Fads versus Fundamentals In Farmland Prices: Comment

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In a recent article in this journal Falk and Lee (FL) employed a present-value model to study the dynamics of farmland prices in Iowa over 1922–1994. They decompose farmland prices into fundamental and nonfundamental components using a three variable vector autoregression model. The logged variables included are the change in real farmland rents, the change in rents less the real interest rate, and the spread between real farmland price and rent. FL find that nonfundamental shocks are an important source of volatility in farmland prices and that these price movements are due to fads not speculative bubbles. We argue to the contrary and provide evidence that supports a partially collapsing bubble.

In the finance literature both a fad and a bubble describe asset prices above (or below) what is considered to be the asset's fundamental market value. This component of the asset's price is sometimes called the nonfundamental price. One can think of a fad as when a large group of investors follow each other into the market. The nonfundamental price in this case is transitory although mean reversion can take a long time (statistically, it is usually modelled by a stationary autoregressive process). One can think of a bubble as when the anticipation of rising prices induces more market participants in the pursuit of short-term capital gains. Movements in asset prices reflect this behavior and become self-fulfilling prophecies of speculators. In this comment the nonfundamental price is made up of an explosive component if the bubble survives and a stationary component if the bubble collapses. Note in their footnote 2 FL mention fads and bubbles as descriptions of the behavior of the nonfundamental component of real farmland prices in Iowa. However, they do not statistically test which of these phenomena is more likely in the data but base judgement on impulse responses and variance decompositions.

The fads model developed by Summers can be investigated following Cutler, Poterba, and Summers by regressing the current periods return from investing in farmland, Δp_t, on last periods nonfundamental price, p_{t-1}^{nf},

$$(1) \quad \Delta p_t = -0.001 - 0.303 p_{t-1}^{nf}$$
$$(0.02) \qquad (2.46)$$

where the t-statistics are in parentheses.

Because the fundamental component of p_t is assumed to be a random walk, the slope coefficient in equation (1) gives a measure of the persistence of shocks to the nonfundamental component of p_t. FL kindly supplied us with their data and RATS code which we used to estimate equation (1). Thus our estimate of the nonfundamental price is also based on their present-value model and is the same as that produced by FL in panel D of their figure 2. The coefficient on the nonfundamental farmland price is significant and negative, indicating positive autocorrelation in the nonfundamental price but eventual mean reversion. One might use this as evidence supporting the fads interpretation in FL. However, van Norden suggests that regime-switching statistical techniques could be employed to test a variety of models of nonfundamental price behavior. These include not only the fads model but also the stochastic bubbles model of Blanchard and Watson as special cases.

Van Norden assumes that (a) there are two states of nature, one a high variance (bad, crash) state, C, and the other a low variance (good, survival) state, S; (b) the nonfundamental price will survive (collapse) with a probability $q(1-q)$; (c) the probability of the nonfundamental price's continued growth falls as the nonfundamental price grows; and (d) the nonfundamental price is expected

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to partially collapse in state C where the expected size of the collapse depends on the relative size of the nonfundamental price to the fundamental market price. The general regime-switching model that incorporates these assumptions is given by

$$(2)\quad \Delta p_t = \beta_{S0} + \beta_{S1} p_{t-1}^{nf} + e_t \qquad e_t \sim N(0, \sigma_s^2) \quad \text{with a probability of } q$$

$$(3)\quad \Delta p_t = \beta_{C0} + \beta_{C1} p_{t-1}^{nf} + e_t \qquad e_t \sim N(0, \sigma_c^2) \quad \text{with a probability of } 1 - q$$

and

$$(4)\quad \text{Prob(State at time } t = \text{S)} = q(p_{t-1}^{nf}) = \Phi\left(\beta_{q0} + \beta_{q1}\left(p_{t-1}^{nf}\right)^2\right).$$

The probability of the bubble surviving is bounded between 0 and 1 using the logit function $\Phi(\bullet)$.

