JEESS
Journal of Empirical Economics and Social Sciences
Uygulamalı Ekonomi ve Sosyal Bilimler Dergisi
Cilt/Volume: 4 Sayı/Issue: 1 Mart/March 2022 ss./pp. 1-19
S. Mukherjee, http://dx.doi.org/10.46959/jeess.951413

TESTING FOR LONG-RUN RELATIONSHIPS BETWEEN EUROPEAN HOUSING AND STOCK MARKETS: EVIDENCE OF THE WEALTH, CREDIT-PRICE AND CAPITAL-SWITCHING REGIME EFFECTS

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ABSTRACT

The purpose of this paper is to study the asymmetric relationship between house prices and stock followed by the wealth effect/credit-price effect/capital-switching regime. Stockprices are more volatile in case of negative news, while real estate is rigid downwards. To depict this potential asymmetry, the TAR/M-TAR model is employed and the asymmetric ECM for causal inferences. For cases with no asymmetry are tested with the Johansen framework and the VECM. Empirical results indicate asymmetric credit-price effect for Finland and symmetric cointegration for Ireland and Sweden. The VECM indicates that Sweden exhibits wealth effect and there is credit-price effect for Ireland. It is the first to examine asymmetric linkages between the house and stock prices under the capital-switching behavior found in the European markets as well as their unification after the implementation of Maastricht Treaty by theEuropean Union.

Keywords: *Housing price index, Stock market index, Wealth effect, Credit-price effect, Capital-switching regime, Asymmetric cointegration, WCM.*

JEL Codes: *C58, E44, C01.*

1. INTRODUCTION

Real estate and share prices are believed to be two of the most significant asset classes in an individual's portfolio. Various researchers have worked on this topic, but the results are still inconclusive, and the answer to this question will be discussed in this paper. Furthermore, a handful of the previous studies have taken the asymmetric phenomenon of households as well as stock prices into account (Tsai, Lee, and Chiang, 2012: 1005-1020). This asymmetric relationship between these two indices makes the conventional methods of regression ineffective.

In recent times, Europe has experienced a severe change following the Maastricht Treaty that came into effect in 1993, even though there were quite a few impediments set by several European Community (EC). According to Grieco (1996), it aimed to make the European stock markets more

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Makale Geçmişi/Article History
Başvuru Tarihi / Date of Application : 16 Mayıs / May 2021
Düzeltme Tarihi / Revision Date : 30 Temmuz / July 2021
Kabul Tarihi / Acceptance Date : 01 Eylül / Eylül 2021

Research Article

integrated and it also leads to the foundation of the European Monetary Union (EMU) by introducing the Euro as a single currency. Moreover, Westermann (2004) supported the claim that the single currency was a crucial part of the integration process of the European markets. Therefore, from a theoretical aspect, it may be intuitive to think that there is integration of the European markets.

However, frequent changes in the domestic policies as well as in the European Central Bank renders asymmetry in the financial markets. This corrects back to the equilibrium depending upon the sign of the shocks; hence, the effect of the independent variable upon the dependent one is not constant throughout time. Macro-financial variables are known to have a non-linear behavior due to being non-stationary at levels and the methodology developed by Engel and Granger (1987) fails to capture this phenomenon (Liu and Su, 2010). Therefore, the threshold and momentum-threshold cointegration autoregressive (TAR/M-TAR) model proposed by Enders and Siklos (2001) is applied to examine the possibility of the asymmetric wealth/credit-price effect and capital switching behavior. Moreover, Enders and Dibogloo (2001) state that the orthodox methods of cointegration have a lower power to reject the null of no cointegration. Therefore, these tests are biased if the correction towards the long-run equilibrium value is non-linear.

The paper contributes to the empirical literature in several ways. Firstly, it is an updated version of previous research as it checks for any asymmetry between the two markets for Europe. Secondly, the asymmetric wealth effect/credit-price effect/capital-switching behavior depicts a form of hedging in the stock or housing markets.

The motivation for this research is that despite the aim of the Eurozone attempting to converge the financial markets for various countries it is believed to be largely unsuccessful due to significant differences between fiscal and regulatory structures across countries, which acts as an impediment in the process of unification of the EMU. The convergence of the financial markets and their interactions across the Eurozone has not been successful and hence it has undermined the single currency.

2. LITERATURE REVIEW

There are several documented works, which embody various properties of stock and house prices. Recent evidence for the various properties of stock and property markets as well as the different econometric methodologies used are briefly highlighted as follows.

2.1. Asymmetric Volatility of House Prices: Downward-rigidity

Asymmetry in housing prices is classified distinctively as the best form of hedging asset. According to Gao, Lin and Na (2009) there is a downward-rigidity in property prices that do not fall as much as they rise. Gao *et al.* (2009) supported this hypothesis of non-linear movement of home prices and added that they are more likely to be mean-reverting when it is overvalued.

2.2. Asymmetric Volatility of Stock Prices: Leverage Effects

The most prominent phenomenon relating to volatilities in the equity markets is known as 'leverage effects' (Figlewski and Wang, 2000). They discussed this phenomenon vividly in their studies. According to them, it is defined as a negative correlation between stock returns and volatility. They claimed that a fall in the market value of equity raises the leverage of the firm due to a fall in the debt-equity ratio.

