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Factors affecting development patterns: econometric investigation of the Japan equity market

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ABSTRACT

In this paper it is assumed that equity markets reflect the development of the overall economy of a country. Equity markets, among other factors, are considerably affected by factors such as inflation or deflation. Therefore, when inflationary or deflationary pressures appear, Central Banks try to manage those pressures in order to minimise their impact on the economy. In this paper, the case of Japan will be examined. Japan can be considered an example of a country which was under extended deflationary pressures for about three decades. In this study, the authors investigate different time frames for the Japan equity market. The research is based on Japan equity market (NIKKEI) returns. The authors aim to answer the question of whether the Japanese market complies with the Efficient Market Hypothesis (EMH) for different time frames, as well as test analytically if Japan's stock market and economy have improved after the implementation of different attempts at Quantitative Easing (QEs), a Zero Interest Rate Policy (ZIRP) or a Negative Interest Rate Policy (NIRP) to curb deflationary impacts on the economy. The analysis and obtained results could be useful for risk and portfolio management, and could be extended to other markets.

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Introduction

Economic development can be seriously injured by various shocks. For example, during the last century, we witnessed extraordinary economic phenomena, such as hyperinflation in Germany in the 1920s, full-fledged deflation, which was recorded in the time frame of the 1930s, inflation in Brazil during the 1990s, and very current inflationary processes in Venezuela. In the majority of those cases inflationary and deflationary pressures in the economies of countries emerged, which, ultimately, were

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managed by central banks in order to establish control over those pressures and minimise damage on economic development. We will focus on the other prolonged deflationary pressure situation in Japan, which lasted from the early 1990s until now. This period caused the so-called 'lost decades' from the point of view of the economic development of Japan. There has not yet been a good, detailed study about deflationary pressures and their impact on the equity market, and, ultimately, their impact on the whole economy of a country. Normally, when one country is under deflationary pressure, it tries to export that process to other countries in order to create demand for its products and become stable internally. An internally stable country has low prices due to deflation, and when it exports at low prices to other countries, this can translate into lower prices in other countries, which can be deflationary for the importing country. More recently, especially after the 2008 financial crisis, there was a question raised of whether the United States has developed some statistical dependence on Japan, which itself has been under deflationary pressure since the beginning of the 1990s. Econometric analysis, presented in this paper, is based on different technical, micro and macro variables. Technical variables have been selected to check the validity of the EMH hypothesis. An Auto-Regressive Distributed Lag (ARDL) Modelling Approach is used based on variable selection. Models were tested for auto/serial correlation, normality, heteroscedasticity and finally for Cumulative Sum Control Chart (CUSUM) and Cumulative Sum Control Chart Squared (CUSUMSQ), with a 5% bound used to test structural stability.

Eugen Fama's Efficient Market Hypothesis (EMH) (1965) guides us in the direction that current and expected economic information is already priced in the markets, and if there is some new information, then markets adjust to that information very quickly. Dann, Mayers, and Raab (1977), Patell and Wolfson (1984), and Jennings and Starks (1985) have found that prices adjust within 1 to 15 minutes upon receiving information. Similarly, according to Brooks, Patel & Su's (2003) study, price reaction to announcements of unanticipated negative events took over 20 minutes, and tended to reverse over the following two hours because of over-reaction to the bad news. Based on EMH and these studies, most researchers believe that most of the developed markets are reasonably efficient in mimicking the current and expected economic situations. Most of the time markets are dependent on a combination of some technical and fundamental variables, and this combination can change from time to time (Celik et al. 2017; Tamulevičienė, 2016; Monni et al. 2017; Paseková et al. 2017; Pietrzak et al. 2017; Illmeyer et al. 2017; Masood et al. 2017; Petrenko et al. 2017; Hilkevics & Hilkevica, 2017). In earlier years fundamental micro and macro variables have been studied extensively by, for example, Roll and Ross (1980), Fama (1981), Hamao (1988), Chen et al. (1986), and Mayasami and Koh (2000). In this study we have chosen a combination of technical and fundamental variables; some of them are based on Microeconomics, and some are based on Macroeconomics. Technical variables are picked just to see the market efficiency (EMH) behaviour. The variables are: Liquidity; Illiquidity; Volatility; and Money Flow Index. In the Microeconomic category we have selected such indicators as Exchange Rate, Ten Year Treasury Rate, Unemployment and Money Supply; in the Macroeconomic category we have selected Crude Prices, U.S. Market (SPY) Return, British Market (FTSE) Return and China

Market (Shanghai) Return. For dependent variables we have selected the broadest Japan market index (NIKKEI) based on EMH in addition to other variables. The main focus is whether Japan's equity market return (indirectly, the economy) has shown some change in statistical significance for the different time frames during which QE1, QE2 and QE3 were implemented. By using these variables we will also be able to confirm or reject the EMH.

