International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2017, 7(1), 46-55.

Detecting Asset Price Bubbles: A Multifactor Approach

André Tomfort*

Department of International Finance, Berlin School of Economics and Law, Badensche Str. 50-51, 10825 Berlin, Germany.
*Email: tomfort@hwr-berlin.de

ABSTRACT

Asset price bubbles and deep financial crises have occurred frequently over the past three decades. No wonder that decision makers are searching for ways to protect their economies. Recognizing price bubbles in time could be very helpful in this regard to implement counter measures such as higher interest rates, taxes or capital buffers. In this paper a solution to this problem shall be proposed: A multifactor valuation approach based on a discounted cash flow and a cointegration model that links asset prices with selected variables to determine the valuation of a market. In addition, the gaps of credit and private fixed investments to gross domestic product are measured to assess whether the economy is facing overleveraging and overinvestment. If the four measures lead to a clear picture, policy makers are advised to take action. An exemplary analysis has been done for the former bubbles in Japan, and in the US stock and housing market.

Keywords: Asset Price Bubbles, Cointegration, Credit and Investment Expansion
JEL Classifications: E44, G01, G 15, G 17

1. INTRODUCTION

Throughout the past 30 years a high frequency of sharp asset price increases with a following deep financial crisis occurred. Often these cases were regarded as asset price bubbles. Such bubbles happened in Japan in the late eighties, in several Asian countries in the late nineties, in many stock markets before the millennium, and in the real estate market in the US and in parts of Europe before 2007. All these bubbles have caused high social and financial costs and some of them have led to a long-lasting economic crisis. Most researchers, central bankers and investors believe that a major asset price bubble is not predictable (Issing, 2009). The policy conclusion is that countermeasures should only be taken after a burst of a bubble to limit the costs that have to be expected. This "laisser-faire" approach, however, is not without risks. Governments are becoming more and more indebted after every crisis and world financial markets have been flooded with central bank money to save the financial system. This liquidity is now vagabonding between different financial markets and may facilitate excessive risk-taking as described by Minsky (1986). Under these circumstances, a new bubble may occur at any time somewhere in the world and particularly emerging markets with limited market liquidity are vulnerable. Recognizing such price bubbles in an early stage could be very helpful to dampen them through effective countermeasures. In addition, a good timing is very important because countermeasures such as higher interest rates, taxes or capital buffers for banks and other financial institutions are costly and should only be raised if a crash and devastating crisis are looming. In this paper a solution to this problem shall be proposed: A multifactor approach that consists of a discounted cash flow (DCF) and a cointegration model that links asset prices with selected variables to determine the valuation of a market. In addition, the gaps of credit and private fixed investments to gross domestic product (GDP) are calculated to assess whether the economy is facing an overleveraging and overinvestment. If all four measures surpass their respective threshold value which is the 10-year average plus 50% of the standard deviation, policy makers are advised to take action. The 10-year time span was chosen because-from historical experience-we know that this often was the duration of a bubble formation process. A back-testing analysis will be presented for the housing bubble in Japan in the eighties and the one in the US after the millennium as well as for the technology bubble in the US stock market (USSM). The reason for that choice was that all three bubbles were of major size, caused high economic and social costs and happened in different markets. In contrast to most other studies in the field which are based on a large sized cross-sectional analysis, the chosen procedure is an inductive one. The advantage of that is two-fold: First, just major, "high-cost" bubbles will be included and not simple market overreactions to stress the strong speculative element in the bubble formation process, as well as the overleveraging and overinvestment in the economy that are typical for them. Secondly, the individual bubble analysis avoids certain losses of information that may happen in the aggregation process of a cross-country analysis. The most innovative element of this paper is the autoregressive-distributed-lag model for cointegration used as a valuation instrument. The main hypothesis is that large asset price bubbles can be detected in time to be able to take countermeasures.

The paper starts with a background discussion and a literature review followed by an empirical analysis that consist of a DCF model and an autoregressive distributed lag (ARDL) model to test for cointegration between asset prices and several macroeconomic or financial variables. Out of the resulting long-term variation coefficients a fundamental value has been derived. The differences of market prices from the two independently calculated fundamental values can be regarded as a bubble component. In a second step, the credit and investment-to-GDP gap will be measured to assess whether the bubble building in financial markets is reflected in a leveraging and investment boom in the real economy. At the end of every investigated price bubble a conclusion for policy advices will be given.

2. BACKGROUND

A first problem analysing asset price bubbles is that there is no commonly accepted view what an asset price bubble really is. Some authors already define an asset price bubble as a 10% deviation from a long-term price trend (Adalid and Detken, 2007). The most accepted definitions however, do not refer to numbers but to the characteristics of a bubble formation process. According to them, asset price bubbles contain a strong speculative element, the fundamental value will be at least partially neglected by investors, and a strong market correction has to be expected once the bubble bursts. In addition, the process of the bubble formation seems to be explosive and non-linear (Kindleberger, 2000 or Shiller, 2000). Of equal importance is that the bubble formation and risk-taking in financial markets is also reflected in the real economy in terms of leveraging and overinvestment. An asset price bubble that has not a strong impact on financing and investment decisions of corporations and private households should not be of major concern because its burst would cause only limited damage for the economy. In this paper, the focus shall be on major asset price bubbles that are of explosive nature and have the potential to cause high economic costs.

