Estimating Financial Bubbles in Emerging Markets

Case of Turkey

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Motivation

- Financial markets are becoming ever more integrated which result in frequent comovements of stock price indices in emerging and developed countries. (Shiller, 1989; Epps, 1979; Bekaert, Hodrick and Zhang , 2009; Morana, 2008, etc.) Coupled with the fact that fundamentals differ substantially among emerging and developed markets, the finding suggests that high correlation of asset prices can not be explained solely by the fundamentals themselves.

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- While bubbles are frequently cited as plausible factors explaining the stock price movements within a single market, little attention has been paid to how bubbles originating in one country affect prices in another country.

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- While bubbles are frequently cited as plausible factors explaining the stock price movements within a single market, little attention has been paid to how bubbles originating in one country affect prices in another country.
- Few works on emerging market bubbles despite the large literature on bubbles.

Research Question

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- Can we establish a casual link between bubbles in an advanced economy and bubbles in an emerging market economy

Our Argument and What's New?

- Emerging market portfolios are held to a large extent by international investors therefore the positive and negative effects of market sentiments in one country might be transferred to another via the chains of asset positions. Bubbles might start and collapse on more than one market. Any bubble emanating from one country might spill over to another either simultaneously or with a time lag.

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- First study about the empirical link between bubbles in a large and a relatively small economy.

Results

- Show casual links between US and Turkish bubbles.
- We identify the shape and magnitude of bubble formation during major financial crises.
- Show that Unscented Kalman Filter performs better then previous methods in predicting price fluctuations.

Methodology

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- The success of our strategy relies on the hypothesis that we can successfully capture the size of the bubbles by our proposed methodology.

Rational Bubbles

- Consider the following standard present value model with risk neutral agents:

$$P_t = \frac{1}{1+r_t} E_t(P_{t+1} + d_t)$$

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- $P_t = \left(\frac{1}{1+r_t}\right)^2 E_t(P_{t+2} + D_{t+1})) + \frac{1}{1+r_t} D_t = \ldots =$
$\underbrace{\sum_{i=0}^{\infty} \left(\frac{1}{1+r_t}\right)^i E_t D_{t+i}}_{\text{Fundamentals}} \quad + \quad \underbrace{\lim_{i\to\infty} \left(\frac{1}{1+r_t}\right)^i E_t(P_{t+i})}_{\text{Bubble}} \quad (1)$

Rational Bubbles

- If the transversality conditions hold, i.e. $\lim_{i \to \infty} \left(\frac{1}{1+r_t}\right)^i E_t(P_{t+i}) = 0$ or if $E_t(P_{t+i})/P_t \leq 1 + r_t$ then $P_t = \sum_{i=0}^{\infty} \left(\frac{1}{1+r_t}\right)^i E_t D_{t+i}$.In this setup the bubble is not due to wrong pricing of the asset but it is a basic component of its price.

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- Standard assumptions of this literature: fixed returns due to constant discount rate, constant dividend growth (or constant divident process), risk neutral consumers, constant dividend price ratio, non-negative bubbles.
- The above assumptions make the estimation of bubbles problematic since the model of fundamentals is too simplistic.

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- Uncertainty about bubbles. Exogenous or intrinsic?
- For each time the hypothesis of bubbles is not rejected, there might be other fundamental processes that explain the price volatility.

Assumptions

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- State space setup is similar to Wu(1997) but bubbles are assumed to be stochastic and feature time variable parameters. The growth rate of the bubble is not necessarily constant. Bubbles are not observable but extracted from data by an unscented Kalman filter.

Model

- The model in state-space form is given by:
  $\Delta p_t = \Delta d_t + F\Delta Y_t + \Delta b_t + \varepsilon_t$
  $\Delta Y_t = A_t + (B - I)Y_{t-1} + \nu_t$
  $\Delta b_t = (1 - \rho_t)b_{t-1} + \gamma_t \Delta d_t + \eta_t$

where b_t is the bubble component, d_t real dividends and p_t are real stock prices in logarithm and γ_t captures regime shifts in the bubble process, ρ_t is a random walk and captures the non-linearity inherent in the bubble process.

$Y_t = (d_t, d_{t-1}, ..., d_{t-h+1})'$ is a h vector and

$B = \begin{pmatrix} \phi_1 & \phi_2 & \dots & \phi_{h-1} & \phi_h \\ 1 & 0 & \dots & 0 & 0 \\ 0 & 1 & \dots & 0 & 0 \\ \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & 1 & 0 \end{pmatrix}$ and F is of the same size.