Data is collected from two different time frames: from 2002 to 2008 and from 2008 to 2015. Additionally, one time frame embraces all years from 2002 to 2015. The indicated time frames were selected since Japan implemented QE1 in March 2001, QE2 in October 2010 and QE3 in April 2013. It has been seen that whenever QEs (Quantitative Easing) were implemented for a very short period of time, Japan's economy and equity market performed well but again saw deflationary pressures. This was even when Japan had a Zero Interest Policy (ZIRP) in place at the same time, in addition to different QEs. The main aim is to compare and differentiate the results, in order to reveal if there is any EMH and any statistical change during these time frames. All these variables were tested for stationarity, and, after finding out that some of these variables are I(0) and some are I(1), we chose the best approach to test the relationship, which is an Autoregressive Distributed Lag (ARDL). This approach allows the exploration of the correct dynamic structure for a mixture of variables of stationary at level I(0) and at first difference I(1). Since our variables in this research are I(0) or I(1), ARDL is therefore a better choice for us to use compared to other techniques.

The rest of the paper is organised as follows: Section 2 reviews the literature; Section 3 presents data, variables and the research methodology; Section 4 discusses the main empirical results and Section 5 concludes the paper.

2. Literature review

There has been theoretical and empirical research for equity markets with reference to some of the individual factors we have selected, but not in combination as we are analysing in this study. Kessel (1956) studied the impact of inflation on wealth effect. Gultekin (1983) pointed out a positive relationship between equity prices and inflation. Recently for Greece, Ioannidis et al. (2004) found a positive relationship between equity prices and inflation. Contrary to these studies Spyrou (2001) finds negative correlation between equity market return and inflation for a specific time period. There are some studies which see equity markets as a hedge against inflation. Nevertheless, despite the complexity of the relationship between equity prices and inflation, it is claimed that in the long run this relationship appears to be significant and positive. Pesaran and Shin (1995) in their study see the negative impact of interest rates on equity markets. Other studies on equity markets and macroeconomic variables are e.g., Chen et al. (1986), Chan et al. (1991), Eugene F. Fama (1996), and Dickinson (2000).

There are also some other studies in which technical variables have been studied in relation with equity markets, e.g., Amihud (2002) and Ardalan et al. (2017), which tackled the impact of illiquidity on the institutional organisation of the market and the efficiency of market transactions. According to Baker (1996) these are three different properties: depth; breadth; and resiliency. Based on these characteristics we can say whether a market is liquid or illiquid. Based on Gabrielsen, Marzo and Zagaglia's (2011) survey there are different ways liquidity can be measured, like the Index of Martin (1975). Based on the Taiwan equity market, an empirical study of Volatility and Momentum was made by Lo, Lin, and Chen (2014).

In their study on the impact of different QEs on Japan's economy, Andolfatto, and Li (2014) found that after three QEs higher inflation could be expected. There have been studies regarding the impact of either fundamental or technical variables on equity markets; alas, they did not put emphasis on inflationary or deflationary aspects of the economy. Similarly there have been some other studies regarding the inflation illusion, such as Modigliani and Cohn (1979), Crosby (2001), Ritter and Warr (2002), Ioannidis et al. (2004), Campbell and Vuolteenaho (2004), Cohen et al. (2005), as well as studies on deflation such as Bernanke (2002), Borio et al. (2015), Eichengreen (2015) and Clemens (2016). However, nothing much has been done in a single study on differentiating inflationary and deflationary time frames and its impact on equity market returns, and, as was mentioned, indirectly the economy. Clemens found out in his study that recessions cause deflation; equity returns are low in inflationary periods and higher returns are in deflationary periods until deflation sets in.