An early recognition of asset price bubbles would be of great use to allow monetary and fiscal policy as well as financial regulators to intervene in time and avoid high economic costs for the society. In the past, the idea of interventions of central banks was rejected by central bankers and mainstream academics (Bernanke and Gertler, 2001). The argument was that a central bank which successfully stabilises output and inflation would also smooth prices in financial markets. Empirical evidence, however, points into a different direction: In most of the major asset price bubbles inflation remained moderate until the final stage of the bubble. This was the case for the stock market bubble before the great depression, for Japan in the eighties, for the technology bubble before the millennium or for the recent bubble in housing markets. Another argument against central bank intervention is that central banks would not have the appropriate instruments available to fight asset price bubbles effectively. The effects of changes in interest rates and money supply on asset prices were too uncertain in terms of their impact and their time-lags (Ceccehett et al., 2000). In addition, many researchers doubted the capability of central banks or governments to recognise a bubble better than the overall market (Filardo, 2000). These concerns led to the so called Jackson Hole consensus which only favoured active central bank and governmental intervention once financial market prices have a strong and lasting impact on the inflation rate for goods and services (Borio, 2008). This is usually the case if a burst of a price bubble alters consumption and investment expenditures in the real economy. According to this view, intervention should only take place in a crisis to dampen its economic costs but not in a pre-emptive way. The consequences of such a policy strategy can be severe. If central banks only intervene in downturns and let the upswings run, then-in the long run-central bank balance sheets balloon and a dangerous liquidity overhang may be the result (Hoffmann, 2009). Dangerous, because in combination with an insufficiently regulated financial sector the liquidity overhang could be the foundation for the next even bigger price bubble in asset markets (Crotty, 2009 or Schnabl and Hoffmann, 2007). Another dilemma for central banks is that financial markets get used to this liquidity overhang-particularly through a corresponding high valuation of asset prices. In this case it will become difficult for central banks to withdraw that liquidity without causing a collapse of asset prices and economic activity. The current difficulty of the Federal Reserve to raise interest rates is a good example. Several authors confirm that the overall economic costs of an interventionist approach as proposed in this paper were significantly lower compared to the economic costs of a bursting bubble (Blanchard, 2000). This is also a very important conclusion for emerging economies. In countries with less developed financial markets the incentive for local agents is high to borrow money abroad and market liquidity is limited. This makes these countries particularly vulnerable for a bubble contagion.

Apart from monetary or fiscal policy measures, some regulatory instruments can be used to prevent an asset price bubble. Basel III, for example, provides the pro-cyclical capital reserve in order to hedge better against the risks of strong credit expansion, and a "funding ratio," which should reduce the risk of maturity transformation (Claessens and Kodres, 2014). The systemic risk that arises from asset price bubbles is also addressed by so called macro-prudential policies. Countercyclical capital requirements and dynamic loan loss provisioning could be powerful additional tools in this context. Both instruments require that that credit institutions must increasingly build up equity capital and provisions when their risks grow in line with their loan portfolio. The use of all these regulatory instruments has to be based upon a guideline. The proposed approach in this paper may be helpful in this respect.

3. LITERATURE REVIEW

Several empirical studies with regard to asset price bubbles gained broader attention. Jones (2014) was proposing a two-pillar-approach to bubble surveillance. The first one consists of a check whether risk premiums (RPRs) in financial markets are extraordinary low which is taken as a warning signal. The second pillar is referring to the level of market quantities such as issuance, trading activity, fund flows, and return expectations provided by surveys. Jones wants to provide an alternative approach to the ones that rely on monetary or credit data. Alessi and Detken (2009) researched for an early warning indicator with respect to asset price bubbles and financial crises using data for 18 Organization for Economic Cooperation and Development (OECD) countries between 1970 and 2007. They defined critical threshold levels and found that global measures for credit expansion are particularly useful in this respect. Gerdesmeister et al. (2011) were defining a composite indicator to predict asset price bubbles based upon a probit approach. For their indicator they used variables such as credit aggregates, the investment-to-GDP ratio, an interest rate spread, a house price growth gap and stock market price growth. They did their analysis for 17 OECD countries for the time span between 1969 and 2010 and found that their indicator had enough predictive power to justify pre-emptive measures. Detken and Smets (2004) have analysed stock market and real estate price bubbles for 18 OECD countries between 1970 and 2003. They used a cross-sectional cointegration procedure for their analysis. According to their approach a bubble was identified when asset prices deviated by more than 10% from their long-term trend. The cross-sectional approach was used to draw general conclusions out of their big sample of "bubbles." Their major findings were that money and credit supply are relevant factors for the bubble formation. They got evidence that a financial accelerator process was at work and that monetary policy was generally too expansionary in comparison to the Taylor rule during bubble phases. Investment booms went often along with asset price bubbles but inflation remained remote. Another important aspect of their study was that real estate market busts lead to significantly higher economic costs than stock market busts. Adalid and Detken (2007) investigated the impact of monetary shocks on asset price bubbles for OECD countries between 1970 and 2005. They used a specific VAR-technique to resolve the endogeneity problem of monetary policy. Adalid and Detken recognized 42 bubbles whereas again a difference of 10% of the actual price from the long-term trend was considered as a bubble. The analysis was done cross-sectional. The authors divided the whole bubble in a prosperity, boom and crises phase. For all of the phases the relationship between monetary variables, macroeconomic variables and asset prices were individually investigated. Major findings of this study were that money supply had a bigger impact on the bubble formation than credit growth. They also found evidence that a financial accelerator effect played an important role, that monetary policy was too generous, that an investment boom in the real economy and asset price bubbles were closely linked, and that Inflation remained relatively tame during the bubble periods. Economic costs of real estate price busts were significantly higher than the ones of stock market busts. Borio and Lowe (2002) did an asset bubble study for 34 countries for the years 1960-1999. They found that asset price bubbles followed a strong credit expansion and a high financial leverage in the banking and/or corporate sector. They also found evidence that inflation did not accelerate dramatically in bubble situations. They explained that somewhat surprising phenomenon with high productivity gains and with central banks that were able to anchor inflation expectations due to their credibility to ensure price stability. In contrast to the two previously mentioned studies, Borio and Lowe showed that cumulative credit growth has a higher explanatory power than just credit growth. They also found strong evidence that a combination of rising asset prices, a strong cumulative credit and investment expansion is particularly dangerous for the stability of a financial system. One of their important conclusions was that the mentioned indications are able to forecast the formation and burst of a future asset price bubble. Greiber and Setzer (2007) analysed the recent housing price bubble in the USA and some European countries by running a cross-sectional cointegration analysis. They were focussing on the impact of money supply on housing prices. According to their findings, money supply had a significant impact on housing prices while inflation remained tame during the bubble. Gurkaynak (2005) was investigating rational bubbles, detected by discounted dividend models. He came to the conclusion that these models were not successful to assess asset price bubbles. If time-varying discount rates or structural breaks were introduced, historical tests could not detect a bubble.