2.3. House and Stock Prices Indices: Wealth Effect

The rise in stock returns leads to an increase in the purchasing capability of the consumer and this leads to more demand in the form of housing, which induces wealth effects. The idea is clearly explained by various authors (Ando and Modigliani, 1963; Tsai, Lee and Chiang, 2012; Calomiris, Longhofer, and Miles, 2009; Buiter, 2008). Ando and Modigliani (1963) introduced the idea is that even if there are disturbances in the ratio of wealth to disposable income in the short-run, a person's long-run consumption is stable over time. Tsai et al. (2012) deemed that the way the wealth effect operates is through the stock market to the housing market as the stock market is liquid in comparison. If the market is bullish, it causes the prices to increase in both markets that account for the positive correlation between them, and the wealth effect persists. Nevertheless, Calomiris et al. (2009) and Buiter (2008) proposed a counter-argument that a change in housing wealth has little or no impact on consumer spending and hence, no contribution to the real economy.

2.4. House and Stock Price Indices: Credit-price Effect

Similar to the wealth effect, the credit-price effect also explains a positive lead-lag causal direction but from house prices to stock prices. Lee, Lee, Lee and Liao (2017) and Sim and Chang (2006) explained the idea that when property prices increase, there is a gain in buyer profits by the rise in its collateral value, which in turn reduces the cost of borrowing and the buyer has the opportunity for easier access to financing. Furthermore, the buyer will gain when its equity value rises due to the realized expected returns leading to a rise in stock and house prices.

2.5. House and Stock Price Indices: Capital-switching Behavior

Few authors have introduced the idea of 'capital switching behavior' (Lee et al., 2017; Case and Shiller, 2003 and Oikarinen, 2006). It accounts for the tendency of the investors to switch their capital from a less profitable sector to a more profitable sector over time. It hypothesizes a negative lead-lag causal transmission between stock and property prices due to backward-looking investors who invest following past returns in the asset. Lee et al. (2017) points out, the investments that have performed well previously will tend to yield a flow of capital into that sector, as there is an expectation of falling profits from the other sector. Case and Shiller (2003) assert that capital switches between stock and house markets. Furthermore, Oikarinen (2006) laid out the possibility of a negative causal relationship between house prices and stock prices due to house markets being driven by local factors whereas global factors drive stock prices.

2.6. Econometric Methodology: Symmetric and Asymmetric Cointegration

Apergis and Lambrinidis (2007) and Wolski (2020) are one of the few authors who incorporated the conventional method of cointegration for house markets and stock markets. Apergis and Lambrinidis (2007) remarked an integration of both the stock markets and unsecuritized real estate markets in addition to the wealth effects for both the UK and the US. Wolski (2020) extrapolated cointegration results for the seven Polish cities. He implemented the Engle-Granger (1987) test from the third quarter of 2006 to the fourth quarter of 2018 and found that there was little or no case of cointegration. The generalisability of Apergis and Lambrinidis (2007) and Wolski (2020) can be questioned because they implemented the orthodox norms of cointegration that does not take into account the asymmetric volatilities of both indices. To overcome the hindrances of a biased result for the conventional model, several studies have incorporated asymmetric cointegration for this topic.

Lin and Lin (2011), Liu and Su (2010), and Su, Chang and Jiang (2013) worked on this topic by implementing asymmetric cointegration. Lin and Lin (2011) incorporated both the linear and non-linear methods of cointegration and found that both models showed cointegration for Japan only between these two markets. Furthermore, the stock indices for the four Asian economies did not granger-cause real estate indices. Liu and Su (2010) confirmed the existence of a long-run bi-directional relationship between property and stock markets in China. Moreover, they found the asymmetric model is superior to the symmetric model due to the persistence of the wealth effect in the short-run for the latter model. More recently, Su et al. (2013) depicted that the threshold error-correction model showed that short-run Granger-causality prefers the wealth effect, although there is bi-directional causality in the long run.

Tsai et al. (2012) and Su (2011) used the non-linear convention to determine the long-run relationship between the two indices. Tsai et al. (2012) implements asymmetric cointegration via the TAR/M-TAR model for the United States and concluded that there is the existence of an asymmetric long-run relationship between them. Moreover, the non-linear error correction model yields the wealth effect between the two markets is more robust when the stock price outperforms house prices. Su (2011) detected non-linear cointegration from the rank transformation of the series and the threshold error-correction model (TECM) depicted that the credit-price effect was more relevant for Western European countries (UK, Germany, Netherlands), while the wealth effect was found in Italy and Belgium.

2.7. Econometric Methodology: VAR

Recent notable studies that utilized the vector autoregression (VAR) model include Lee et al. (2017), Oikarinen (2006), Chou and Chen (2011), Sim and Chang (2006), Kapopoulos and Siokis (2005), and Chen (2001). Lee et al. (2017) incorporated the VAR for Australia (1993:1-2013:4) and concluded that there is the persistence of a capital-switching effect due to negative lead-lag price linkages between the housing and stock markets. In addition, there is unidirectional causality from house prices to stock prices. They also implied that the capital-switching theory is weak for large-cap stocks and investors must consider this. Oikarinen (2006) concluded that there is Granger-causality from stock prices to house prices pre 1993 as derived from the Finnish data. Chou and Chen (2011) discovered that there is a long-run relationship between the two markets for the U.S. although the property market is segmented from the stock market in the short-term. Sim and Chang (2006) produced a Granger-causation from the property to the stock market for the Korean economy over nineteen years. Moreover, they revealed that the credit-price effect is relevant to industrial land markets. They found that there is a unidirectional Granger-causality from property prices to stock prices.

Kapopoulos and Siokis (2005) concluded that there is a wealth effect in Athens even though it does not exist for other urban-housing properties. One study found that the volatility of stock prices is much higher compared to house prices (Chen, 2001). It is clear from the research that there is a high level of auto/serial correlation between the two indices for Taiwan and both the bivariate and multivariate model indicated that the wealth effect is relevant.