2. Data, variables and method

In this study, we picked monthly data from the broadest Japan market NIKKEI index. As was mentioned earlier, the data has been split into three time frames: 2002 to 2008; 2008 to 2015; and an overall one 2002 to 2015. Most of the data is taken from the Federal Reserve Bank of St. Louis in addition to some market information from Yahoo. For all these time frames a minimum requirement has been fulfilled for a number of observations for an ARDL time series approach. The first time frame covers the QE1 period, and the second time frame covers both QE2 and QE3. The final one covers overall with all QEs, all with deflationary pressures with ZIRP. The Japan marker % return based on the NIKKEI Index is calculated as (1):

$$\left(\left(\mathrm{Nikkei}_t/\mathrm{Nikkei}_{t-1}\right) - 1\right) \times 100 \tag{1}$$

Where,

Nikkei_t is Nikkei Price at time t

$\mathrm{Nikkei}_{t\text{-}1}$ is Nikkei Price at time t-1

Liquidity, illiquidity and money flow index is based on current and previous monthly closing prices and volumes. Amihud's (2002) calculation, which is based on the return and volume for that period, was used. All other variables like Exchange Rates, Money Supply, Ten Year Treasury Rates, Unemployment Rate and Crude Prices were taken based on a monthly basis from different investing and Federal Reserve sites. U.S., FTSE and Shanghai index returns were calculated similarly to NIKKEI returns.

The basic model to investigate the relationship of different variables to the NIKKEI (Japan) return is as follows (2):

Table 1. Stationary level for different time frames for Japan.

Variable	2002 to 2015	2002 to 2008	2008 to 2015
jr	Level	Level	Level
l	Level	D1	D1
ll	Level	Level	Level
v	D1	D1	D1
mfi	Level	D1	Level
yrtr	D1	D1	D1
er	D1	D1	D1
uemp	D1	D1	D1
m2	D1	D1	D1
crude	D1	D1	D1
ur	Level	Level	Level
br	Level	Level	Level
cr	Level	Level	Level

Source: own results.

$$jr = \beta_0 + \beta_1 l + \beta_2 il + \beta_3 v + \beta_4 mfi + \beta_5 yrtr + \beta_6 uemp + \beta_7 er + \beta_8 m2 + \beta_9 crude + \beta_{10} ur + \beta_{11} br + \beta_{12} cr + \mu_t \quad (2)$$

Where,
jr = Japan Return (Nikkei 225)
l = Liquidity
il = Illiquidity
v = Volatility
mfi = Money Flow Index
yrtr = 10 yr Treasury Rate
uemp = Unemployment Rate
er = Exchange Rate (Dollar Index)
m2 = M2 Money Supply
crude = NYMEX Crude Price ($)
ur = U.S. return (SPY)
br = British Return (FTSE100)
cr = China Return (Shanghai Index)
μ = Error Term
β_s are coefficients for different variables

First of all, we tested all these series for their stationarity level, after testing for unit root with Augmented Dickey Fuller (ADF) and Phillips Perron (PP) techniques. We found that some of these series are integrated at zero lag I(0) or stationary at level and some of them are integrated at 1st order I(1), stationary at first difference (D1) as shown in Table 1. Based on this finding compared to different available techniques, Autoregressive Distributed lag (ARDL) is suitable for the combination of I(0) and I(1) variables. A couple of other approaches which used a long-run relationship are Engle and Granger (1987), which is a two step approach, and, e.g., Phillips and Hansen (1990), which is a fully modified OLS. Disadvantages for the Engle Granger approach are that the static level estimate may create bias, which transmits to a poor second step. These are not the issues with ARDL. Ouattara (2004) also mentioned that the ARDL Bound test is basically based on the assumption of the combination of I(0) and I(1) variables. ARDL and later the Error Correction Model approach is used for both long run and short run relationships for this analysis. This approach is applied based on that of Pesaran et al. (2001); it is better suited as mentioned for a combination of 1(0) and I(1) variables, and also it permits inferences for long run estimates, which is not available for other competitive approaches. One more advantage to using ARDL compared to other Vector Autoregressive (VAR) models is using a greater number of variables, which is the case in our study.

In an ARDL approach, we first need to add first lag order for each variable in the equation, in order to create the Error Correction Model (ECM) equation. Then we need to find optimal lags, Akaike Information Criteria (AIC) and Schwarts Bayesian Information Criteria (SBIC). Others like Hannan and Quinn Information Criteria (HQIC) and Final Prediction Error (FPE) were used, but AIC with a better significance level was used to pick up the optimal lag. AIC is used because it is preferred for monthly data. After finalising variable lags, the ARDL model for Nikkei (Japan return) is as follows (3):