4. THE DCF MODEL

The fundamental price of real estate or stocks can be assessed by discounting the future expected rents/dividends.

$$P_{h/s} = \frac{\mathrm{Re}\,nts\,/\,Dividends}{i} \tag{1}$$

$P_{h/s}$ represents the fundamental price of a house or stock, and i the discount rate for which a typical mortgage rate (MGT) can be used. In the same way the fair value for the overall housing or stock market can be calculated as proceeded in this paper. In the academic discussion it remained doubtful whether cointegration based present value estimates work (Campell and Shiller, 1987). Therefore, the simple DCF-model was used in this paper. Its purpose was to indicate broadly the degree of a market overvaluation. Despite its limitations and its openness for different kinds of interpretation, it is still considered as a useful guide to assess whether the market is entering a speculative phase.

5. ARDL MODELS AND COINTEGRATION

The ARDL-model can be used to determine in a linear way the fair value of stock or housing prices if financial or macroeconomic variables can be found that are cointegrated. The resulting long-term equilibrium path can then be transmitted into a fundamental value for the asset markets. The cointegration methodology of Engle and Granger (1987) or Johanson (1995) demand explanatory variables of the same integration order. This would exclude a lot of potential variables and restrain the quality of a model. This problem can be avoided by working with the ARDL-methodology. It allows the use of variables with different orders of integration (Pesaran and Shin, 1999). For the distribution of the F-statistics two kinds of critical values are calculated. For the first one the variables are taken to be of integration order one and for the second one they are taken as zero order variables. These two kinds of values define a range that captures all possible integration assessments of the variables. If the critical value of the F-statistic is higher than the one of the defined range, the estimation does not require an exact determination of the integration order of the variables. Only if the critical value is located within the range, the order of integration has to be fixed in the model specification. The error-correction version of the ARDL-model is suited to test the significance of the explanatory variables and the degree of cointegration. The derived long-run coefficients which are selected by the Akaike information criterion or Schwarz-Bayes criterion can be used to calculate the fundamental value for housing and stock prices.

For Japanese housing market prices econometric pretesting delivered the results that the unemployment rate (UR), business failures (BFs), and business confidence (BC) could be cointegrated by assuming an integration order of one. The equation for Japanese housing prices is as follows:

$$JPHP = \alpha_o + \alpha_1 UR + \alpha_2 BF + \alpha_3 BC + \mu_t \tag{2}$$

The error correction model:

$$\begin{aligned}\Delta JPHP_t = \alpha_o &+ \sum_{i=1}^{n} \alpha_{1i} \Delta JPHP_{t-i} + \sum_{i=1}^{n} \alpha_{1i} \Delta UR_{t-i} \\ &+ \sum_{i=1}^{n} \alpha_{1i} \Delta BF_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta BC_{t-i} + \alpha_{4i} JPHP_{t-1} \\ &+ \alpha_{5i} UR_{t-1} + \alpha_{6i} BF_{t-1} + \alpha_{6i} BC_{t-1} + \mu_t\end{aligned} \tag{3}$$

For USSM prices before the millennium, econometric pretesting delivered the results that corporate profits (CPRs), the economic leading indicator (LI), capacity utilisation (CU), and bank lending (BL) were significant variables that could be cointegrated with the S&P 500 assuming an integration order of one. The equation for stock market prices in the US takes looks like that:

$$USSM = \alpha_o + \alpha_1 CPR + \alpha_2 LI + \alpha_3 CU + \alpha_4 BL + \mu_t \tag{4}$$

The error correction version:

$$\begin{aligned}\Delta USSM_t = \alpha_o &+ \sum_{i=1}^{n} \alpha_{1i} \Delta CPR_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta LI_{t-i} \\ &+ \sum_{i=1}^{n} \alpha_{3i} \Delta CU_{t-i} + \sum_{i=1}^{n} \alpha_{4i} \Delta BL_{t-i} + \alpha_{5i} CPR_{t-1} \\ &+ \alpha_{6i} LI_{t-1} + \alpha_{7i} CU_{t-1} + \alpha_{8i} BL_{t-1} + \mu_t\end{aligned} \tag{5}$$

For US housing prices measured by the Case-Shiller index econometric pretesting delivered the results that the BC, the credit gap (CGAP), the RPR, and MGTs could be cointegrated with housing prices assuming an order of integration of one. The equation for housing prices in the US is as follows:

$$CSI = \alpha_o + \alpha_1 BC + \alpha_2 CGAP + \alpha_3 RPR + \alpha_4 MGT + \mu_t \tag{6}$$

The error correction version:

$$\begin{aligned}\Delta CSI_t = \alpha_o &+ \sum_{i=1}^{n} \alpha_{1i} \Delta BC_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta CGAP_{t-i} \\ &+ \sum_{i=1}^{n} \alpha_{3i} \Delta RPR_{t-i} + \alpha_{4i} 4BC_{t-1} + \alpha_{5i} CGAP_{t-1} \\ &+ \alpha_{6i} RPR_{t-1} + \mu_t\end{aligned} \tag{7}$$

For all equation the null of no cointegration defined by $H_0 = \alpha_{4i} = \alpha_{5i} = \alpha_{6i} = 0$ against $H_1 = \alpha_{4i} \neq \alpha_{5i} \neq \alpha_{6i} \neq 0$ will be tested.

6. DATA

For the Japanese housing market monthly data from M1 1980 to M12 1992 was analysed, for the USSM monthly data from M1 1990 to M12 2000, and for the US housing market quarterly data from Q1 1990 to Q4 2009. In the first two cases, monthly data was used to densify the data before the burst of the bubble as much as possible. The ARDL-model for the US housing market required quarterly data and was therefore estimated over a time horizon of 19 years to include the necessary degrees of freedom. For the assessment of the results of the two valuation models as well as for the two gap calculations a 10-year rolling window was used. The 10-year time span was selected since we know from historical experience that the formation process of a major asset price bubble-from its beginning to its burst-takes about that time. Variables have been selected by proven financial or macroeconomic theories. All data was transformed into logarithms except interest rates. The augmented Dickey–Fuller test proved that the included variables had an integration order zero or one. The only exception was Japanese housing prices were the results varied between order one and two. For the following analysis it was assumed that they were of integration order one. All variables entered the calculation with their assessed integration order.

