# Fads Versus Fundamentals in Farmland Prices: Comment

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**Abstract**

A trivariate vector autoregression time series process, based on a present-value land price model, is used to decompose Iowa farmland prices into fundamental and non-fundamental components. A recent study, by Falk and Lee (1998), found that non-fundamental shocks are an important source of volatility in farmland prices and it was interpreted that these price movements were due to fads not speculative bubbles. We argue to the contrary and use a regime-switching model to provide evidence that supports a partially collapsing bubble story of the dynamics of Iowa farmland prices.

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*Keywords*: Vector autoregression; Regime-switching; Farmland prices; Bubbles

In a recent article in this journal, Falk and Lee (FL) employ a present-value-model to study the dynamics of farmland prices in Iowa over 1922-1994. They decompose farmland prices into fundamental and non-fundamental 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 non-fundamental 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 non-fundamental price. One can think of a fad as when a large group of investors follow each other into the market. The non-fundamental price in this case is transitory although mean reversion can take a long time (statistically, it is usually modelled by a stationary auoregressive 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 behaviour and become self-fulfilling prophecies of speculators. In this comment the non-fundamental 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 behaviour of the non-fundamental component of real farmland prices in Iowa. However they do not statistically test which of these phenomenon 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, $\Delta p_t$, on last periods non-fundamental price, $p_{t-1}^{nf}$,

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

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 non-fundamental 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 non-fundamental 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 non-fundamental farmland price is significant and negative, indicating positive autocorrelation in the non-fundamental 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 non-fundamental 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 (a) that 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) that the non-fundamental price will survive (collapse) with a probability q (1-q); (c) that the probability of the non-fundamental price's continued growth falls as the non-fundamental price grows and; (d) that the non-fundamental price is expected to partially collapse in state C where the expected size of the collapse depends on the relative size of the non-fundamental price to the fundamental market price. The general regime-switching model that incorporates these assumptions is given by:

(2) $\Delta p_t = \beta_{S0} + \beta_{S1} p^{nf}_{t-1} + e_t, \quad e_t \sim N(0, \sigma^2_s)\ with\ a\ probability\ of\ q$

(3) $\Delta p_t = \beta_{C0} + \beta_{C1} p^{nf}_{t-1} + e_t, \quad e_t \sim N(0, \sigma^2_c)\ with\ a\ probability\ of\ 1-q$

and

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

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 non-fundamental 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:

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

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 favour of the general regime-switching model at the 5% significance level. The estimated coefficients in table 1 are consistent with 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) $$\Pr(\Delta p_{t+1} < x) = \left(1 - q\left(p_t^{nf}\right)\right) \bullet \varphi\left(\frac{x - \beta_{C0} - \beta_{C1} p_t^{nf}}{\sigma_C}\right) + q\left(p_t^{nf}\right) \bullet \varphi\left(\frac{x - \beta_{S0} - \beta_{S1} p_t^{nf}}{\sigma_S}\right)$$

where φ(•) 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.

INSERT TABLE1 AND FIGURE 1 ABOUT HERE.

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 over-reject 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.

## References


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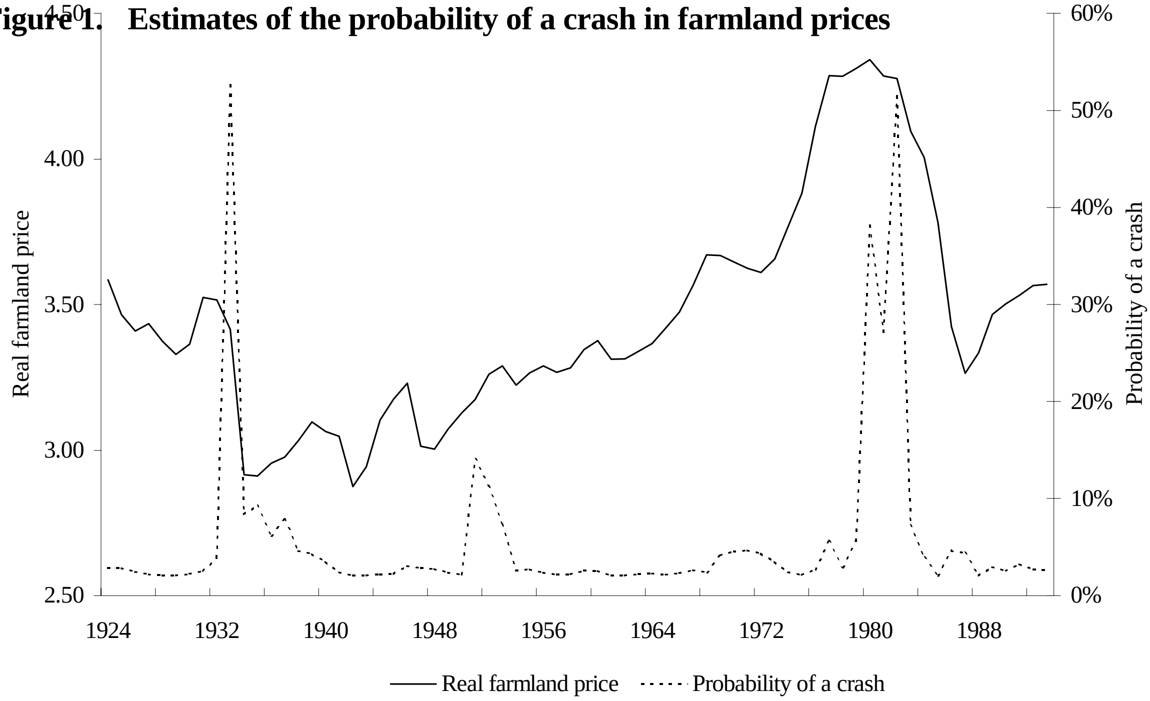
**Table 1. Estimated General Regime-Switching Model**

| | Coefficient estimates |
|---|---|
| $\beta_{S0}$ | 0.033 |
| | (3.645) |
| $\beta_{C0}$ | -0.182 |
| | (3.081) |
| $\beta_{S1}$ | -0.289 |
| | (2.606) |
| $\beta_{C1}$ | -0.578 |
| | (2.277) |
| $\beta_{q0}$ | -1.963 |
| | (3.183) |
| $\beta_{q1}$ | 62.169 |
| | (2.601) |
| $\sigma_S$ | 0.061 |
| | (8.808) |
| $\sigma_C$ | 0.121 |
| | (3.345) |

| Alternative model | Likelihood ratio tests p-value |
|---|---|
| Fads | 0.026 |
| Normal-mixture | 0.014 |

*Note*: *t-statistics are in parentheses.*

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



**Note**

[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.