$$\begin{aligned} \mathrm{jr_t} = {} & \beta_0 + \Sigma\beta_{1i}\mathrm{l}_{t-1} + \Sigma\beta_{2i}\mathrm{il}_{t-1} + \Sigma\beta_{3i}\mathrm{v}_{t-1} + \Sigma\beta_{4i}\mathrm{mfi}_{t-1} + \Sigma\beta_{5i}\mathrm{yrtr}_{t-1} + \Sigma\beta_{6i}\mathrm{uemp}_{t-1} \\ & + \Sigma\beta_{7i}\mathrm{er}_{t-1} + \Sigma\beta_{8i}m2_{t-1} + \Sigma\beta_{9i}\mathrm{crude}_{t-1} + \Sigma\beta_{10i}\mathrm{ur}_{t-1} + \Sigma\beta_{11i}\mathrm{br}_{t-1} \\ & + \Sigma\beta_{12i}\mathrm{cr}_{t-1} + \mu_t \end{aligned} \tag{3}$$

where i represents the lag order for the specific variable which could range from 1 to p.

Finally in an ARDL approach we find the Error Correction Equation. The ECM equation could be written as (4):

$$\begin{aligned} ECM = {} & \mathrm{jr_t} - \big(\beta_0 + \Sigma\beta_{1i}\mathrm{l}_{t-1} + \Sigma\beta_{2i}\mathrm{il}_{t-1} + \Sigma\beta_{3i}\mathrm{v}_{t-1} + \Sigma\beta_{4i}\mathrm{mfi}_{t-1} + \Sigma\beta_{5i}\mathrm{yrtr}_{t-1} \\ & + \Sigma\beta_{6i}\mathrm{uemp}_{t-1} + \Sigma\beta_{7i}\mathrm{er}_{t-1} + \Sigma\beta_{8i}m2_{t-1} + \Sigma\beta_{9i}\mathrm{crude}_{t-1} + \Sigma\beta_{10i}\mathrm{ur}_{t-1} \\ & + \Sigma\beta_{11i}\mathrm{br}_{t-1} + \Sigma\beta_{12i}\mathrm{cr}_{t-1} + \mu_t\big) \end{aligned} \tag{4}$$

In options we can use optimal lag lengths for different variables. Error correction, ec or ec1 can be used, but in our case we used ec. Then models for different time frames were tested for post-estimation criteria by using bound testing, Serial/ Autocorrelation with Durbin-Watson, ARCH LM and Breusch-Godfrey LM tests, Functional form with Ramsey RESET test (ovtest), Normality with Cameron & Trivedi's IM test for skewness and kurtosis and heteroscedasticity with Breusch-Pagan and the Cameron & Trivedi IM heteroscedasticity test. Finally, to test for the stability of long-run and short-run coefficients, CUSUM and CUSUMSQ tests were used to see if statistics stay in the 5% criteria bounds.

4. Empirical results

Unit root tests of ADF and PP were done for all variables for all time frames. It was found that within each time frame variables are either stationary at level, I(0) or at first difference, I(1) and no series is stationary beyond I(1), which satisfy the major conditions for an ARDL approach. Table 1 shows stationary levels of different series in different time frames. After that, optimal lags were obtained for all variables for all time frames and for both level and 1st difference series. A maximum of five lags are

Table 2. Japan selected ARDL short run Error Correction Representation Model.

		2002 to 2015		2002 to 2008		2008 to 2015	
Regressor	Symbol	Coefficient	Probability	Coefficient	Probability	Coefficient	Probability
Japan Return	Δjr_{-1}			−0.0511341	0.653		
Liquidity	Δl	2.58E-12	**0.021**	3.00E-12	**0.015**	1.87E-09	0.243
	Δl_{-1}	1.55E-12	0.191				
	Δl_{-2}	−1.07E-12	0.312				
	Δl_{-3}	−1.41E-13	0.895				
	Δl_{-4}	2.04E-13	0.856				
Illiquidity	Δil	3051.815	0.760	8732.093	0.573	6020.818	0.695
Volatility	Δv	0.2335588	0.337	0.2483078	0.645	0.0288605	0.928
	Δil_{-1}	0.1372541	0.522				
	Δil_{-2}	0.1836464	0.388				
	Δil_{-3}	−0.1573097	0.449				
Money Flow	Δmfi	0.0393697	0.309	0.0397335	0.346	−0.0445695	0.640
10 yr Treasury	$\Delta yrtr$	9.136868	**0.004**	14.32316	**0.000**	3.734414	0.568
Unemployment	$\Delta uemp$	−0.8364994	0.638	−1.326997	0.578	−1.474937	0.560
	$\Delta uemp_{-1}$	−0.3950503	0.807				
	$\Delta uemp_{-2}$	−1.294174	0.465				
	$\Delta uemp_{-3}$	−1.193784	0.496				
	$\Delta uemp_{-4}$	−0.2665316	0.875				
Crude	$\Delta crude$	0.0736471	0.183	0.0165109	0.889	0.0585539	0.528
	$\Delta crude_{-1}$	−0.0269016	0.643				
Exchange Rate	Δer	0.6207988	**0.000**	0.287719	0.163	0.9380135	**0.000**
M2 Money Supply	$\Delta m2$	2.11E-13	**0.048**	−4.30E-15	0.976	2.17E-13	0.116
Constants	_cons	−4.510705	0.647	9.02575	0.421	0.5979326	0.948
ECM(−1)		**−1.040908**	**0.000**	**−0.801018**	**0.000**	**−1.073982**	**0.000**
R-Squared		0.81552306		0.78698255		0.81993199	
Adj. R-Squared		0.76419034		0.70266314		0.76100064	
Root MSE		3.5205827		3.2532098		3.6598669	