JPHP (nominal housing prices)	Japan Residential Property Prices, Index 1995=100, month-on-month change, not seasonally adjusted (n.s.a), Source: Bank for International Settlements
Rents	Japan, Housing Rent, Index, 2005=100, n.s.a. Source: Statistics Bureau, Ministry of Internal Affairs and Communication. To transfer that index into cash flows, rent figures in Yen from the Household Living Export were used. Source: Statistics Bureau, Ministry of Internal Affairs and Communication
Mortgage rate	Japan, Interest Rate on Building Society Mortgages, 10 years, Source: Oxford Economics
UR	Japan, unemployed rate, total, s.a., Source: Statistics Bureau, Ministry of Internal Affairs and Communication
BF	Japan, Corporate Bankruptcy, Total Cases, n.s.a., Source: Tokyo Shoko Research Ltd.

(*Contd...*)

BC index	Japan, Manufacturing, Composite Indicators, Manufacturing - Industrial Confidence Indicator, s.a., Source: Economic Indicators, OECD
Bank lending	Japan, Loans and Discounts, Domestically Licensed Banks, Yen, n.s.a., Source Bank of Japan. This time series was deflated by the GDP deflator, Source: Cabinet Office
Private fixed investment	Japan, Expenditure Approach, Gross Capital Formation, 2005 Chained Prices, n.s.a., Source: Cabinet Office
S&P 500	US Stock Market Capitalisation Index, monthly average, Source: S&P Dow Jones Indices
CPR	US National Income Account, Corporate Profits, with Inventory Valuation Adjustment and Capital Consumption Adjustment, Total, Current Prices, USD, s.a., Source: Department of Commerce
LI	US leading index, total, index, 2010=100, s.a., Source: The Conference Board
CU	US capacity utilization, total index, s.a., Source: US Federal Reserve
BL	US Assets and Liability of Commercial Banks, Loans and Leases in Bank Credit, USD, s.a., Source: US Federal Reserve. The time series was deflated by the Implicit Price Deflators for Gross Domestic Product: Index numbers, 2009=100, s.a., Source: Federal Reserve Bank of St. Louis
CSI (house price index)	United States, House Prices, Standard and Poor's Case-Shiller, National, Index, 2000 M1=100, Source: (www.econ.yale.edu/~shiller/data.htm)
BC	US BC measured by the Purchasing Manager Index, Source: ISM Institute
CGAP	US Assets and Liability of Commercial Banks, Loans and Leases in Bank Credit, USD, calculated as actual deviation from 10 year trend, Source: See bank lending
RPR	US risk premium, measured by the difference between the 3 months interbank rate and the treasury bill rate. Interbank Rate - 3 Month (London), Source: Reuters. Treasury Bill Rate - 3 Month, Source: Market Rates and Yields
10 year bond yield	US, Long-Term Government Bond Yields, 10-Year, Source: Main Economic Indicators, OECD
Rents	US, City Average, Consumer Prices, Rent, Primary Residence, Index, 1984=100, Source: Bureau of Labor Statistics. To transfer that index into cash flows, a rent from US Market Rent - Apartments (Units), USD, current prices was taken, Source: REIS Apartment, Office, Retail and Industrial Property Trends
MGT	US Mortgage lending rates, conventional mortgage points - 15 year fixed rate mortgage, Source: MBA - Mortgage Bankers Association of America
Private fixed investment	Real Gross Private Domestic Investment: Fixed Investment: Residential, Annual, n.s.a., Source: US Bureau of Economic Analysis

(*Contd*...)

UR: Unemployment rate, BF: Business failures, BC: Business confidence, MGT: Mortgage rate, RPR: Risk premium, CGAP: Credit gap, BL: Bank lending, LI: Leading indicator, CPR: Corporate profits, CU: Capacity utilisation

7. ESTIMATION RESULTS OF THE ARDL MODEL

The following variables for Japan turned out to be significant: The UR, the amount of BFs, and BC. The economic foundations for these variables are straight-forward. The level of unemployment is directly affecting the disposable income to finance housing. BFs were important because corporations were heavily invested in the real estate sector at that time so that a change of that figure had a significant impact on the demand for housing. In addition, the willingness of banks to finance housing activities of corporations was influenced by the overall amount of BFs. Business sentiment was impacting the readiness of corporations to invest in the housing market. The ARDL estimates were done for the time period from M1 1980 to M12 1991. The error correction version can be seen in Table 1a.

Table 1a shows that all explanatory variables were significant as indicated by their t-ratios and had the theoretically expected sign. The error correction term had significant negative variation coefficient. It was −0.135 suggesting that 13.5% of its distance from equilibrium will be reduced after a month. One can conclude that the explanatory variables were cointegrated with housing prices. This conclusion was confirmed in Table 1b by the F-statistic value of 5.479 which exceeded the critical 95% and 90% upper bound level. The R-squared showed a relatively high correlation, although it might have been somewhat distorted from the autocorrelation of residuals as indicated by the Durbin–Watson coefficient. The long run coefficients are shown in Table 1c.

The values in the first row are the long-term variation coefficients of the explanatory variables. In brackets the t-statistics can be seen. The explanatory variables had the expected sign and were significant. Based upon these results the fundamental value for the housing market can be estimated. It will be shown in Figure 1.

In econometrical pretesting for the USSM before the millennium, the following variables were selected for the cointegration model: CPRs, the LI for the economy, the measured CU, and the amount of BL. Theoretically, CPRs impact stock prices because they represent the potential cash flows that a stock investor could receive from her investment. The LI is showing the likely future course of the business cycle and is influencing RPRs and expected cash flows alike. The degree of CU is having a direct impact on the efficiency of capital through the fixed cost effect and it represents indirectly the amount of sales. Bank lending is important to finance investments and in economic boom times the amount of investments and corporate profitability are directly related to each other. The ARDL was estimated for the time period from M1 1990 to M12 2000. The error correction results can be seen in Table 2a.