2.8. Econometric Methodology: Dynamic Conditional Correlation

Shi and Tan (2013) attempted to implement this methodology across six economies (US, UK, Australia, Hong Kong, Ireland, and Singapore) between each sub-sectors of properties and equity markets. It is clear from this research is that this model has procured a fine set of results after overcoming previous studies of low unconditional correlation. However, there was capital-switching behavior for 1993-94 and 2001-03 periods.

Overall, a review of the existing literature suggests that the linkages between stock prices and house prices produce notable ambiguity. Moreover, the interrelationships between these two parameters are complex and the linkages have not been investigated under the capital-switching regime for European economies. Therefore, a closer examination of the non-linear dynamic between house prices and stock prices under the capital-switching regime is required along with the credit-price effect and wealth effect.

3. METHODOLOGY AND HYPOTHESES

The research comprises reed stages. At first, it is necessary to assess if the two indices are non-stationary in levels, but stationarity is achieved in the first difference form. Thereafter, the test for asymmetry and cointegration is conducted in the model. Finally, the lead-lag linkage between house prices and share prices is tested for in the asymmetric error-correction model and the linear ECM depending on the prevalence of asymmetry.

3.1. Unit Root Test

To study the long-run dynamics of the two indices, stationarity tests need to be conducted. In the case of macro-financial time series data, it is a necessary condition to establish stationarity, which depicts that the mean is zero and the variance is constant irrespective of time. If a series is non-stationary in levels, it can be differenced once or any higher-order times to produce stationarity after taking its log transformed values. The paper incorporates three-unit root tests; the Augmented Dickey-Fuller (ADF) test, Philips-Perron (PP) test, and the Kwiatkowski, Phillips, Schmidt (KPSS) approach as per Shin and Schmidt (1992) to determine that both the indices are integrated of the same order.

3.2. The Johansen Cointegration Test

The idea of cointegration is to portray the long-run relationship between two or more variables as defined by Engel and Granger (1987). Moreover, it is the phenomenon where a linear combination of $I(1)$ variables have an $I(0)$ error term. If the variables in the model are cointegrated, then their linear combination will be stationary and there may be up to $r \leq k-1$ relationships in total. Johansen (1991) established an efficient way to find cointegrating relations in a partially modeled system i.e. Vector Autoregression (VAR) via the maximum likelihood estimate.

The Johansen model introduces a Vector Error Correction Model (VECM) from the basic VAR model. Consider a general VAR model with Gaussian errors and k variables and p lags:

$$y_t = \pi_1 y_{t-1} + \pi_2 y_{t-2} + \cdots + \pi_p y_{t-p} + u_t \_\_\_\_(1)$$

where $y_t, y_{t-1}, \ldots, y_{t-p}$, and u_t are of the order $(k*1)$ vectors and their coefficients are $(k*k)$ vectors. This VAR can be converted into a VECM that is written as:

$$\Delta y_t = \pi y_{t-1} + \gamma_1 \Delta y_{t-2} + \cdots + \gamma_{p-1} \Delta y_{p-1} + u_t \_\_\_\_(2)$$

where $\pi = \sum_{i=1}^{p} \pi_i - I_k$ and $\gamma_i = -(\sum_{j=i+1}^{p} \pi_j)$. Furthermore, π is denoted as the long-run coefficient matrix because if the lagged differences of y_t are zero, the equation becomes $\pi y_{t-1} = 0$.

From equation (2), the number of cointegrating relations in the system is denoted by the rank of the matrix π. The problem lies in the estimation of π as it is random and conventional OLS methodology cannot be implemented. Therefore, a statistical test is required to determine the rank and in this case, the trace (λ_{trace}) and max (λ_{max}) Eigenvalue tests are incorporated. For a system with k variables and k equations, the Eigenvalues are ordered in the following manner:

$$\lambda_1 \geq \lambda_2 \geq \cdots \geq \lambda_k \_\_\_\_(3)$$

The root of the λ's is a part of a non-explosive system and so it must lie between zero and one and the test statistics are developed as follows:

1. $\lambda_{trace}(r) = -T\sum_{i=r+1}^{k}\ln(1-\widehat{\lambda_i})$ {Joint test}
2. $\lambda_{max}(r, r+1) = -T ln(1-\widehat{\lambda_{r+1}})$ {Sequential test}

Both these tests aim to determine the Eigenvalues that are statistically different from zero. The i^{th} order Eigenvalue from the matrix π is denoted by $\widehat{\lambda_i}$.

3.3. The Threshold Effect between Real House Prices and Share Prices: TAR/M-TAR model

According to Balke and Fomby (1997 cited in Tsai, Lee and Chiang, 2012, 1011), "adjustment to long-run equilibrium is asymmetric". In other words, it is dependent upon the positive or negative signs of the error term as per Enders and Dibogloo (2001); therefore, it renders the orthodox cointegration ineffective and it makes substantial ground to employ the TAR/M-TAR model developed by Enders and Siklos (2001).

HP and *SP* denoted the real house price index and share price index respectively. They are required to be stationary at first difference i.e. $I(1)$ for which confirmatory evidence is found in the Section Hata! Başvuru kaynağı bulunamadı.. The TAR model as proposed by Enders and Granger (1998) test the asymmetric adjustment, which is discussed as follows:

$$\Delta\varepsilon_t = I_t\rho_1\varepsilon_{t-1} + (1-I_t)\rho_2\varepsilon_{t-1} + \mu_t \_\_\_(4)$$

where I_t is the Heaviside indicator function such that:

$$I_t = \begin{cases} 1 \; if \; \varepsilon_{t-1} \geq 0 \\ 0 \; if \; \varepsilon_{t-1} < 0 \end{cases} \_\_\_(5)$$