Source: own results.

used for this ARDL study. After finalising the basic needs to run the model, both long and short run ARDL models were run. A common finding from the Short Run Error Correction Representation Model for overall analysis and individual ones show that exchange rates and U.S. market returns have statistical significance for Japan's market return, or, we can say, indirectly for the economy. Even though in the period 2002 to 2008 there was a statistical significance of liquidity, that significance does not show up in the overall period, even for the period from 2008 to 2015, which shows liquidity problems in the early 2000s for Japan's markets and economy; with the implementation of three different QEs this problem has been resolved. Since 2008 liquidity has not been a problem, but for the equity market and economy to improve, Japan had to work on exchange rates, since ER and U.S. market returns are significant for Japan. That confirms the observation that whenever there is adjustment in QE (QE1, QE2 and QE3), then the market and economy respond positively for an export oriented country because of the negative trend of the Yen exchange rate and equity market. Then with the passage of time as these exchange rates settle down, this impact diminishes with some retracing of exchange rate adjustment. One more observation is that NIKKEI market returns are mostly dependent on fundamental variables like treasury and exchange rates, which shows that the Nikkei market is an efficient market compared to other markets in Asia which are still inefficient. Another significant observation is that in the Long Run model, U.S. returns have

Table 3. Japan long run model relationship comparison and significance.

	2002 to 2015		2002 to 2008		2008 to 2015	
Variables	Coefficient	Probability	Coefficient	Probability	Coefficient	Probability
Liquidity	−4.70E-13	0.382				
Volatility	0.0288265	0.737	0.053884	0.852	0.1161444	0.460
Money Flow Index	0.0280197	0.199	0.022000	0.549	0.0278871	0.534
10 Year Treasury	−1.8335000	0.103	−4.134787	0.102	−2.504632	0.391
Exchange Rate	0.0348206	0.424	−0.0588939	0.672	−0.0108842	0.852
Unemployment	0.5811920	0.653				
Crude	−0.0206946	0.343	−0.0068165	0.894	−0.0178964	0.633
U.S. Return	0.5748671	**0.000**	0.2349461	0.533	0.6409922	**0.004**
British Return	0.1341913	0.388	0.4897904	0.157	0.038499	0.857
China Return	0.0119861	0.773	0.0963254	0.203	−0.0423329	0.533
ECM(-1)	**−1.040908**	**0.000**	**−0.801018**	**0.000**	**−1.073982**	**0.000**

Source: own results.

statistical significance for most of the time, which is shown in the Long Run ECM approach. Table 2 shows ARDL's Short Run Error Correction Representation and Table 3 shows the Long Run Model Relationship. In STATA Long Run and Short Run are calculated with the same step and with the same command, what means R-squared, adjusted R-squared and Root MSE are in both cases equal.

The Variance Inflation Factor (VIF) test is used for multicollinearity. Then these models are tested for auto or serial correlation, functional form, normality and heteroscedasticity. These results are shown in Table 4. These results show that no problem was seen for all these parameters. Finally as shown in Figure 1 we used CUSUM (Cumulative sum) and CUSUMSQ (Cumulative sum square) plots to test the stability of long run and short run coefficients; results show that for all time frames developed models are in the critical bound of 5%, which shows that developed models are structurally stable.

In all long run and short run models, we know now which variables are statistically significant for all time frames. Based on the Efficient Market Hypothesis, most of the time fundamental variables are significant for the market returns, which theoretically is the image of Japan's economy. A couple of major observations from this analysis are that for Japanese markets, economy exchange rate and the performance of the U.S. equity market, returns, or, indirectly, the U.S. economy, is very significant.

