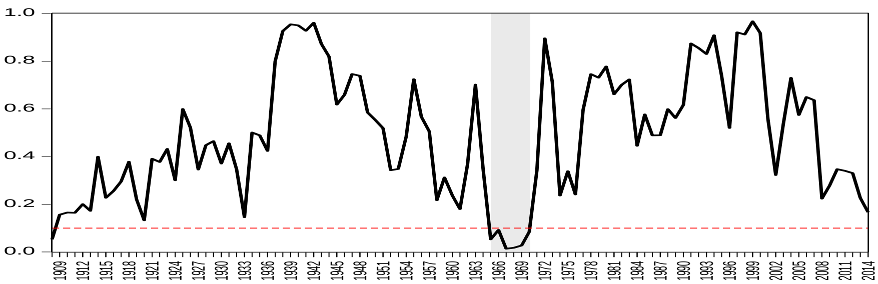
Source: *Authors' calculations.*

***Figure 2.** Bootstrap estimate of the sum of the rolling coefficients for the impact of house price on stock price.*



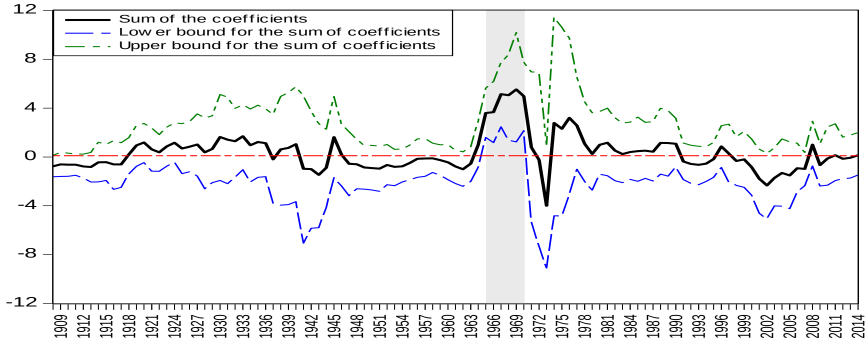
Source: *Authors' calculations.*

***Figure 3**. Bootstrap p value of LR test statistic testing the null hypothesis that stock price does not Granger cause house price.*



Source: *Authors' calculations.*

Figure 4. *Bootstrap estimate of the sum of the rolling coefficients for the impact of stock price on house price.*



Source: *Authors' calculations.*

An interesting picture of causal nexus of the US stock and housing-market is reported in Figure 2. This housing-market conducts the stock-market in the periods, i.e., from 1918 to 1922, 1926 to 1931, 1932 to 1934, 1953 to 1955, and 1971 to 1972, in spite of recurrent boom-bust variations in both markets in these terms. In the period between 1918 and 1922, the massive petroleum industry changes during the WWI years and its consequences led to the first world oil shortage. The housing building in the 1920s surpassed population increase by 25%, creating a housing bubble that burst in 1925. Simultaneously, debt got unavailable levels, and stock conjecture brought prices equal to extraordinary evaluation levels. This may provide evidence of a positive nexus causing from the housing to the stock-market during the period, i.e., from 1926 to 1931, when the huge housing-bubble burst resulted in the significant stock-market crash.

Following the stock market crash in late October 1929, the global economy jumped into the Great Depression (from 1929 to 1941). According to economic history (Note 1), the US currency supply started to reduce by 1/3. Unemployment arrived at 25% in the worst days of 1932-1933. Governments attempted to encounter the depression by increasing public-work plans during the period from 1930 to 1931. After 1933, new sales taxes and federal-money infusions aided relieve the fiscal distress of the cities, and there started a steady, sharp upward recovery. GNP was 34% higher in 1936 than it was in 1932. The house price continued downward from 1932 to 1936, while the S&P 500 index rose nearly 150% simultaneously. Therefore, there is negative nexus causing from housing to stock-market between 1932 and 1934. The US labour union membership summitted archaeologically in 1950s, in the centre of such huge economic development. The "Baby Boom" got a melodramatic growth in fruitfulness in this term. Therefore, there is positive nexus casing from the housing to the stock-market from 1953 to 1955. In contrast, the US housing market got a negative substantial influence on the stock-market for the period 1971-1972. The post war boom completed with several events in the initial 1970s. Notably, the

“Bretton Woods Agreement” collapsed between 1971 and 1972, the US officially went off the gold standard, and a corresponding 100% inflationary increase in prices was assured in the future. Numerous product markets boomed. It is the uppermost gold price/lowest dollar value in US history.