The long-run equilibrium is established when the error term is zero i.e. $\varepsilon_t = 0$ and equations (4) and (5) refers to the adjustment variables in case of discrepancies from its long-run value. If it is above its equilibrium value, then the correction is made by $\rho_1\varepsilon_{t-1}$, and when below, the correction is $\rho_2\varepsilon_{t-1}$. This model is superior to the linear cointegration model by Engle and Granger (1987) as the latter forfeits asymmetric adjustment i.e. $\rho_1 = \rho_2$, which is a special case. Furthermore, the stationary condition for the series ε_t is given as $-2 < (\rho_1, \rho_2) < 0$. The objective of this test is to reject the null hypothesis of symmetric adjustment ($\rho_1 = \rho_2 = 0$) using the standard F-test. For instance, if $-1 < \rho_1 < \rho_2 < 0$, then the negative phase of the series ε_t is more persistent compared to its positive phase. Enders and Granger (1998) modified equation (5) as:

1. Alternative Adjustments Specifications: The only change here compared to equation (4) is that the differenced form of lagged residual term i.e. $\Delta\varepsilon_{t-1}$ is considered.

$$I_t = \begin{cases} 1 \; if \; \Delta\varepsilon_{t-1} \geq 0 \\ 0 \; if \; \Delta\varepsilon_{t-1} < 0 \end{cases} \_\_\_(6)$$

Considering the differenced form, the TAR model is transformed into a momentum threshold autoregressive model (M-TAR). If $|\rho_1| < |\rho_2|$, then it is said that the adjustments from negative deviations have higher velocity compared to positive deviations. To reject or accept the null hypothesis $\rho_1 = \rho_2 = 0$, the φ stats table developed by Ender and Siklos (2001) is referred to. Once this hypothesis is rejected, the long-run relationship is established between the two indices. Moreover, to test the different rates of adjustments from its long-run value, the F-statistic is used for the null $\rho_1 = \rho_2$. When this hypothesis is rejected, it is concluded that the speeds of adjustments for two indices are non-linear and a threshold effect exists between stock and house markets.

3.4. Asymmetric Error-correction Model

Having found evidence supporting asymmetric cointegration, the asymmetric error-correction model is implemented as follows:

$$\begin{cases} \Delta HP_t = \alpha_0 + A_{11}(L)\Delta HP_{t-1} + A_{12}(L)\Delta SP_{t-1} + \omega_{11} z_{t-1}^{+} + \omega_{12} z_{t-1}^{-} + \varepsilon_{1t} \\ \Delta SP_t = \beta_0 + A_{21}(L)\Delta HP_{t-1} + A_{22}(L)\Delta SP_{t-1} + \omega_{21} z_{t-1}^{+} + \omega_{22} z_{t-1}^{-} + \varepsilon_{2t} \end{cases} \quad (7)$$

In equation (7), $z_{t-1}^{+}, and\ z_{t-1}^{-}$ is the error correction term that represents two different speeds of adjustment terms towards the long-run value from above and below the long-run value respectively. To further, investigate the wealth/credit-price/capital-switching effect for various economies, this model is used to understand the behavior between these indices.

3.5. Hypothesis

In this sub-section, the following hypotheses is developed for the asymmetric relationship between real estate and equity prices after the leverage effect and downward-rigidity of house prices have been taken into account.

H_a: There is cointegration between stock and house markets, but the adjustments towards equilibrium from above or below are asymmetric.

After the hypothesis *(H_A)* is accepted or rejected, the following three hypotheses are developed:

H_b: The wealth effect is present if the share prices positively granger-cause house prices. Otherwise, the wealth effect ceases to exist.

H_c: The credit-price effect is present if house prices positively granger-cause stock prices. Otherwise, the credit-price effect does not exist.

H_d : The capital-switching regime is present if there is a negative lead-lag causal transmission between stock and property markets. Otherwise, capital-switching behavior does not exist. This is valid only when any lags of the cross variable is negative and statistically significant.

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From the above hypotheses, it is clear that the conclusions of this research will be based on checking the leverage effects of equity prices and the defensive mechanism of house prices.

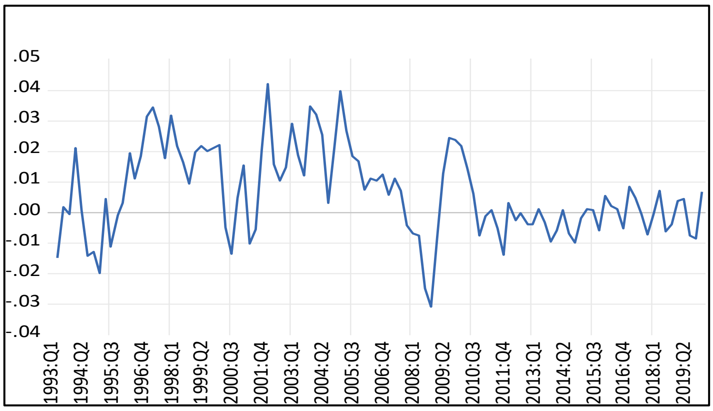
4. DATA AND RESULTS

This section has carried out empirical analysis using share price and house price indices to assess the linkages between stock prices and property prices. Quarterly prices data was collected for four countries (Finland, Ireland and Sweden) from the OECD website for stock prices[1] and house prices[2] for the period 1993Q1 to 2020Q1. All indices are transformed into natural logarithms. In Figure 1 and Figure 2, the housing and stock price indices respectively for all the economies in the first difference form are plotted below.