Models for these time frames with coefficients are as follows (Equations 5–7):

2002 to 2015

$$\begin{aligned} ECM = {} & \mathrm{jr_t} + 4.70E{-}13\mathrm{l_{t-1}} - 0.0288265\mathrm{v_{t-1}} - 0.0280197\mathrm{mfi_{t-1}} + 1.8335\mathrm{yrtr_{t-1}} - 0.581192\mathrm{uemp_{t-1}} \\ & - 0.0348206\mathrm{er_{t-1}} + 0.0206946\mathrm{crude_{t-1}} - 0.5748671\mathrm{ur_{t-1}} - 0.1341913\mathrm{br_{t-1}} - 0.0119861\mathrm{cr_{t-1}} \end{aligned} \tag{5}$$

2002 to 2008

$$\begin{aligned} ECM = {} & \mathrm{jr_t} - 0.053884\mathrm{v_{t-1}} - 0.022\mathrm{mfi_{t-1}} + 4.134787\mathrm{yrtr_{t-1}} + 0.0588939\mathrm{er_{t-1}} \\ & + 0.0068165\mathrm{crude_{t-1}} - 0.2349461\mathrm{ur_{t-1}} - 0.4897904\mathrm{br_{t-1}} - 0.0963254\mathrm{cr_{t-1}} \end{aligned} \tag{6}$$

Table 4. Post-estimation tests for Japan.

Item	Test Applied	Probability		
		2002–2015	2002–2008	2008–2015
Serial/Auto Correlation	Durbin-Watson	1.958667	2.108693	1.881765
	ARCH LM	0.6521	0.2797	0.6246
	Breusch-Godfrey LM Test (bgodfrey)	0.7230	0.4540	0.5343
Functional Form	Ramsey RESET Test (ovtest)	0.2541	0.8972	0.3887
Normality	Cameron & Trivedi's IM Test (skewness)	0.3688	0.6877	0.4057
	Cameron & Trivedi's IM Test (kurtosis)	0.9723	0.1357	0.5818
Heteroscedasticity	Cameron & Trivedi's IM Test (hetero)	0.5077	0.4429	0.4453
	Breusch-Pagan (hettest)	0.0764	0.7173	0.1079

Source: own results.