From Table 2a it can be seen that all explanatory variables were significant as indicated by their t-ratios and had the theoretically expected sign. The error correction term had a significant negative variation coefficient. The explanatory variables were cointegrated with stock market prices. This conclusion was confirmed in Table 2b by the F-statistic value of 4.651 which exceeded the critical 95% and 90% upper bound level. The R-squared showed a meaningful correlation.

The autocorrelation of residuals did not seem to pose a problem. The long run coefficients are shown in Table 2c.

The values in the first row are the long-term variation coefficients of the explanatory variables. In brackets the t-statistics can be seen. The explanatory variables had the expected sign and were significant. However, some doubts have to be assessed with respect to the LI. Based upon these results, the fundamental value for the USSM before the millennium can be estimated. It will be shown in Figure 2.

Econometrical pretesting for the US housing market showed that the following variables could be cointegrated: The BC index, the CGAP, and the RPR. Theoretically, BC and housing prices are linked through sentiment and the overall economic conditions. A rising CGAP is indicating that financing houses becomes easier and credit conditions improve. It could also be an indication that a higher demand for housing is spurring credit growth. The level of the RPR is an indication for the risk perception in the banking sector and for the banks willingness to lend. The ARDL was estimated for the time period from Q1 1990 to Q4 2009.

According to their t-ratios in Table 3a, the explanatory variables were significant and had the hypothesized sign. The error correction term was highly significant as well, proving the cointegration. Its variation coefficient was −0.252 indicating that around 25% of the difference from equilibrium will be reduced after a quarter. From Table 3b can be seen that the F-statistic had a value of 10.134 - exceeding the upper bound levels. The R^2 confirmed the explanatory power of the model. The diagnostics statistics did not reveal any distortions. The long run coefficients of the ARDL model van be seen in Table 3c.

The values in the first row are the long-term variation coefficients of the explanatory variables. In brackets the t-statistics can be seen. The explanatory variables had again the expected sign and were significant. Based upon these obtained results, the fundamental value for the US housing market can be estimated. It will be shown in the Figure 3.

8. GRAPHICAL RESULTS

The dotted line in Figure 1 represents the DCF model results, the slashed line the ARDL-estimates, the continuous line the housing

Table 1a: ARDL (2,0,0,0) error correction estimation

Estimated variable	0.574* $dJPHP_{t-1}$	−0.197* dUR	0.067* dBF	0.419* dBC	−0.135* $ec1_{t-1}$
STDE	0.0739	−0.0058	−0.0351	0.2071	0.0273
T-R.	(7.76)	(−3.39)	(−2.52)	(2.02)	(−4.94)
Probit	(0.00)	(0.001)	(0.013)	(0.045)	(0.00)

Table 1b: Estimation and diagnostic statistics

R-squared=0.447		R-bar-squared=0.422	
F-statistics=17.63 (0.00)		DW-statistics=1.726	
F-statistic: 5.479			
95% Low. Bound/	95% Up. Bound	90% Low. Bound	90% Up. Bound
3.3202	4.433	2.774	3.830

Table 1c: Long-run coefficient estimates and diagnostics

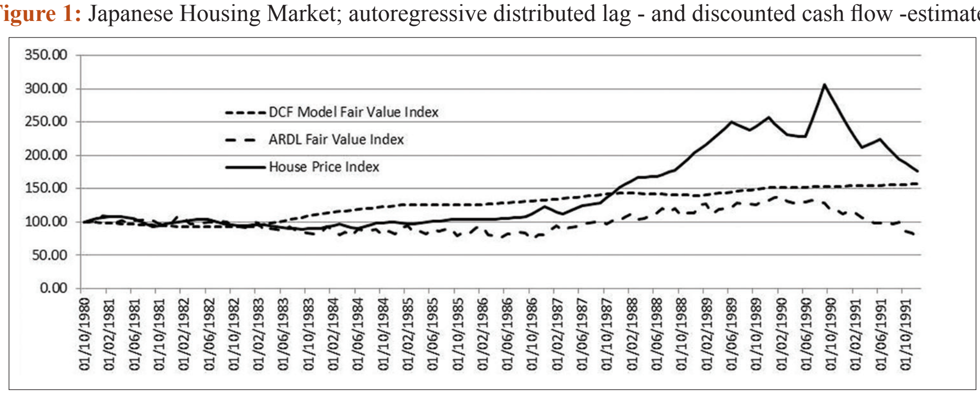
Constant	UR	BF	BC
0.01405 (3.72)	−0.146 (−3.23)	−0.496 (−3.20)	3.105 (2.39)

Table 2a: ARDL (1,0,1,2,0) error correction model

Estimated variable	0.368* dCPR	1.957* dLI	0.299* dCU	0.384* dCU_{t-1}	–0.433* dBL	–0.221* $ec1_{t-1}$
STDE	0.0948	0.3585	0.1047	0.1033	0.221	0.0454
T-R.	(3.88)	(5.46)	(2.86)	(3.72)	(1.96)	(–4.88)
Probit	(0.000)	(0.000)	(0.005)	(0.000)	(0.052)	(0.000)

ARDL: Autoregressive distributed lag

Figure 1: Japanese Housing Market; autoregressive distributed lag - and discounted cash flow -estimates



market. Both fair value estimates show that the housing market was extraordinary overvalued by a level of around 100%. Furthermore, the price bubble entered its final and explosive phase from 1988 onwards when market prices left the estimated values behind. The DCF results pointed towards a higher fair value than the ARDL-model. The advantage of an eclectic approach becomes visible at this point. Estimates may deliver quite different results, depending on the methodology and variables involved. If, however, two largely independent approaches indicate a strongly overvalued market, the confidence in such an assessment can be high. It is important to state that housing prices in the large centres of Japan such as in Tokyo or Osaka rose by a multiple of four in relation to the average countrywide housing price index used here. It can be fairly assumed that the degree of the asset price bubble was rather understated in this calculation.