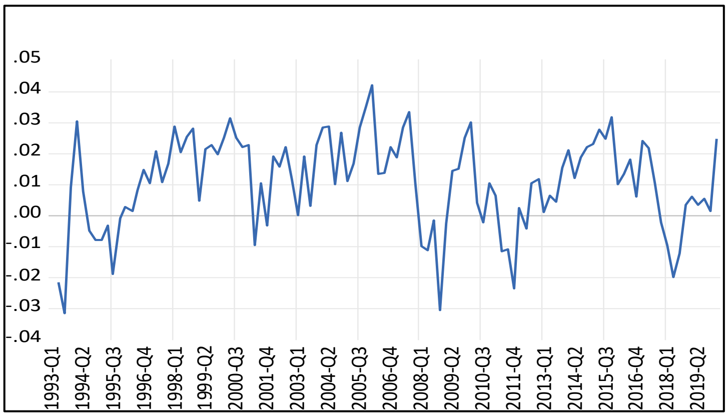
By visualization of Figure 1, it can be said that the house price indices portrays no robust trending behavior, which suggests that there might be no unit root in the series at the first difference, but it is non-stationary at levels. Figure 2 provides a corresponding snapshot of the share prices of various countries. It was found that the volatilities of share prices are much higher compared to property prices.

Figure 1: The house price indices (LHP) for four countries in first difference form

a) Finland



b) Sweden



[1] OECD (2020), Stock prices (indicator). doi: 10.1787/6ad82f42-en
[2] OECD (2020), Housing prices (indicator). doi: 10.1787/63008438-en

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c) Ireland

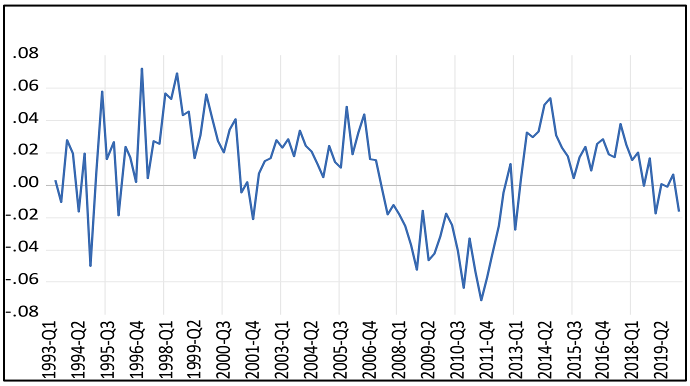
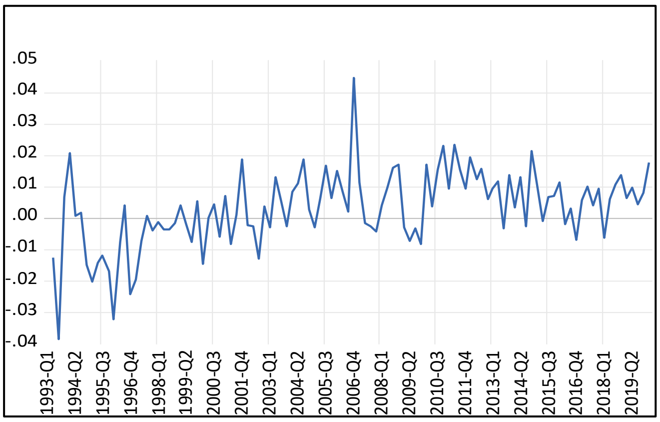
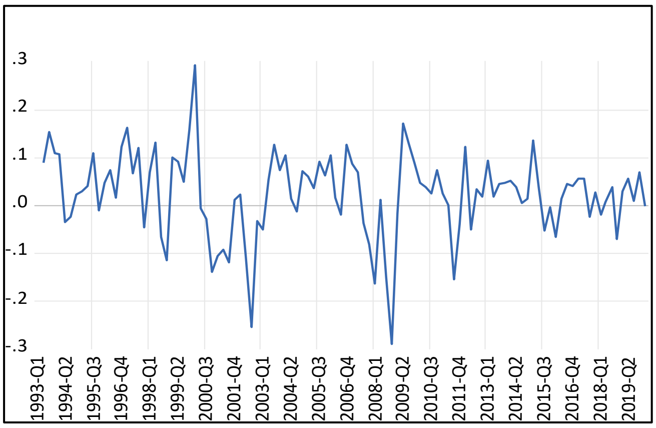


Figure 2: The stock price indices (LSP) for 13 countries in first difference form

a) Finland



b) Sweden



c) Ireland

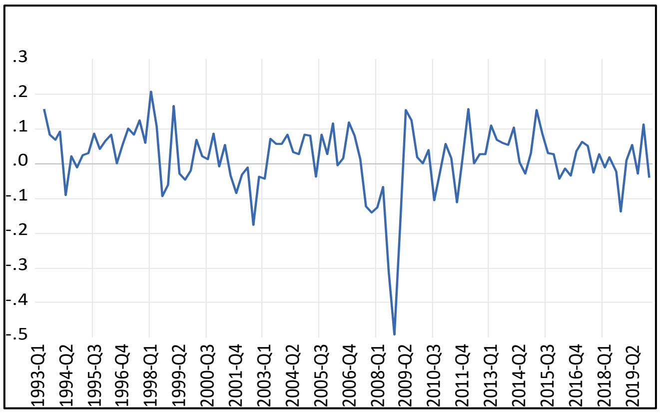


Table 1[3] to

Table 2[4] presents a summary of the descriptive statistics for these two price indices along with the preliminary unit root test results. The standard deviation statistic of share prices is larger than house prices for the majority of the countries except for Ireland. Moreover, the volatility of the house prices is relatively stable over time, unlike the share prices. Overall it is noted that two series were found to be stationary in their first differences; hence, they are integrated of order one i.e. $I(1)$.

