How Scary Are Food Scares? Evidence from Animal Disease Outbreaks

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INTRODUCTION

Recently, livestock commodities have displayed **considerable volatility in financial markets**, making it more **difficult for producers to use futures markets** to hedge against price risks.

Some of the most significant impacts have come from animal disease outbreaks, such as **BSE and H1N1**.

Unfortunately, BSE and animal flu strains have not been eradicated, thus presenting an **ongoing threat to society and the economy**.

Through understanding the dynamics of commodity prices during disease outbreaks, this study will **guide policymakers in implementing price stabilization measures** and elucidate the behavior of derivatives during food scares in general.

We estimate the impact of **four disease outbreaks** on **futures market returns and variances in the United States,** while incorporating **volatility spillover effects**. We further include the **impacts of livestock reports** and evaluate the average

BACKGROUND

The economics of food scares

- There is a vast literature on the economic impact of food safety and animal diseases and economic growth (Paiva, 2003; Thomsen and McKenzie, 2001; Lusk and Schroeder, 2002).
- H1N1 yielded a $200 million market revenue loss for the pork industry over a four month span, while the 2003 BSE outbreak in the U.S. significantly reduced beef sales for nearly three months (Attavanich et al., 2011; Schlenker and Villa-Boas, 2008).

Food scares and financial markets

- U.S. live cattle futures were affected by U.K. BSE events (Paiva, 2003).
- BSE link to human health causes drop in equity for various sectors, including beef, pet food, animal feed and dairy (Henson & Mazzochi, 2002).
- BSE outbreaks in Spain caused serious price adjustments for producers (Hassouneh, 2010) and changed farm-level price volatility (Serra, 2011).
- 2003 Canadian and U.S. BSE cases increased volatility of nearby live cattle futures contracts and decreased prices for several months (Jin et al., 2008).

Animal disease timeline

- May 20, 2003 – Angus cow in Northern Alberta (BSE)
- December 23, 2003 – Holstein cow in Washington state (BSE)
- April 24, 2009 – H1N1 flu epidemic
- July 24, 2012 – California dairy cow (BSE)

OBJECTIVES

To assess the economic impact of four serious animal disease outbreaks:

- What was the economic impact on live cattle and lean hog futures prices following three North American BSE cases and one H1N1 flu event?

To identify the time horizon of the outbreak impacts:

- Were the impacts different for nearby compared to deferred contracts?

To identify presence of other common factors influencing livestock markets:

- Were the variances affected by livestock reports and the variance of a substitute commodity?

METHODOLOGY

Return Model:

$$R_t = \alpha + \sum_{p=1}^{P} \phi_p R_{t-p} + \beta_1 CN2003_t + \beta_2 US2003_t + \beta_3 US2012_t + \beta_4 H1N1_t + \varepsilon_t$$

where

- R_t: continuously compounded return on livestock (cattle--LC or hog--LH) futures (nearby--NB or deferred--DF) on day t calculated as $R_t = 100 \times \ln(P_t/P_{t-1})$
- P = 3 for deferred lean hog (DF LH); P=1 for the rest (NB LC, NB LH, DF LC)
- $CN2003_t$, $US2003_t$, $US2012_t$, & $H1N1_t$: outbreak dummy variables with event windows [0, 5], [0, 10], [0, 15], [0, 30]
- Model is estimated for each futures contract and each event window separately

Variance Model:

$$\hat{\varepsilon}_t^2 = \mu + \lambda_1 CF_t + \lambda_2 HP_t + \delta_1 CN2003_t + \delta_2 US2003_t + \delta_3 US2012_t + \delta_4 H1N1_t + \eta_1 Mon_t + \eta_2 Tue_t + \eta_3 Wed_t + \eta_4 Thu_t + \psi_1 Q1_t + \psi_2 Q2_t + \psi_3 Q3_t + \zeta \hat{\varepsilon}_{\ell,t-1}^2 + \theta \hat{\varepsilon}_{t-1}^2 + \gamma \omega_{t-1} + \omega_t$$