The general regime-switching model nests the fads model as a special case. The slope coefficient in equation (2) should be equal to that in equation (3) if the data support the fads story, and the slope coefficient in equation (4) should not be significantly different from zero. Thus if the restrictions $\beta_{S0} = \beta_{C0} = \beta_0, \beta_{S1} = \beta_{C1} = \beta_1 < 0$, and $\beta_{q1} = 0$ hold, then nonfundamental farmland prices are mean reverting as in the fads model. Note this assumes that the fads model equation (1) has heteroscedastic errors. However, this assumption is reasonable considering that the residuals from estimated equations such as equation (1) are usually found to be heteroscedastic.[1]

Another solution to the present value model is an explosive one. Van Norden assumes that this will be the case in a period when a speculative bubble exists and is growing. As the bubble grows the probability of a collapse increases. This is an assumption based on many historical accounts of speculative periods. Thus it is assumed that farmland prices come from two distinct regimes where equation (4) classifies each regime. We note there are other ways to classify regimes such as Markov-switching but that is beyond the scope of this short comment. The slope coefficient in equation (2) should be greater than that in equation (3) and the slope coefficient in equation (4) should be significantly positive if the data support the bubbles story. The general regime-switching model only allows identification up to a renaming of parameters (i.e., one could swap the names of the two regimes). Van Norden shows that the partially collapsing bubbles model imposes either $\beta_{S0} \neq \beta_{C0}, \beta_{S1} > \beta_{C1}, \beta_{q1} > 0$ and $\sigma_C > \sigma_S$ or $\beta_{S0} \neq \beta_{C0}, \beta_{S1} < \beta_{C1}, \beta_{q1} < 0$, and $\sigma_S > \sigma_C$ on the general regime-switching model.

Finally note that if $\beta_{S1} = \beta_{C1} = \beta_{q1} = 0$ then farmland prices fluctuate randomly around their fundamental values. In this case the errors generating returns are assumed to be from a mixture of normal distributions with different means and variances. Van Norden labels this the normal-mixture model. Since we have assumed that the errors generating returns, e_t, have normal, independent, and identical distributions, the loglikelihood function for the general regime-switching model is given by

$$(5)\quad \sum_{t=1}^{T} \ln \left[\begin{array}{l} \left(1 - \dfrac{1}{1+e^{-\left(\beta_{q0}+\beta_{q1}\left(p_{t-1}^{nf}\right)^2\right)}}\right) \\ \bullet \dfrac{\varphi\left((\Delta p_t - \beta_{C0} - \beta_{C1} p_{t-1}^{nf})/\sigma_C\right)}{\sigma_C} \\ +\left(\dfrac{1}{1+e^{-\left(\beta_{q0}+\beta_{q1}(p_{t-1}^{nf})^2\right)}}\right) \\ \bullet \dfrac{\varphi\left((\Delta p_t - \beta_{S0} - \beta_{S1} p_{t-1}^{nf})/\sigma_S\right)}{\sigma_S} \end{array} \right]$$

where φ is the standard normal probability density function.[2]

We estimate the regime-switching model equation (5) and present the results in table 1. The fads and normal-mixture models are also estimated by imposing $\beta_{S0} = \beta_{C0} = \beta_0, \beta_{S1} = \beta_{C1} = \beta_1$, and $\beta_{q1} = 0$ and $\beta_{S1} = \beta_{C1} = \beta_{q1} = 0$, respectively, on equation (5). The p-values from likelihood ratio test statistics suggest that the fads and normal-mixture models can be rejected in favor of the general regime-switching model at the 5% significance level. The estimated coefficients in table 1 are consistent with

[1] The results from these Cutler, Poterba, and Summers type regressions are available from the authors upon request.

[2] The regime-switching model can be estimated by maximum likelihood using Gauss programs kindly supplied by van Norden and Vigfusson.

Table 1. Estimated General Regime-Switching Model

Coefficient Estimates	
β_{S0}	0.033
	(3.645)
β_{C0}	−0.182
	(3.081)
β_{S1}	−0.289
	(2.606)
β_{C1}	−0.578
	(2.277)
β_{q0}	−1.963
	(3.183)
β_{q1}	62.169
	(2.601)
σ_S	0.061
	(8.808)
σ_C	0.121
	(3.345)
Alternative model	Likelihood ratio test p-value
Fads	0.026
Normal-mixture	0.014

Note: t-statistics are in parentheses.

the $\beta_{S1} > \beta_{C1}, \beta_{q1} > 0$, and $\sigma_C > \sigma_S$ restrictions on the coefficients of the general regime-switching model and all of the coefficients are significant at conventional levels. These results suggest that the partially collapsing bubbles model provides a reasonable description of the dynamic movements in farmland prices in Iowa over the 1922–1994 period.