Table 1. Descriptive Statistics for Ireland and Finland

	Ireland		Finland	
Variables	**RHP**	**SP**	**RHP**	**SP**
Mean	101.1043	76.26127	88.24239	80.54802
Median	103.7934	78.67252	102.85	80.7637
Maximum	162.3306	154.5685	111.94	191.5637
Minimum	47.81166	21.38772	50.54	10.92439
Std. Dev.	32.09105	30.67828	21.93811	36.77899
Skewness	-0.065363	0.157578	-0.580379	0.197298
Kurtosis	2.110454	2.361652	1.680407	3.332096
Jarque-Bera	3.671402	2.301769	14.02777	1.208057
Probability	0.159502	0.316357	0.000899	0.546605
Sum	11020.36	8312.478	9618.42	8779.735
Sum Sq. Dev.	111222.2	101644.9	51978.31	146090.9
Variables at level				
ADF test	-2.150278	-2.311373	-0.615613	-2.51756
PP test	-1.477831	-2.379604	-0.26329	-2.734678
KPSS test	0.3877	0.1939	0.5224	0.186
Variables in first difference				
ADF test	-2.505965	(-6.228491)***	(-4.206597)***	(-6.793853)***
PP test	(-3.528767)*	(-6.240234)***	(-4.638017)***	(-6.81115)***
KPSS test	0.1723***	0.1002***	0.157***	0.0846***

[3] HP and SP denote the housing and share price indices, respectively for Ireland and Finland. The model with both intercept and time trend is chosen for all the tests. The optimal lag selection is chosen by Bayesian information criteria. *, ** and *** denotes statistical significance at the 5%, 10% and 1% level respectively.

[4] HP and SP denote the housing and share price indices, respectively for Sweden. The model with both intercept and time trend is chosen for all the tests. The optimal lag selection is chosen by Bayesian information criteria. *, ** and *** denotes statistical significance at the 5%, 10% and 1% level respectively.

Table 2. Descriptive Statistics for Sweden

	Sweden	
Variables	**RHP**	**SP**
Mean	70.89484	59.3981
Median	74.49995	57.21777
Maximum	115.6228	126.1832
Minimum	35.43331	11.09424
Std. Dev.	26.17538	30.24305
Skewness	0.143102	0.430282
Kurtosis	1.761079	2.268069
Jarque-Bera	7.343138	5.796501
Probability	0.025437	0.05512
Sum	7727.537	6474.393
Sum Sq. Dev.	73996.26	98781.37
Variables at level		
ADF test	-1.88047	-3.361106
PP test	-1.820468	-3.060908
KPSS test	0.123	0.1939
Variables in first difference		
ADF test	(-4.89746)***	(-7.245467)***
PP test	(-4.9778140***	(-7.145547)***
KPSS test	0.1388***	0.1002***

4.1. Empirical Results

In this subsection, the countries that have a long-run relationship between property and stock prices is documented with couple of cointegration tests. At first, the Enders and Siklos (2001) test is conducted to determine asymmetric cointegration. Finally, after acknowledging the asymmetry between the two markets, Johansen (1991) econometric methodology is adapted for countries with no asymmetric long-run relationship which checks for cointegrating vectors.

The TAR/M-TAR model shows that the response of both the price indices differs for shocks above and below the equilibrium level. Therefore, the correction back to the equilibrium is asymmetric, and the linear model of cointegration, which assumes symmetric adjustment and is ineffective to depict a long-run relationship between the real estate and share prices.

Table 3[5] represents Finland, the only country to depict asymmetric cointegration that is denoted for the φ statistics overwhelmingly reject the null hypothesis of no cointegration $H_0{:}\rho_1 = \rho_2 = 0$ at the 10% level. Moreover, the test for asymmetric reversion is performed by the F statistic and it rejects the null of symmetry at the 10% level for the M-TAR model. This suggests that the speed of adjustments towards the long-run value differs when disequilibrium is there below the threshold level for ρ_2 and leverage effects persists.

[5] The numbers in the parenthesis are standard errors. ***, ** and * denote the statistical significance level at 1%, 10% and 5% respectively. Model 2 refers to the case where the dependent variable is SP. The critical values of φ and F statistics are obtained from the simulated critical values of the Monte Carlo experiment.

After asymmetric cointegration has been established between the two indices, the results seem to imply that a faster speed of adjustment is present in the regime when the threshold variable $\Delta\varepsilon_{t-1}$ for the M-TAR and ε_{t-1} for the TAR model falls below the equilibrium level. Further analysis is made by studying that when $\Delta\varepsilon_{t-1}$ is below the equilibrium value, it depicts that $\Delta LSP_{t-1} < \Delta LHP_{t-1}$. In other words, when the housing market outperforms the share markets, cointegration is established; otherwise, no long-run relationship is present.

Table 3. Asymmetric cointegration test

Country	ρ_1	ρ_2	$H_0: \rho_1 = \rho_2 = 0$ φ statistic	$H_0: \rho_1 = \rho_2 = 0$ F statistic	Tau (τ)	Flag
Finland						
Model 2	0.105222	-0.133285*	11.54942**	16.97582**	0.060005	MTAR
	(0.048296)	(0.030733)				

In Table 3 the estimates of the threshold are the updated version of equations (5) and (6), with the following specifications. The indicator function is constructed with respect to the threshold values (τ) of different cases.

$$I_t = \begin{cases} 1 \text{ if } \varepsilon_{t-1} \geq \tau \\ 0 \text{ if } \varepsilon_{t-1} < \tau \end{cases} \quad or \quad I_t = \begin{cases} 1 \text{ if } \Delta\varepsilon_{t-1} \geq \tau \\ 0 \text{ if } \Delta\varepsilon_{t-1} < \tau \end{cases} \text{———(8)}$$

The Johansen framework is implemented to check for symmetric cointegration for others. It is based on the Vector Autoregression (VAR) model. Table 4[6] depicts that Ireland and Sweden rejects the null hypothesis of no cointegration for both the Trace and Max-Eigen statistics.