Data

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- The data employed for Turkey has been taken from DataStream and ISE. All data is consolidated on monthly basis.
- Real stock prices are the nominal Standard and Poor's (S&P) 500 and ISE100 indices, deflated by the Consumer Price Index (CPI). Real dividends are the nominal dividends deflated by the CPI.

Algorithm

1)Obtain the order of the log-dividend process (ARIMA (2,1,0))
2)Run the unscented Kalman Filter and extract the bubble component.
3)Run causality tests on bubbles.

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- Extended Kalman Filter propagates the state distribution through the first order linearization of the nonlinear system. As a result of that the posterior mean and covariance could be corrupted.
- UKF uses a deterministic sampling approach so this problem is eliminated naturally. UKF estimates a nonlinear function of a random variable through a linear regression between n points drawn from the prior distribution of the random variable and it is a derivative free alternative to EKF.

Results

Table 1. ARIMA (2,1,0) Parameters.

	USA	Turkey
μ_0	0.001	-0.005
ϕ_1	0.828	0.104
ϕ_2	-0.102	-0.063

Table 2. Root Mean Square Error: Comparison with Alternative Models.

	This Model	Wu(1997)	Intrinsic Bubbles	Simple Present Value
RMSE%	4.02	4.33	21.38	39.97

Results

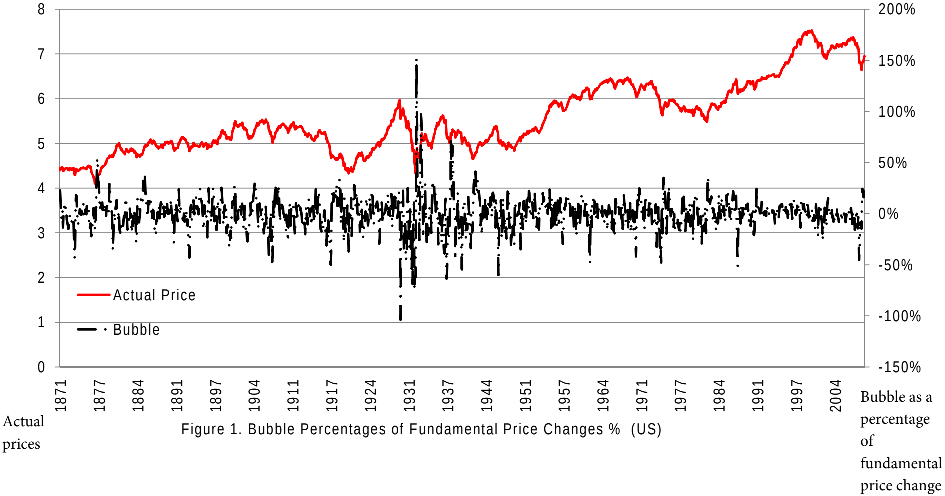

Figure 1. Bubble Percentages of Fundamental Price Changes % (US)

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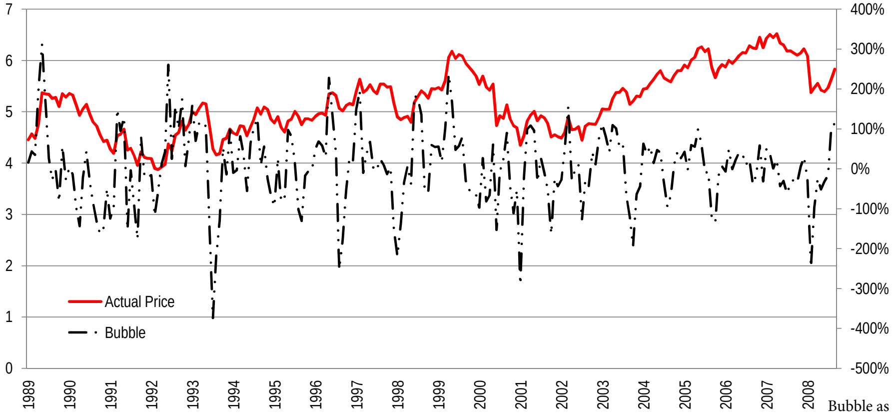

Actual prices

Figure 2. Bubble Percentages of Fundamental Price Changes % (TUR)