We can use the model to explore historical accounts of the speculative periods. Van Norden shows that the conditional probability of a crash in farmland prices in the next period can be calculated as

$$(6) \qquad \Pr(\Delta p_{t+1} < x) = \left(1 - q\left(p_t^{\mathrm{nf}}\right)\right) \bullet \varphi\left(\frac{x - \beta_{C0} - \beta_{C1} p_t^{\mathrm{nf}}}{\sigma_C}\right) + q(p_t^{\mathrm{nf}}) \bullet \varphi\left(\frac{x - \beta_{S0} - \beta_{S1} p_t^{\mathrm{nf}}}{\sigma_S}\right)$$

where $\varphi(\bullet)$ is the standard normal cumulative distribution function. We present these probabilities (dashed line) and the logarithm of real farmland prices (solid line) in figure 1. Given that point estimates are presented caution must be exercised interpreting these results. However, it is evident that the probability of a crash reached two peaks. In 1933 the probability of a crash in the following year was just over 50% and in 1934 real farmland prices in Iowa fell by nearly 50%. Again in 1982 the probability of a crash in the following year was just over 50% and in 1983 real farmland prices in Iowa fell by nearly 18%. Both of these falls were the two largest recorded falls in farmland prices in Iowa over the 1922–1994 period.

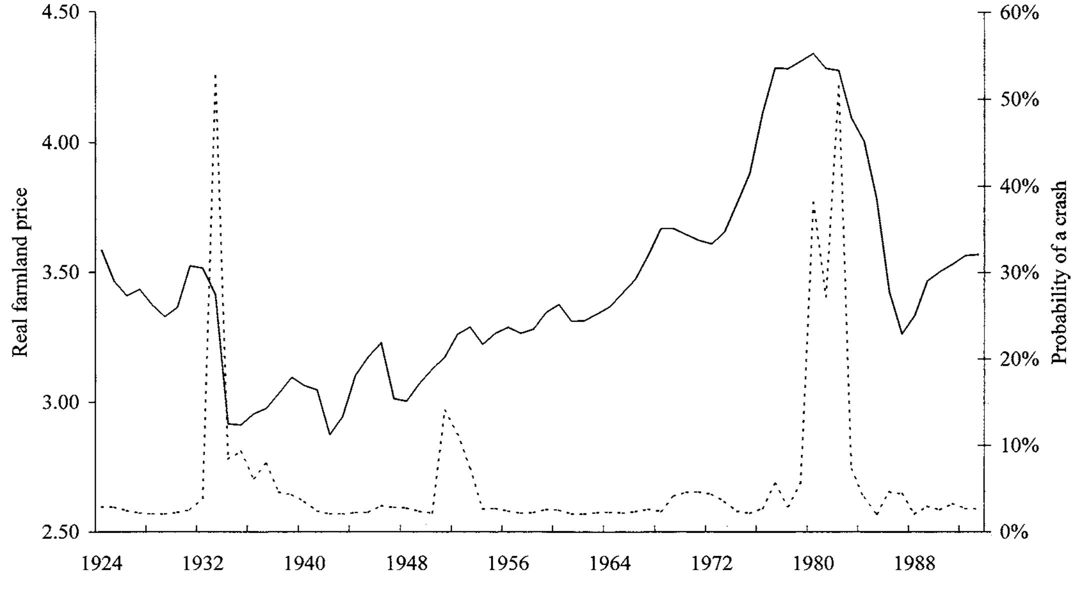

Figure 1. Estimates of the probability of a crash in farmland prices

FL may argue that farmland price and rents are cointegrated given that they found the spread between them to be stationary. This might be interpreted as evidence against a speculative bubble. However, this interpretation may be incorrect as Evans has shown that the stationarity tests overreject the presence of bubbles even when a bubble exists by construction. In addition, van Norden and Vigfusson have shown that their bubbles tests using regime-switching models have better finite sample properties than tests based on unit root and cointegration methodologies.

FL may also argue as in Flood and Hodrick that evidence of behavior predicted by a speculative bubble is not definitive proof that a bubble exists. If there were regime-switching in the economic model describing market fundamentals, then this would be observationally equivalent to the regime-switching model motivated by bubbles. However, while this may be true, if this is the case then the vector autoregression model in FL will not capture regime-switching in fundamentals either.

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