Table 4. Johansen cointegration test

Null hypothesis: No cointegration	Trace statistics	Critical value	Prob.[a]		Max-Eigen statistics	Critical value	Prob. [a]
Ireland							
No cointegration vector	19.95377**	10.47457	0.0022		19.79611**	9.474804	0.0013
At most 1	0.157664	2.976163	0.7427		0.157664	2.976163	0.7427
Sweden							
No cointegration vector	18.69447**	17.98038	0.081		12.28941**	13.9059	0.1698
At most 1	6.405062	7.556722	0.1617		6.405062	7.556722	0.1617

4.2 Different effects in various market condition: The Vector Error Correction Model

After establishing cointegration, the vector error correction model (VECM) is used to determine the error-correcting term, which will be relevant only if the coefficient is negative. For each case, the long-run significance of the error-correcting term is defined as follows:

[6] The model with no trend and intercept is chosen. *, ** and *** represents the significance level at 5%, 10% and 1% level.

[a] Denotes Mackinnon-Haug-Michelis (1999) p-values

4.2.1 Ireland

From the VECM, the evidence of the error-correcting terms for Irish house and stock prices are cited in Table 5[7].

Table 5. VECM results of ΔSP_t for Ireland

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ec_{t-1}	0.143546	0.043344	3.311781	0.0013
ΔHP_{t-1}	0.636560	0.412699	1.542433	0.1263
ΔHP_{t-2}	0.350435	0.427093	0.820512	0.4140
ΔHP_{t-3}	-0.130970	0.425660	-0.307687	0.7590
ΔHP_{t-4}	0.527783	0.405869	1.300377	0.1966
ΔSP_{t-1}	0.542297	0.100303	5.406608	0.0000
ΔSP_{t-2}	-0.126688	0.114335	-1.108042	0.2706
ΔSP_{t-3}	0.137071	0.112680	1.216467	0.2268
ΔSP_{t-4}	0.104050	0.103356	1.006717	0.3166
AIC			-2.106410	
SBC			-1.877569	
F-stats for $H_0: A_{11} = A_{12} = A_{13} = A_{14} = 0$			2.639118	0.0386
F-stats for $H_0: A_{21} = A_{22} = A_{23} = A_{24} = 0$			8.200726	0

The error correction term is given by $ec_t = \Delta HP_{t-1} - 1.0921\Delta SP_{t-1}$. The disequilibrium in property prices is adjusted at the rate of 2.1%, which is weakly significant at the 5% level. In contrast, the long run discrepancies in stock prices are corrected at the rate of 14.35% due to its relevance at the 1% level. Furthermore, the F-stats for $H_0: A_{11} = A_{12} = A_{13} = A_{14} = 0$ is statistically significant at 5% and it can be concluded that the credit-price effect exists.

4.2.2 Sweden

The character of the Swedish economy can be well justified by Table 6[8] where the VECM is given for house prices.

Table 6. VECM results of ΔHP_t for Sweden

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ec_{t-1}	-0.016061	0.006117	-2.625782	0.0101
ΔHP_{t-1}	0.401996	0.100310	4.007549	0.0001
ΔHP_{t-2}	0.185180	0.108953	1.699624	0.0925
ΔHP_{t-3}	0.144125	0.105453	1.366730	0.1749
ΔHP_{t-4}	-0.081303	0.092886	-0.875297	0.3836
ΔSP_{t-1}	0.044574	0.014014	3.180608	0.0020
ΔSP_{t-2}	-0.005623	0.015486	-0.363084	0.7173
ΔSP_{t-3}	0.000113	0.014981	0.007552	0.9940
ΔSP_{t-4}	-0.035822	0.013960	-2.565981	0.0119
AIC			-6.163304	
SBC			-5.934463	
F-stats for $H_0: A_{11} = A_{12} = A_{13} = A_{14} = 0$			12.82685	0

[7] The table reports the estimation for the results of the following VECM: $\Delta SP_t = A_{11}\Delta HP_{t-1} + A_{12}\Delta HP_{t-2} + A_{13}\Delta HP_{t-3} + A_{14}\Delta HP_{t-4} + A_{21}\Delta SP_{t-1} + A_{22}\Delta SP_{t-2} + A_{23}\Delta SP_{t-3} + A_{24}\Delta SP_{t-4} + \omega_2 ec_{t-1} + \varepsilon_{2t}$. *, **, *** denotes the significance level at 5%, 10% and 1%.

[8] The table reports the estimation for the results of the following VECM: $\Delta HP_t = A_{11}\Delta HP_{t-1} + A_{12}\Delta HP_{t-2} + A_{13}\Delta HP_{t-3} + A_{14}\Delta HP_{t-4} + A_{21}\Delta SP_{t-1} + A_{22}\Delta SP_{t-2} + A_{23}\Delta SP_{t-3} + A_{24}\Delta SP_{t-4} + \omega_1 ec_{t-1} + \varepsilon_{1t}$. *, **, *** denotes the significance level at 5%, 10% and 1%.

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Cilt/Volume: 4 Sayı/Issue: 1 Mart/March 2022 ss./pp. 1-19
S. Mukherjee, http://dx.doi.org/10.46959/jeess.951413

F-stats for $H_0: A_{21} = A_{22} = A_{23} = A_{24} = 0$			4.228318	0.0034

where $ec_t = \Delta HP_{t-1} - 0.799\Delta SP_{t-1}$ is the long-run adjustment term. In Table 6, any discrepancies in the house prices are corrected at the rate of 1.6% with a p-value of 0.01. It is also seen here that the F-stats for $H_0: A_{21} = A_{22} = A_{23} = A_{24} = 0$ is 4.228; thereby lags of stock prices granger-cause house prices. In other words, there is the persistence of wealth effects. Moreover, the ΔSP_{t-4} has a negative coefficient with a p-value of 0.0119, which supports the hypothesis of capital-switching behavior where the investors would increase their holding in real estates that have performed well in the past and reduce the holding of low performing stocks.