The risk that Japan could run into a financial crisis was confirmed by the rising gaps of credit and investment relative to the GDP. The continuous line stands for GDP, the slashed line for credit expansion, and the dotted line for investments. Credit demand started to accelerate sharply in the late seventies and was likely to spur investments in housing and business equipment. As interest rates were still at high levels of 6% or higher, the sharp rise of credit was driven by the deregulation of the financial sector that took place at that time. In the course of the eighties the gap of credits to GDP became smaller despite the fact that interest rates were falling. However, it was existent until the bubble burst and contributed to its development. Usually one can expect that credit is expanding particularly fast in the last 3 years of the bubble formation when buying assets on margin seems very attractive. This was different in the Japanese bubble but the high ratio in the first two-thirds of the eighties was enough to fuel the bubble in asset markets as well as the overinvestment in the economy. Once a portion of the investment boom turns out to be loss-making in a recession, an operational and financial deleveraging will be forced in the private, corporate and banking sector alike. The more credit and investment rose in the boom phase, the deeper and longer the

Table 2b: Estimation and diagnostic statistics

R-squared=0.357		R-bar-squared=0.315	
F-statistics=11.28 (0.00)		DW-statistics=2.036	
F-statistic: 4.651			
95% Low. Bound	95% Up. Bound	90%Low. Bound	90% Up. Bound
2.957	4.113	2.501	3.577

Table 2c: Long-run coefficient estimates and diagnostics

Constant	CPR	LI	CU	BL
−0.0205 (−2.33)	1.663 (4.23)	0.477 (1.11)	0.238 (1.91)	1.953 (2.11)

Table 3a: ARDL (1,0,1,0) error correction model

Estimated variable	0.0937* dBC	0.1356* dCGAP	−0.0104* dRPR	−0.2520* $ec1_{t-1}$
STDE	0.0262	0.0408	0.0046	0.0604
T-R	(3.58)	(3.32)	(−2.23)	(−4.17)
Probit	(0.001)	(0.001)	(0.028)	(0.000)

Table 3b: Estimation and diagnostic statistics

R-squared=0.759		R-bar-squared=0.742	
F-statistics=45.35 (0.00)		DW-statistics=1.92	
F-statistic: 10.134			
95% Low. Bound	95% Up. Bound	90% Low. Bound	90% Up. Bound
3.412	4.566	2.847	3.882

Table 3c: Long-run coefficient estimates and diagnostics

Constant	BC	CGAP	RPR
0.0072 (1.09)	0.372 (2.86)	0.538 (2.95)	−0.148 (−3.08)

Figure 2: US stock market; autoregressive distributed lag - and discounted cash flow-estimates before 2000

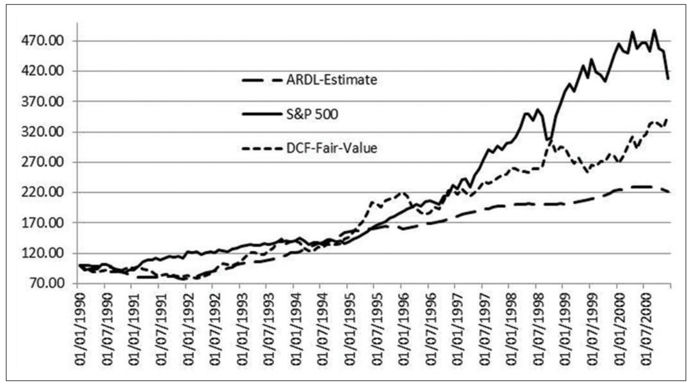


Figure 3: House price index, autoregressive distributed lag - and discounted cash flow-estimates for the US housing market

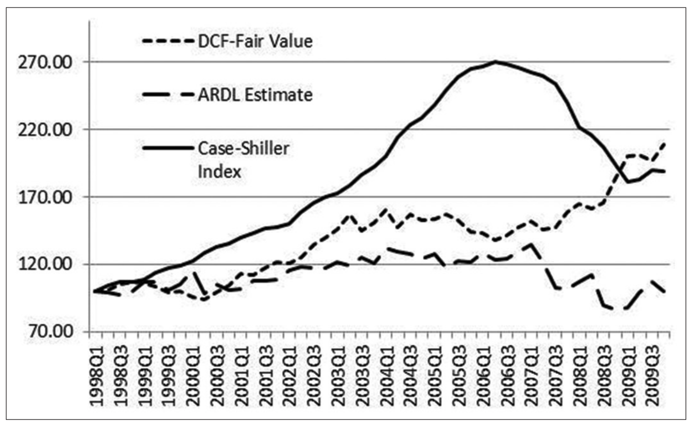


Figure 4: Credit and investment to gross domestic product gap in Japan before 1990

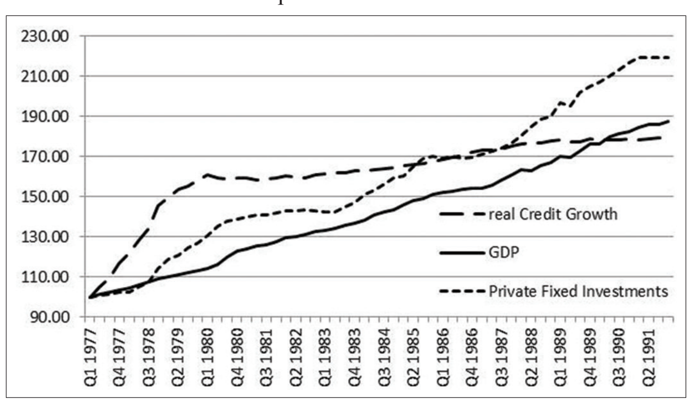


Figure 5: Credit and investment to gross domestic product gap before the US stock bubble

