

# Potential for Technical Cooperation Biofuels Project

# Technical Topics

## Nonlinear Regression Models:

Standard univariate models

Stochastic and nonparametric frontiers

Grafted Polynomials (splines)

Multivariate responses (GMM methods)

## Time Series Methods

VARMA processes

Markovian representations

Cointegration and Error correction models

# Evaluating Crop Substitution: An Empirical Approach Involving Sugarcane, Soybean, Beef and Corn

Empirical assessment of the relationship between the relative use of Brazilian agricultural areas in the production of soybean, beef, corn and sugarcane as a function of relative prices and other economic constructs.

$$\left(\frac{q_i}{q_j}\right)_t = \gamma \exp\{\delta t\} \left(\frac{p_i}{p_j}\right)_t^\alpha c_t^\beta r_t^\lambda \epsilon_t$$

- .  $i$  and  $j$  denote crops,
- .  $q_i$  and  $q_j$  are cultivated areas.
- .  $p_i$  and  $p_j$  are crop prices.
- .  $c_t$  is the nominal exchange rate.
- .  $r_t$  is the nominal interest rate,
- .  $t$  is time
- .  $\epsilon_t$  is a positive random shock.
- .  $\gamma$ ,  $\delta$ ,  $\alpha$ ,  $\beta$ , and  $\lambda$  are unknown parameters.

- ✓ There is no statistical evidence that sugarcane agricultural area is invading significantly the agricultural areas of beef, soybean and corn as a function of the respective relative prices;
- ✓ Marginally significant substitution effects are noticed between soybean and corn and sugarcane and corn;
- ✓ The occupation of degraded areas of pastures by the sugarcane observed in the recent past in the south of Brazil, typically in São Paulo, is not strong enough to change the regression results involving beef and sugarcane;
- ✓ if the price of soybean relative to sugarcane favors soybean then this culture will tend to invade sugarcane areas (historical trend).

## The Meat Market in Brazil

A partial equilibrium model for the meat market is fit to Brazilian data by three stages least squares. The model is consistent with the data and may be used for simulation purposes. In this context we compare model simulations for the near future with the OECD/Aglink outlook. To illustrate using the model for simulations in policy assessments, we investigate the **effect of a relative increase in corn price on the poultry and pork markets, *ceteris paribus***.

# Basic Model

$$\begin{cases} q_c = f(p, p_s, i, pop, ex, v) + \varepsilon_1 \\ q_p = g(p, p_{in}, r, u) + \varepsilon_2 \\ ex = k(p, c) + \varepsilon_3 \end{cases}$$

where  $q_c$  is the demand function,  $q_p$  can be considered as the supply function,  $ex$  denotes exports,  $p$  is own price,  $p_s$  is a price vector of substitutes,  $i$  is *per capita* income,  $pop$  is population,  $v$  and  $u$  are covariates or lagged values of consumption or production,  $p_{in}$  is a vector or index of input prices,  $r$  is the (Brazilian - Selic) interest rate,  $c$  is the exchange rate, and the  $\varepsilon_l$  are non observable errors. All variables measured in natural logs.

Conclusions:

Conservative predictions (OECD/Aglink).

The effect of a relative 1% price increase in corn price:

poultry market: the domestic demand would decrease by 1.05%, production would increase by 0.54% and exports would increase by 1.02%.

pork market: domestic demand would decrease by 0.088%, production would increase by 0.36% and exports would increase by 0.87%.

## Multivariate Time Series

The present work studies the three products composing the soybean complex: grain, meal and oil. The forecasts are generated using the Markovian representation of stationary vector auto regressive moving average time series. The analysis is carried out for production, consumption, exports and price of exports. The series were observed in 1972-2008.

The state space representation of a multivariate time series  $x_t$  of dimension  $r$  has the form

$$z_t = Fz_{t-1} + Ge_t$$

where  $z_t$  it is a stochastic vector process of dimension  $s > r$ , whose first  $r$  components coincide with  $x_t$  and the other  $s - r$  components contain all the necessary information for the forecast of future values of  $z_t$ .  $F$  is a transition matrix  $s \times s$ ,  $G$  is  $s \times r$  and  $e_t$  it is an error vector of dimension  $r$ . The sequence  $e_t$  it is a multivariate white noise with zero mean and constant variance-covariance matrix  $\Sigma$ .

Typically the parameters of the state space representation are estimated by maximum likelihood assuming a multivariate normal distribution for the shocks.