Bubble as a percentage of fundamental price change

A closer look at some episodes

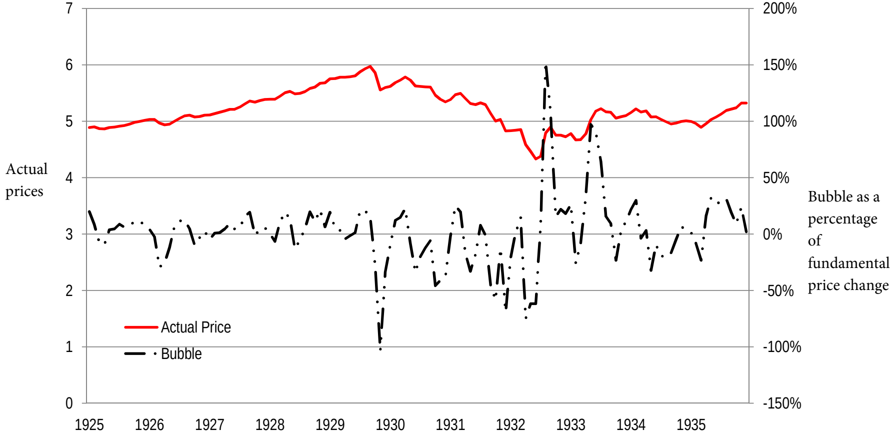

Figure 3. Great Depression (US)

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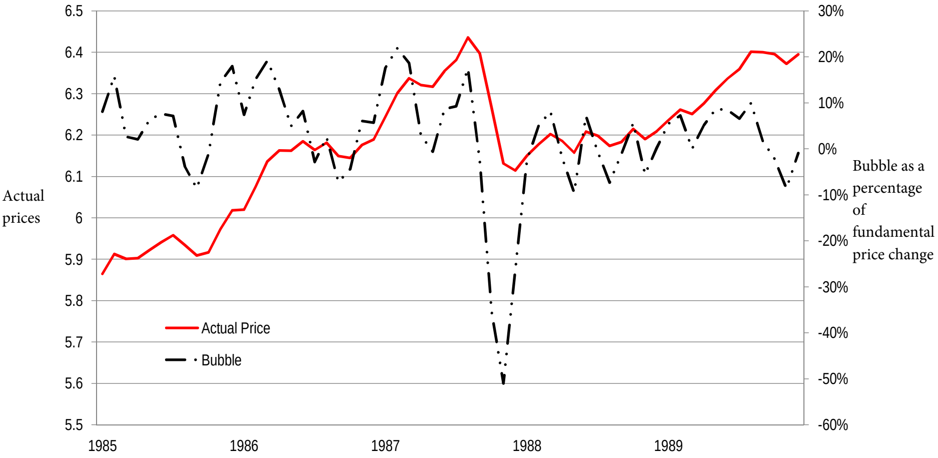

Figure 4. Black Monday (US)

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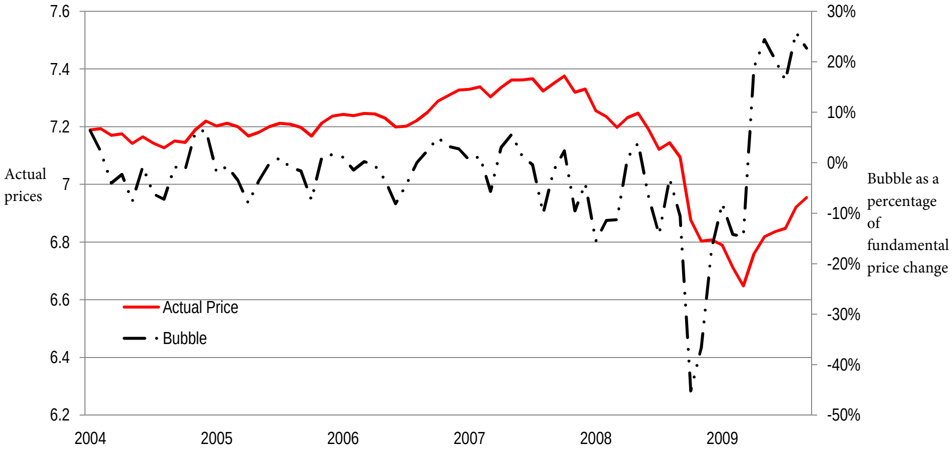

Figure 5. The 2008-09 Episode (US)