The F-stats are used for the VECM to show that only Sweden has a wealth effect present at the 5% and 1% level respectively. This finding is in line with the theory proposed by Markowitz (1952). In other words, there is a capital spillover from stock markets to the property markets when the returns in stocks are rising. Investors can rebalance their portfolio by gains in share prices and boost their consumption in housing. It also shows that Ireland is the sole country to have a credit-price effect at the standard level of 5%. This provides an excellent opportunity for businesses to use their profits in properties as collateral for gaining capital and these profits lead to output expansion and credit creation as per Maclennan, Muellbauer, and Stephens (1998).

4.3 Different effects in various market condition: The Asymmetric Error Correction Model

According to Table 3, Finland shows house prices change only in response to a negative deviation and not a positive deviation. Therefore, now the asymmetric error correction model is estimated in which, both the short term and long term adjustments are specified.

4.3.1 Finland

The asymmetric correction model given in Table 7[9] for Finland depicts that there is an asymmetry in stock prices for deviations below the equilibrium (z_{t-1}^{-}) due to its significance at the conventional level. In other words, it means that any disequilibrium from below the long-run level is corrected at a rate of 13.2%, which suggests that adjustments are big. Furthermore, ΔHP_{t-2} is statistically relevant at the 1% level. In other words, investors shift their portfolio from low performing housing assets to equities, based on previous earnings; hence, there is the existence of a capital-switching regime. The F-stats indicate that the lags of house prices granger-cause stock prices and thereby credit-price effect exists.

[9] The model is chosen where DSP=ΔSP_t is the dependent variable: $\Delta SP_t = \beta_0 + A_{11}\Delta HP_{t-1} + A_{12}\Delta HP_{t-2} + A_{13}\Delta HP_{t-3} + A_{14}\Delta HP_{t-4} + A_{21}\Delta SP_{t-1} + A_{22}\Delta SP_{t-2} + A_{23}\Delta SP_{t-3} + A_{24}\Delta SP_{t-4} + \omega_{21} z_{t-1}^{+} - \omega_{22} z_{t-1}^{-} + \varepsilon_{2t}$. The error correction term is denoted by $z_t = \Delta SP_t - \beta_0 - \Delta HP_t$ *, **, *** denotes the level of significance at 5%, 10% and 1%. z^{+}_t is z_t if $z_t \geq 0$ otherwise, $z^{+}_t = 0$ and z^{-}_t is z_t if $z_t < 0$ otherwise, $z^{-}_t = 0$.

Table 7. Results from the asymmetric ECM for Finland for ΔSP_t

Variable	Coefficient	Std. Error	t-Statistic	Prob.
β_0	-0.006420	0.010955	-0.585996	0.5593
ΔHP_{t-1}	3.178149	1.032758	3.077340	0.0027
ΔHP_{t-2}	-3.462431	1.235465	-2.802533	0.0062
ΔHP_{t-3}	2.664347	1.221986	2.180342	0.0318
ΔHP_{t-4}	-0.110147	0.990004	-0.111259	0.9117
ΔSP_{t-1}	0.139415	0.102121	1.365191	0.1755
ΔSP_{t-2}	-0.052110	0.094579	-0.550966	0.5830
ΔSP_{t-3}	0.237876	0.097090	2.450040	0.0162
ΔSP_{t-4}	-0.074917	0.098867	-0.757752	0.4505
${z^+}_{t-1}$	0.085889	0.050903	1.687319	0.0949
${z^-}_{t-1}$	-0.132437	0.031641	-4.185621	0.0001
AIC			-1.757654	
SBC			-1.477959	
F-stats for $H_0: A_{11} = A_{12} = A_{13} = A_{14} = 0$			4.331383	0.0029

This finding contradicts the work of Oikarinen (2006) where only the wealth effect was established in Finland. Moreover, the finding in this research is an updated version of the work of Takala and Pere (1991), where they found cointegration but by using the Engel and Granger (1987) technique of linear cointegration. The empirical results found here are consistent with the hypothesis H_A, H_C, and H_D for Finland.

5. CONCLUSIONS

This research has been able to overcome the obstacles of ignoring the asymmetric feature of the housing and stock markets mentioned in the literature. The existence of asymmetric credit-price effect brings a profound implication for the investors in housing assets and organizations who use real estate as collateral for loans. In other words, during the bullish market, when the prices of real estate rise, the owner profits from the increase in house prices. Thus, the property owners can undertake mortgage loans at a lower cost of borrowing and they can diversify their investments. The returns from these investments will lead to an increase in the equity value of the households and hence, there is a substantial upward spiral from the stocks and housing portfolio. The distinctiveness of Finland to procure asymmetric credit-price effect also makes Finnish stock prices act as a hedging asset as its value does not fall whenever there is an economic turmoil.

Regarding the synchronisation of the European markets there is turbulence for Finland, other than that Ireland and Sweden adapts a proper unification of the markets. This finding depicts a similarity of all these three markets and that the viscosity of the Maastricht Treaty has been attained robustly.

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Hakem Değerlendirmesi: Dış bağımsız.

Çıkar Çatışması: Yazar çıkar çatışması bildirmemiştir.

Finansal Destek: Yazar bu çalışma için finansal destek almadığını beyan etmiştir.

Teşekkür: -

Peer-review: Externally peer-reviewed.

Conflict of Interest: The author has no conflict of interest to declare.

Grant Support: The author declared that this study has received no financial support.

Acknowledgement: -