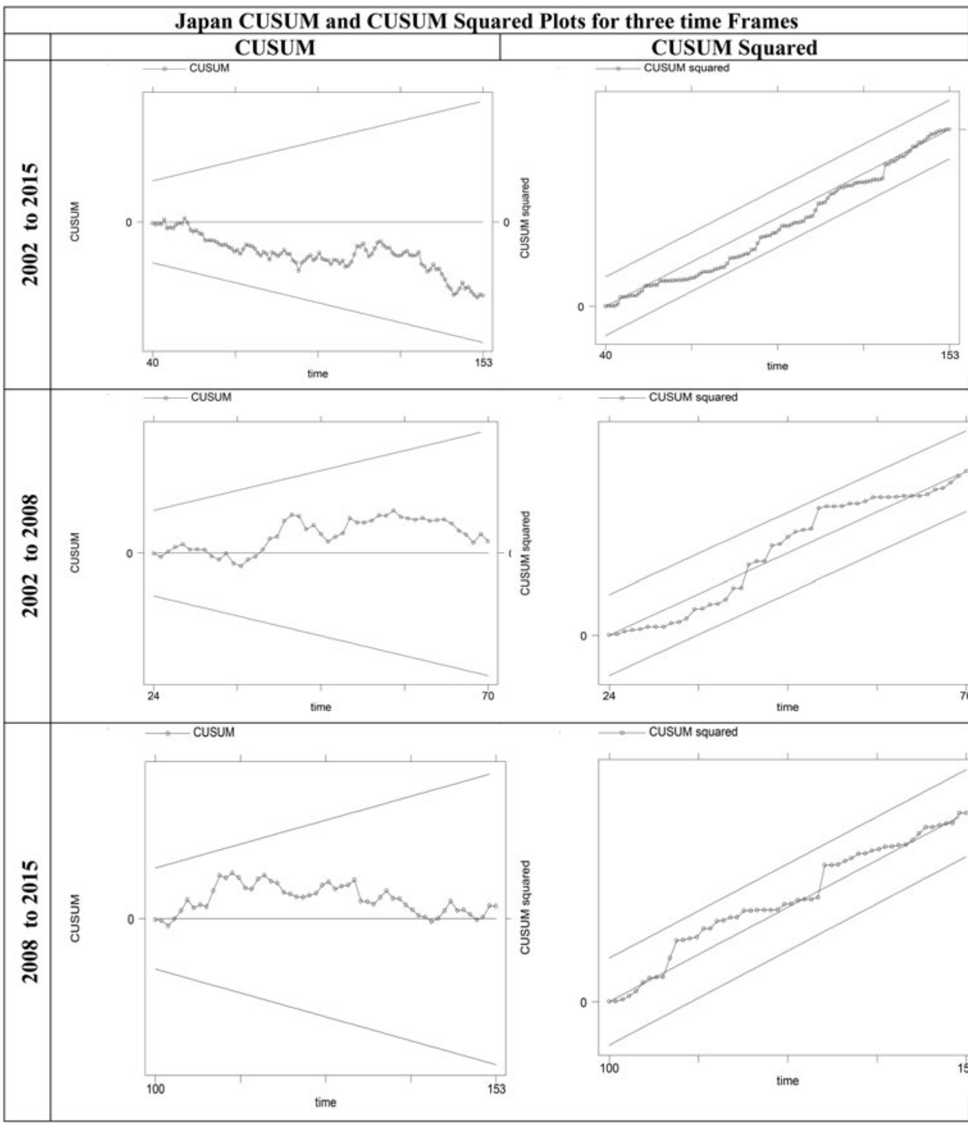

Figure 1. Japan CUSUM and CUSUM squared plots for three time frames. Source: own results.

2008 to 2015

$$ECM = \mathrm{jr_t} - 0.1161444\mathrm{v_{t-1}} - 0.0278871\mathrm{mfi_{t-1}} + 2.504639\mathrm{yrtr_{t-1}} + 0.0108842\mathrm{er_{t-1}} - 0.0178964\mathrm{crude_{t-1}} - 0.6409922\mathrm{ur_{t-1}} - 0.038499\mathrm{br_{t-1}} + 0.0423329\mathrm{cr_{t-1}} \quad (7)$$

ECM(-1) is the one period lag value of the error term from the long run relationship and it shows how much of the short run disequilibrium is fixed in the long run. In all three cases ECM(-1) is negative and very high. As shown in Table 3, almost 100% of the previous month's disequilibrium in the return is corrected in the current month for the 2002 to 2015 and 2008 to 2015 periods and 80% for the 2002 to 2008 period. Fitness of these models is shown in Table 4 with different tests for serial/auto correlation, functional form, normality and heteroscedasticity, and 5% bound test plots in Figure 1.

The obtained relationship allows us to forecast Japan's market behaviour by monitoring exchange rates and U.S. market returns. The relationship is neither good nor bad for Japan's economy. Alas, when revealed, it allows us to perceive the extent and specifics of interconnection of the considered economies. Japan can employ the obtained results by adopting economic policies mitigating the impact of U.S. economic performance in periods of downturn. The statistical significance of U.S. market returns for Japanese market returns and the economy shows that Japan's economy could be vulnerable to the conditions in the U.S. markets and economy. This could be positive or negative for Japan's economy going forward, but it would depend on the performance of U.S. markets and economy as one of the major factors, which also shows the linkages between these two economies.

Japan has a positive trade balance since it has more exports than imports. When Japan has a lower exchange rate, it also helps to increase inflation, and so to reduce deflationary pressures. Exchange rates were a concern historically, and for the last three decades, up to early 2012, when Japan's currency appreciated to around US$0.72/Yen. Since then Japan's new Quantitative Easing (QE) and negative interest rate policy (NIRP) has depreciated the Yen compared to the U.S. dollar. This has been a positive effect, since both of these policies are relevant. Concerns still remain about the efficiency of these policies in the long run. There is a possibility that a trade war between the U.S. and China could be beneficial to Japan.

Conclusion

We aimed to answer the question of whether the Japanese market complies with the Efficient Market Hypothesis (EMH) for different time frames. In this paper it is analytically tested if the Japanese markets and economy have changed after the implementation of different attempts at quantitative easing (QEs) in addition to ZIRP and NIRP to curb deflationary impacts on equity markets.

This study basically attempts to test EMH, any difference for inflationary and deflationary time frames in general, and, specifically, if there were any change in Japan's equity market return based on the other world markets' performances. The ARDL model was developed based on the optimal lags from the selection of the variables based on the VIF multicollinearity analysis of the variables. Then long run and short run relationships were developed. These relationships and models were tested and validated by Durbin-Watson, ARCH LM, Breusch-Godfrey LM (bgodfrey), Ramsey RESET (ovtest), Cameron and Trivedi's (skewness, kurtosis and hetero) and Breusch-pagan tests. Table 4 shows all these post estimation results. Later, for all models, structural viability was tested with CUSUM and CUSUMSQ, which is shown Figure 1 for different time frames.