## Poor Level Consumption Basket

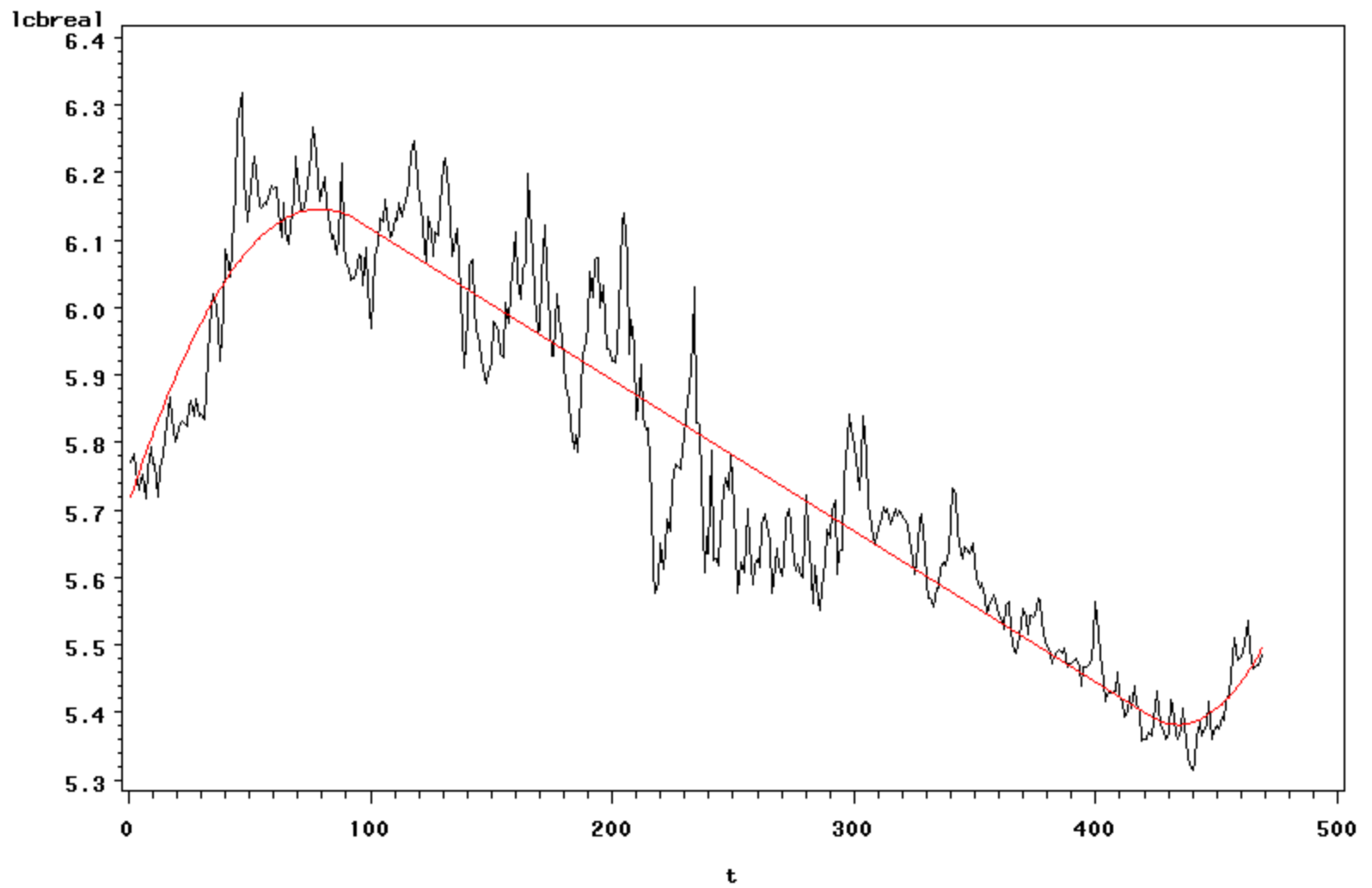
- . Nonlinear Model with time series errors
- . Unknown join points

Model:

$$y_t = \alpha + \beta t + \delta T_2(\gamma - t) + \rho T_2(t - \phi) + \epsilon_t$$

$$T_2(z) = I(z > 0)z^2$$

$$\epsilon_t = \sum_{i=1}^r a_i \epsilon_{t-i} + u_t$$



| Equation | DF Model | DF Error | SSE    | MSE     | Root MSE | R-Square |
|----------|----------|----------|--------|---------|----------|----------|
| lcbreal  | 11       | 458      | 0.7806 | 0.00170 | 0.0413   | 0.9756   |

| Parameter  | Estimate | Approx Std Err | t Value | Approx Pr >  t |
|------------|----------|----------------|---------|----------------|
| t1         | 6.340838 | 0.0502         | 126.39  | <.0001         |
| t2         | -0.00224 | 0.000182       | -12.30  | <.0001         |
| t3         | -0.00007 | 0.000025       | -2.66   | 0.0081         |
| t4         | 95.04463 | 18.5232        | 5.13    | <.0001         |
| t5         | 422.2723 | 30.8754        | 13.68   | <.0001         |
| t6         | 0.000094 | 0.000133       | 0.71    | 0.4804         |
| lcbreal_l1 | 1.007293 | 0.0465         | 21.67   | <.0001         |
| lcbreal_l2 | -0.19432 | 0.0661         | -2.94   | 0.0034         |
| lcbreal_l3 | 0.011737 | 0.0667         | 0.18    | 0.8604         |
| lcbreal_l4 | -0.05113 | 0.0661         | -0.77   | 0.4395         |
| lcbreal_l5 | 0.106659 | 0.0465         | 2.29    | 0.0223         |

#### Test Results

| Test | Type | Statistic | Pr > ChiSq | Label |
|------|------|-----------|------------|-------|
|      | Wald | 0.50      | 0.4800     | t6=0  |
|      | L.R. | 4.69      | 0.0303     | t6=0  |
|      | L.M. | 4.78      | 0.0288     | t6=0  |

# Project: Effect of Embrapa's research on poverty alleviation

- Production function
- Total factor productivity
- Efficiency of Production

Stochastic Frontier

DEA and FDH

- Multivariate Descriptive Analyses
- Census Data (1995/1996 – 2006)