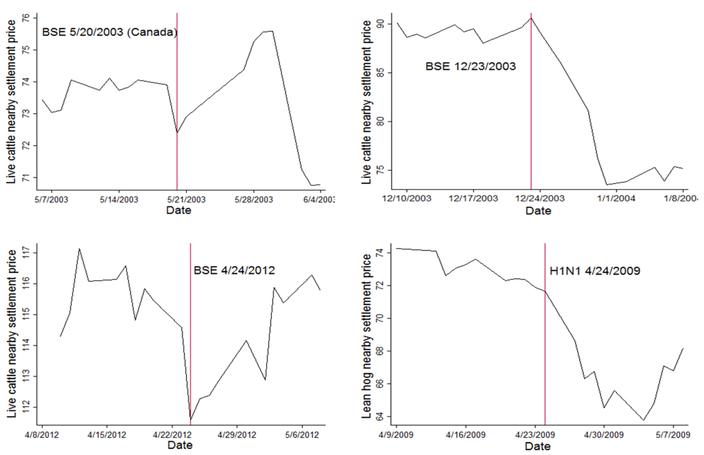
where

- $\hat{\varepsilon}_t^2$: the squared residuals from the return equation
- CF_t & HP_t: Cattle on Feed and Hogs and Pigs reports
- $\hat{\varepsilon}_{t-1}^2$ & ω_{t-1}: Autoregressive and moving average terms
- $Q1_t$, …, $Q3_t$ & Mon_t, …, Thu_t: Quarterly and weekly dummy variables
- $\hat{\varepsilon}_{\ell,t-1}^2$: Spillover effect where ℓ identifies the substitute commodity
- Predicted variances from the above estimation are used in the weighted least squares estimation of the return model.

DATA

Futures Prices - Livestock futures contracts are traded at the **CME Group**

- **Live cattle and lean hog** contracts both represent **financial instruments** for live animals ready for slaughter.
- **Nearby Series**: Contracts expiring in 2 to 3 months
- **Deferred Series**: Contracts expiring in 7 to 8 months



RESULTS

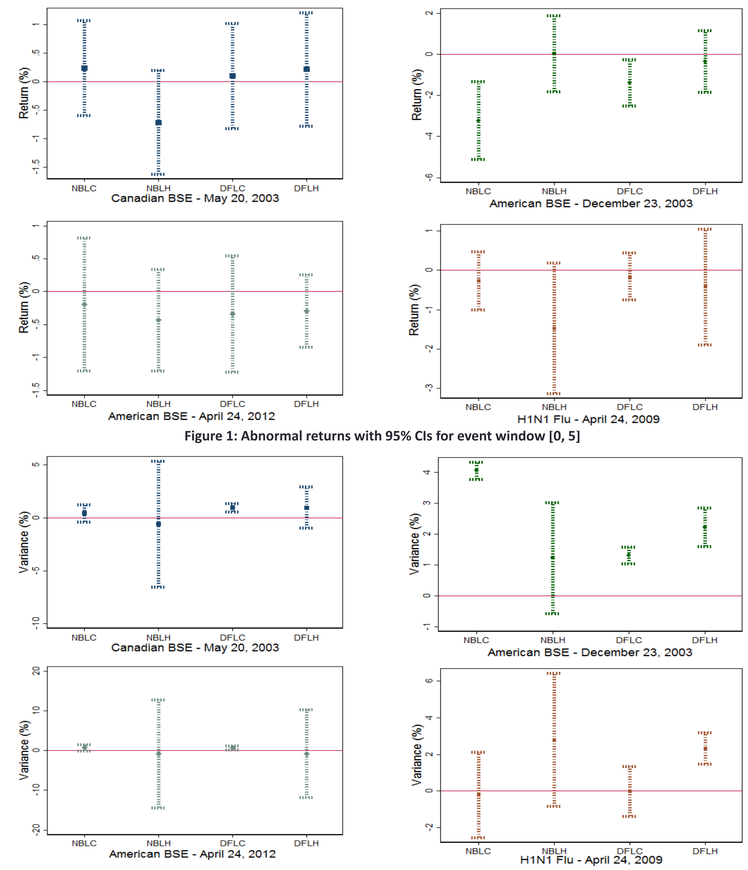


Figure 1: Abnormal returns with 95% CIs for event window [0, 5]

Figure 2: Abnormal variances with 95% CIs for event window [0, 5]

Table 1: Abnormal variances from spillover effects and livestock reports for event window [0, 5]

	NBLC	NBLH	DFLC	DFLH
$\hat{\varepsilon}_{\ell,t-1}^2$	-0.011*	0.051	0.005	0.078***
HP	0.253**	0.695*	0.106	2.129***
CF	0.123	-0.170	0.136**	0.105

CONCLUSIONS

Overall, livestock futures markets **are affected** during animal disease outbreaks; however, impact is **greatest in shorter time horizons**.

Negative abnormal returns occur in nearby & deferred live cattle during 2003 BSE event in the U.S., while **nearby hog returns are adversely affected** (at the 10% significance level) throughout H1N1 flu epidemic.

The **variance of nearby futures contracts, on average, increased** following American 2003 and 2012 BSE outbreaks, and during the H1N1 outbreak.

The **2003 U.S. BSE case had the largest impact** on live cattle variance.

Although impacts were substantial for both commodities, the **market response was greatest for nearby returns** during disease outbreaks, suggesting transitory impacts.

There is a **positive volatility spillover** from deferred cattle to hog futures, but a **negative spillover** from nearby hog to cattle futures.

Hogs and Pigs report has a **positive volatility impact**, while Cattle on Feed only affects volatility of deferred cattle futures.