A closer look at some episodes

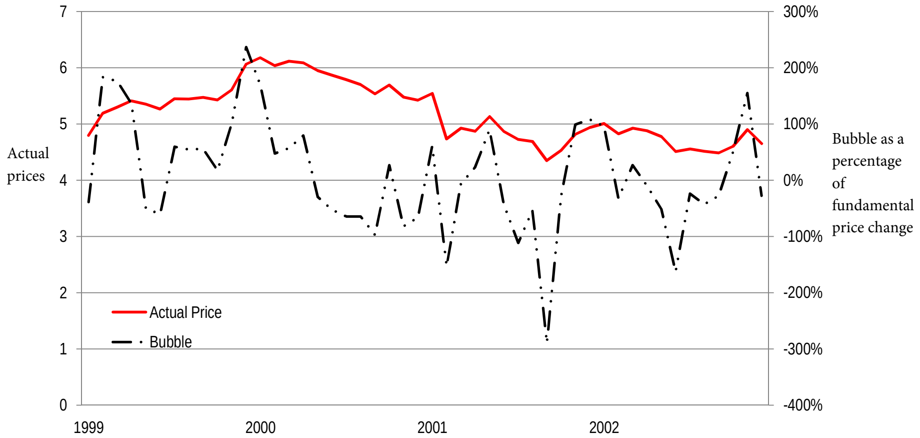

Figure 6. Crisis of 2001 (TR)

A closer look at some episodes

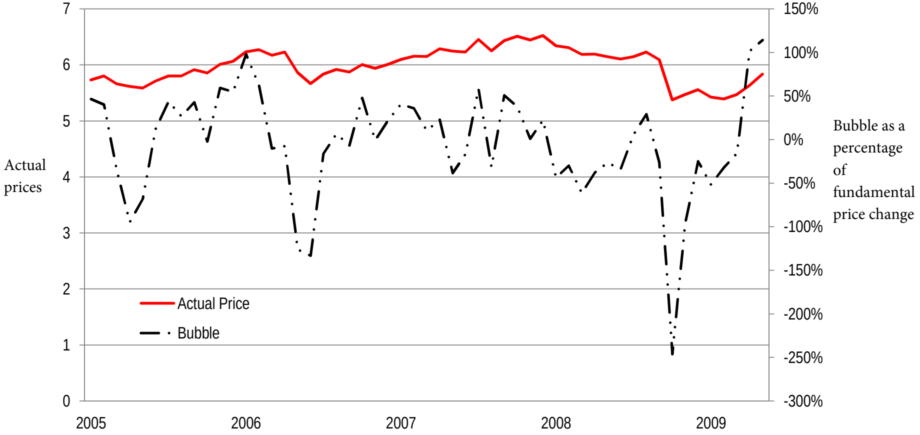

Figure 7.The 2008-09 Episode (TR)

Causality

Table 3. Granger Causality Tests: p-values.

Null Hypothesis	Lags 10	5	1
BTR does not Granger cause BUSA	0.690	0.574	0.458
BUSA does not Granger cause BTR	0.002	0.026	0.569
BTR does not Granger cause BWorld	0.877	0.991	0.793
BWorld does not Granger cause BTR	0.014	0.021	0.261

Literature. Where do we stand?

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- Cointegration tests based on long term relationship between stock prices and dividends Diba and Grossman(1987,1988), criticism by Evans(1991) and subsequent papers with periodically collapsing bubbles. (Hall et al.(1999),Van Norden and Vigfusson(1998))

Literature. Where do we stand?

- Intrinsic bubble tests where bubbles are at least partly determined by dividends. Froot and Obstfeld(1991) and Driffill and Sola(1998), Schaller and Van Norden(2002)). Driffill and Sola (1998) capture the main problem with bubble literature: The model with no bubbles and non-linear fudamental processes and the model with intrinsic bubbles but linear fundamental process have equal power. Bidarkota(2007) assumes a random walk for dividends but extends the innovations to dividend process to the family of stable distributions.

Estimating Unobserved Bubbles

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Estimating Unobserved Bubbles

- Producing times series of intrinsic bubbles. Wu (1997), Assumes ARIMA(2,1,0) for the dividend process. Prone to the same problems.

Literature. Where do we stand?

- Lau et al.(2005) use a Kalman filter estimate bubbles for Taiwan, Singapore, Korea and Malaysia under the classical assumptions. An important caveat with using the rational valuation model in emerging markets:

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- Dividend policy: Do all cash flows filter through dividend payout? If not, the bubbles are overestimated.

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- Bubbles are more pronounced during crises.
- There is a clear spill-over of bubbles from US to Turkey.

Further Research

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- Revisit the causality relationship