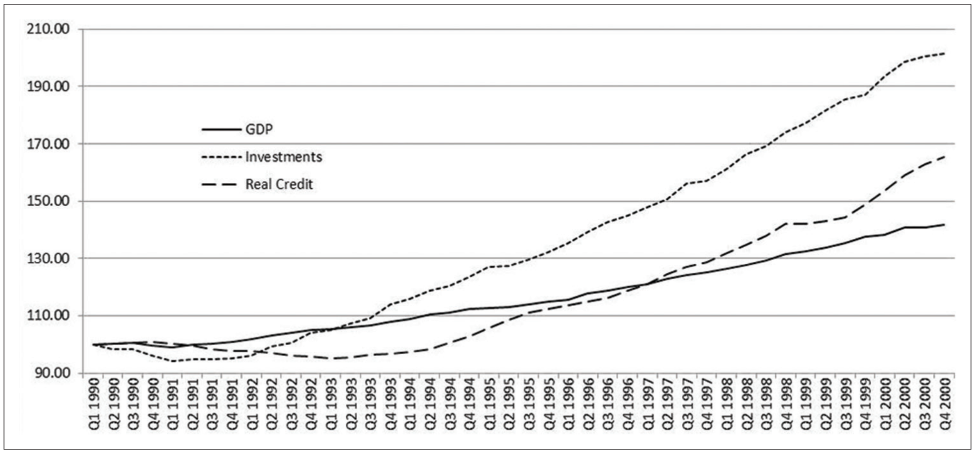
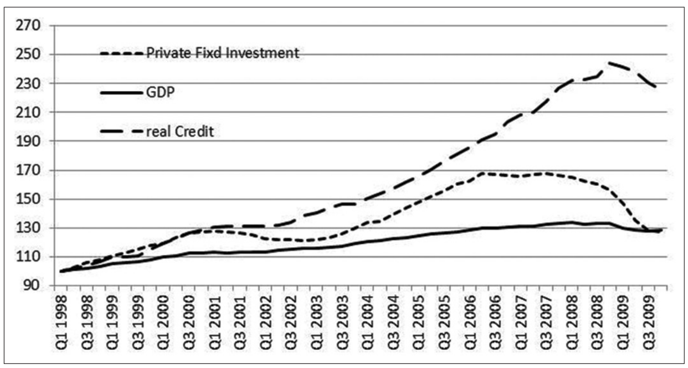


Figure 6: Credit and investment to gross domestic product gap before 2007



deleveraging process will last as well as its negative impact on economic growth. Japan suffered from two "lost" decades after the burst of the bubble (Weingarten, 2010). It became clear that from August 1988 onwards all four indicators were above the threshold value of the 10 year average plus half the standard deviation as it was defined in this paper. The central bank and the government would have had about 2 years to prevent the worst if the appropriate countermeasures would have been taken.

The dotted line in Figure 4 represents again the DCF model results, the slashed line the ARDL-estimate, and the continuous line the S&P 500. Both fair value estimates show that the stock market was overvalued by a margin of around 50-100%. The stock market bubble entered its final and explosive phase from 1997 onwards when market prices surpassed the estimated values. The DCF-results pointed towards a higher fair value since it was spurred by booming CPRs. However, a portion of these profits turned out to elusive and was rather a product of the stock market boom and not a reason. This was true for shares that led to rising asset values in corporations, and for investments that were only profitable as long as the economic upswing moved on. It can therefore be assumed that the DCF - approach was overstating the fair value to some degree. The ARDL - estimate was rising continuously, also pushed by CPRs and BL but held back by a relatively moderate CU, and a LI that remained remote due to the Asian crisis in 1997 and 1998 and rising interest rates afterwards. Again, the eclectic approach allowed a more differentiated view on the valuation of the market and both approaches pointed towards a potential stock market bubble before the millennium.

The risk of a potential asset price bubble was underlined by the rising gaps of credit and investment growth relative to the GDP as can be seen in Figure 5. The continuous line stands for GDP, the slashed line for credit expansion, and the dotted line for investments. In the early nineties, the saving and loan crises in the US and a negative economic environment held back particularly credits and to a lesser extent also investment demands. From the mid-nineties onwards, credits and more so investment demand were outpacing GDP continuously. Both time series were driven by high profit expectations while money supply and interest rates were not very supportive. Credits and investments surpassed GDP growth in 1997 and from mid - 1998 onwards, all four indicators left behind their threshold value of the 10-year average plus 50% of the standard deviation. The assessment that such a twin gap in combination with a highly overvalued financial market may lead to a severe financial crises was also confirmed for the USSM before the millennium. The central bank and the government had close to 2 years to slow down the bubble formation process and to avoid the at least some of the economic costs that followed. Despite the fact that the divergence of credit and investment from GDP was even larger than in the Japan, the economic damage in the years after the crash remained surprisingly remote. This was probably due to the aggressive delivering of US corporations, a more supportive reaction of the US central bank, and the fact, that private households remained less indebted than with a housing bubble.

The dotted line represents the DCF model results, the slashed line the ARDL-estimates, the continuous line the housing market. Both fair value estimates clearly show that the housing market was overvalued by more than 100% according to both fair value measures. The price bubble entered its final and accelerating phase from 2003 onwards when market prices left the estimated values clearly behind. The DCF-results pushed upwards in that time because of falling interest rates in the aftermath of the recession in the years 2000-2003 and continuously rising rents. The ARDL-estimate was influenced by an improving business climate, falling RPRs and an expanding credit demand. It was assuring that the estimation approaches led to similar conclusions. After the burst of the bubble, however, the two valuation measures diverged. The DCF-estimates continued to rise due to falling interest rates while rents were hardly affected by the following economic crises. The ARDL-estimate was dragged down because RPRs increased sharply, business sentiment dropped and credit conditions tightened.

Also in the case of the US housing market, the looming asset price bubble came along with rising gaps of credit and investment growth relative to the GDP as can be seen in Figure 6. The continuous line stands for GDP, the slashed line for credit expansion, and the dotted line for investments. Credits and investment demand were outpacing GDP continuously. The credit as well as the investment gap was driven by high capital gain expectations in the real estate market and accommodative interest rates (Taylor, 2008). The unavoidable delivering process after the burst happened in the financial sector and by private households. The economic costs were estimated to be three times the US GDP (Atkinson and Luttrell, 2013). Overinvestments in housing have caused a sharp break-down of housing activity and even 7 years after the crises has started the sector has not reached pre-bubble construction activity levels. The threshold value of the 10-year average plus 50% of one standard deviation was surpassed by all four indicators from the second quarter 2005 onwards. The Federal Reserve as well as the US government had again about 2 years to dampen this development through monetary policy, fiscal or regulatory measures and thereby to reduce the economic costs of the deleveraging process.