The opposite nexus causing from stock-market to housing-market is found during the period 1965 to 1970, this may provide proof the US stock-market resulted in the housing-market continued downward trend during the period 1965 to 1970. Simultaneously, the postwar boom peaked in 1965 and continued "steadily" downward until 1970. Overall, except for the period of 1965 to 1970, the housing markets are observed as a leader of stock markets, with contrary nexus causing from stock to housing-market for the period of 1965 to 1970, when the postwar boom peaked in 1965 and the great stock market bubble burst, leading to the remarkable housing market crash. Thus, the S&P 500 stomped the housing market over these years.

Stocks and real estate have been typically allocated and managed by home buyers and investors as diverse portfolios (Lin and Fuerst, 2012). However, the variation gain relies on the characteristic and level of causality between both markets. Distinguishing between positive and negative causality of the two markets is pivotal for portfolio managers. Specifically, a low gain has been obtained through diversification of housing and stocks assets in cases of positive causality between the two markets. In contrast, when there is negative causality between the two markets, investors gain from allocating stocks and housing assets as diverse the portfolios. The findings show that a low gain has been obtained through diversification of housing and stocks assets in the US over the past 10 decades, except for the periods, i.e., from 1932 to 1934 and 1971 to 1972. When the US housing market had a negative influence on the stock-market over the short run, the investors gained by allocating stocks and housing assets as diverse portfolios.

Identifying the causality frequencies of the two markets is important for investors because it helps investors allocate their assets more effectively. Investors should concentrate on the causality at a lower frequency and the relevant driving factors if they prefer long-term investing strategies (Smith, 2001). In contrast, if they prefer short-term investing strategies, they should emphasize on the causality at a higher frequency. The result shows positive causality running from housing to stock markets at a 3- to 6-year frequency in the periods, i.e., from 1918 to 1922, 1926 to 1931, and 1953 to 1955, and contrary causality at a 6-year frequency for the period from 1965 to 1970. The nexus causing from housing to stock-market and even the opposite causality are stable over the long term, i.e., lower frequency. The nexus between the US stock-market and housing-market chiefly throughout lower frequency suggest investors should allocate US stock and housing as portfolios over a long-term period horizon as more effective investment strategies. There are two transmission mechanisms of the causality of both markets, namely the “credit-price effect” and the “wealth effect”, to help investors forecast portfolio performance.

Before the 1960s, nexus causing from the housing to the stock-market was found in three sub-periods, i.e., from 1918 to 1922, 1926 to 1931, and 1953 to 1955, representing the occurrence of a credit-price effect. After that, there is a structural variation; the nexus runs from the stock to the housing-market, and the wealth influence dominated in the US economy for the period from 1965 to 1970.

5. Conclusion

Using Granger-causality BRWT between 1890 and 2014, this study's results offer strong proof that the nexus of the housing as well as the stock markets occurs more frequently than the contrary nexus of both markets. Furthermore, the positive cumulative effect of the housing-market on the stock-market occurs three times, while the negative cumulative effect occurs two times. A positive cumulative effect of the stock-market on the housing-market occurs only in one phase. This causality from the housing-market to stock-market chiefly across a lower frequency implies that a more effective investment strategy would be to allocate stocks and real estate as portfolios over a long-run time horizon.

Before the 1960s, housing returns are a leader of stock returns, and both markets commonly show positive causality during both expansion and recession, indicating the occurrence of a credit-price effect, but there're two exceptions. One exception occurred when governments expanded public projects to relieve the fiscal distress during the Great Depression and the stock markets began a steady upward recovery, but the housing markets continued downward. The second occurred when the US went off the gold criterion from 1971 to 1972, and the stock market began to decrease while the dollar reached new lows vs. gold.

Therefore, the Great Inflation led to a portfolio shift by making real estate more attractive than equity, attracting dollars between both markets over these years. The post war boom peaked in 1965, at the time while the stock-market began to collapse, and the inflation of the 1970s reached full blossom. With the positive causality of stock as well as house values, the burst of the great stock-market bubble led to the remarkable housing market crash during the late 1960s as the wealth effect dominated. These findings have implications for fund managers of property assets, for efficient pricing of the real estate market, and for policy makers regarding economic stability**.** A complete analysis would have to include the income derived from portfolios because of data limitations, the results demonstrating causality of both markets are informative only, future research could extend the analysis of this issue.

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