From the results, for all the time frames, Japan's markets are mostly efficient. In the short run, Correction Representation Model liquidity is significant for the earlier period, compared to the period 2008 to 2015. Similarly, the 10-year treasury rate also shows statistical significance. However, for the period 2008 to 2015, the exchange rate shows statistical insignificance, probably due to the Negative Interest Rate Policy (NIRP) of the Bank of Japan, in addition to the implementation of Q1, Q2 and Q3 from 2000 to 2013. Since the implementation of a double dose of QE and NIRP, Japan's market and economy have behaved better and shown some improvement.

At this time, Japan's markets and economy are showing some improvements after these policies, but the major issue of Japan's own demography has not been studied in this research. Other factors, going forward, could be: the impact of an increase in the Federal Funds Rate in the U.S. because Japan has very strong statistical significance to the U.S. equity markets and economy. With the increase of the U.S. Federal Fund Rate theoretically the Yen exchange rate could be changing in the right direction for the improvement of Japan's equity market and economy. Sovereign debt could also be an issue, but that is a global issue for most developed countries. A statistically significant factor for the recent time period for Japan's stock market and economy is the exchange rate with the USD, which should be in favour of Japan; if the Federal Reserve increases the Fed's fund rate, Japan would keep the Negative Interest Rate Policy in place. Good times could be ahead for Japan as long as this trend is in place. Risk should be managed and investment should be done carefully, keeping in mind any hiccups for the global and especially the U.S. economy in which yen could be considered a safe haven and the yen exchange rate could be against Japan's favour.

As far as the Efficient Market hypothesis is concerned, based on the short run results, we can claim that before 2008, Japan's market showed some inefficiency because such technical variables as liquidity were statistically significant. After 2008, the dependence of the market on this technical variable no longer exists anymore, which means that Japan's market could be considered as efficient from 2008 to 2015. For long run results it shows that Japan's market was efficient from 2008 to 2015. To continue, for long run results it shows that Japan's market is efficient because there is no statistical significance present for technical variables. In addition to Q_1, Q_2 and Q_3 and the Zero Interest Rate Policy (ZIRP) from 2000 to 2015, Japan's central bank had to implement a Negative Interest Rate Policy (NIRP) in order to improve Japan's market and economy because there still were deflationary pressures. In this way they were tackling both statistically significant variables of liquidity and exchange rate in Japan's favour. The presented analysis allowed us to discover that the statistical significance of liquidity is not present in the most recent period, which shows that after a brief time of inefficiency marked is again efficient. On the other hand, since liquidity is not an issue any more, and exchange rates have gone in Japan's favour, there is certain improvement in the stock market and economy. Anyway, Japan still needs to do more or wait more with these loose monetary policies to keep these trends in place to be completely out of deflationary pressure.

The research results let us conclude that the Efficient Market Hypothesis (EMH) is valid for the Japanese market. That finding allows us to state that a Zero Interest Rate Policy appeared to be efficient in terms that it facilitated curbing the negative impact of the long-term deflationary pressure on the Japanese economy. We claim further that a Zero or Negative Interest Rate Policy could be used in the future to resist deflationary pressure, in case such pressure appears again. Here we need to note that the *ceteris paribus* assumption has to be held. Our results have shown that for a very short period Japan's market was EMH inefficient when there was some liquidity issue around the 2002 time frame; perhaps that was the reason for policy makers starting the first tranche of Quantitative Easing. Since 2008, we can state that like most of the developed economies, Japan's markets are EMH efficient, which shows that the markets cannot be manipulative since dependence on fundamental variables is genuine; model results are significant. To conclude, economic policy tools, such as Quantitative Easing (QEs), a Zero Interest Rate Policy (ZIRP) or a Negative Interest Rate Policy (NIRP) allow, ultimately, the neutralising of imported deflationary pressures, when the Efficient Market Hypothesis (EMH) is valid. Since the interrelation of Japan's deflationary pressures with the U.S. market is revealed, and the validity of the Efficient Market Hypothesis is found, it could be claimed that research results provide Japan with theoretically tested practical tools for regulating its economy in periods of deflationary pressure. Such tools are a Zero Interest Rate Policy (ZIRP) or a Negative Interest Rate Policy (NIRP). Immediate application of those tools is recommended for extended periods of time, depending on the currency's competitiveness with its competitors, especially China and South Korea.

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