9. SUMMARY AND CONCLUDING REMARKS

The aim of this paper was to test an eclectic approach with respect to its ability to predict major asset price bubbles and following financial crisis in advance. Three of the major asset price bubbles in the more recent past were investigated. The approach included two largely independent valuation measures for the asset markets and a credit and investment gap calculation relative to GDP. The results show that in all cases the proposed approach was able to give a clear warning signal of about 2 years earlier before the burst of the bubble. This should be enough time for monetary, fiscal, and supervisory policies to take countermeasures to dampen the bubble and the corresponding boom in the real economy. The aim is to reduce economic and social costs once the unavoidable delivering process takes place.

In academic literature the gap analysis of this paper is largely supported. The DCF model - despite being somewhat controversial in this context - was sending out reliable signals. The ARDL model for cointegration was a truly innovative approach of this paper and provided accurate signals. As with every empirical investigation, the results are depending on the underlying time horizon. Here the assumption was that the development of a major asset price bubble lasts 10 years and therefore the chosen time horizon for the measurement of the indicators was also 10 years. The author proposes a rolling 10 year analysis for all markets that shall be covered with this approach. Overall, the impression is that the described approach has the potential to be a powerful detector of asset price bubbles and financial crises. Clearly, this approach has to be tested for much more markets and time spans to increase the confidence in its reliability. The author has done that to some extent for the housing markets in Spain, Hong Kong and Shanghai and received positive outcomes as well (Tomfort, 2012). However, this is not sufficient and more research is needed in this respect. Furthermore, there may be other instruments and tools that could be combined with the ones in this paper to improve results.

REFERENCES

Adalid, R., Detken, C. (2007), Liquidity shocks and asset price booms and bust cycles. ECB Working Paper Series No. 732. p4-36.

Alessi, L., Detken, C. (2009), Real time early warning indicators for costly asset price boom/Bust cycles. ECB Working Paper No. 1039. p4-36.

Atkinson, T., Luttrell, D. (2013), The costs and consequences of the 2007-09 financial crisis. Staff Papers Federal Reserve Bank of Dallas, 20, 1-4.

Bernanke, B., Gertler, M. (2001), Should central respond to movements in asset prices? AER, 91(2), 253-257.

Blanchard, O. (2000), Bubbles, liquidity traps and monetary policy. Institute for International Economics, 13, 1-14.

Borio, C. (2008), The financial turmoil of 2007 - A preliminary assessment of some policy recommendations. BIS Working Paper No. 251. p1-26.

Borio, C., Lowe, P. (2002), Asset prices, financial and monetary stability: Exploring the nexus. BIS Working Paper No. 114. p1-43.

Campell, J.Y., Shiller, R.J. (1987), Cointegration and tests of present value models. Journal of Political Economy, 95(5), 1062-1088.

Ceccehett, S.G., Genberg, H., Lipski, J. (2000), Asset Prices and Central Bank Policy, Geneva Reports on the World Economy. p1-133.

Claessens, S., Kodres, L. (2014), The regulatory responses to the global financial crises: Some uncomfortable questions. IMF Working Paper, WP/14/46. p4-34.

Crotty, J. (2009), Structural causes of the global financial crisis: A critical assessment of the new financial architecture. Cambridge Journal of Economics, 33(4), 563-580.

Detken, C., Smets, F. (2004), Asset price booms and monetary policy. ECB Working Paper, No. 364. p4-32.

Engle, R.F., Granger, C.W.J. (1987), Co-integration and error correction: Representation, estimation and testing. Econometrica, 55, 251-276.

Filardo, A. (2000), Monetary policy and asset prices. Fed of Kansas City Economic Review, 85(3), 11-37.

Gerdesmeister, D., Reimers, H.G., Roffia, B. (2011), Early warning indicators for asset price booms. Review of Economic and Finance, 1-19.

Greiber, C., Setzer, R. (2007), Money and Housing – Evidence for the Euro Area and the US. Deutsche Bundesbank Discussion Paper Series 1, No. 12/2007.

Gurkaynak, R.S. (2005), Econometric Tests of Asset Price Bubbles: Taking Stock. Finance and Economics Discussion Series. Washington, DC: Federal Reserve Board. p1-34.

Hoffmann, A. (2009), Asymmetric monetary policy with respect to asset markets. Oxford University Economics Studies, 4(2), 26-31.

Issing, O. (2009), Asset prices and monetary policy. Contribution to Cato Institute 26th Annual Monetary Conference, 11, 2008. p45-51.

Johanson, S. (1995), Liklihood Based Inference on Cointegration in the Vector Autoregressive Model. Oxford: Oxford University Press.

p1-267.
Jones, B. (2014), Identifying speculative bubbles: A two-pillar surveillance framework. IMF Working Paper, 14/208. p1-42.
Kindleberger, C. (2000), Manias, Panics, and Crashes. 4th ed. New York: J. Wiley & Sons.
Minsky, H.P. (2016), Stabilizing an Unstable Economy. 1st ed. New Haven, CT: Yale University Press.
Pesaran, H.M., Shin, Y. (1999), An autoregressive distributed lag modelling approach to cointegration analysis. In: Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium. Ch. 11/Cambridge University Press.
Schnabl, G., Hoffmann, A. (2007), Monetary policy, vagabonding liquidity and bursting bubbles, new and emerging markets – An overinvestment view. CES_{IFO} Working Paper No. 2100. p1-33.
Shiller, R. (2000), Irrational Exuberance. New York: Broadway Books.
Taylor, J.B. (2008), The financial crises and policy responses: An empirical analysis of what went wrong. NBER Working Papers No. 14631. p1-19.
Tomfort, A. (2012), Assessment of potential housing price bubbles in Hong Kong and Shanghai – An ecletic approach. International Review of Business Research Papers, 8(6), 1-14.
Weingarten, B. (2010), The cause of Japan`s boom and the reasons for its prolonged bust. LVM Working Paper. p1-15.