Drivers of price volatility in Brazilian pork market, internal and external effects – DCC GARCH approach

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1. Background

- Pork is the most consumed meat worldwide, and Brazil is one of the major players in the global meat industry.
- The pork market is likely affected by production issues, domestic and macroeconomic conditions and policy interventions (Brümmer et al., 2013; Prikhodko and Davleyev, 2014) that cause price volatility at national and international level.
- Food price volatility generates economic and political instability, affects food and nutrition security and reduces investment in agriculture production with a negative impact on food supply (Kalkuhl et al., 2016).
- The Russian Federation has been the primary pork market for Brazilian exports; however, the Russian government has imposed trade policy interventions that have affected Brazilian meat markets.

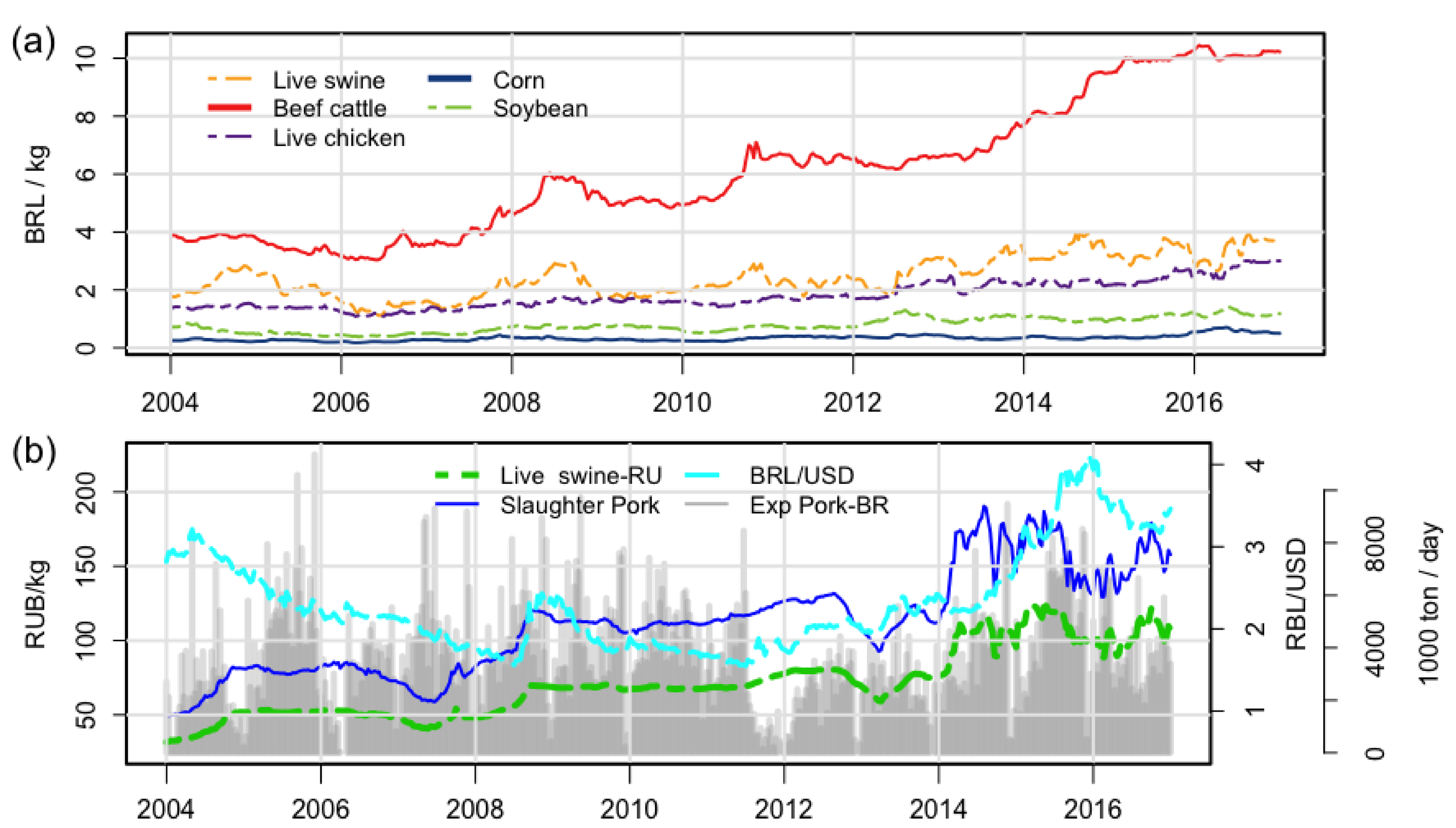
2. Research question

- What are dynamics and drivers of the price volatility in the Brazilian pork market?
- How do trade policies affect the price volatility and volatility transmission in the short-run and long-run?

3. Data

- Time series from January 2004 to December 2016 from SEAB (2017), Rosstat (2017) and CEPEA (2017) with a 10 days' frequency

Price development – Brazilian pork market



Note: Tested variables for volatility drivers on the Brazilian pork market are divided into two groups: a) internal effects (domestic factors) and b) external effects.
Source: Own illustration.

4. Methodology

- Dynamic Conditional Correlation (DCC) model (Engle, 2002) is used to estimate the multivariate price volatility transmission.

Conditional mean equations

- **Log returns:** $r_{it} = ln(P_{it}/P_{it-1}), \quad r = u_t + a_t$
- **ARMA model:** $u_t = \phi_o + \sum_{i=1}^{p} \phi_i r_{t-i} - \sum_{i=1}^{q} \theta_i a_{t-i} + \sum_{i=1}^{l} ODx_t$
- **Seasonal-ARMA model:** $(1-\phi L)(1-\phi_s L^s) r_t = (1-\theta L)(1-\theta_s L^s) a_t$

Conditional variance equation

- **GARCH (1,1) model:** $\sigma_t^2 = \alpha_o + \alpha_1 a_{t-1}^2 + \beta_1 \sigma_{t-1}^2; \quad a_t = \sigma_t \epsilon_t$
- **EGARCH (1,1) model:** $h_t = \alpha_o + (\alpha_1 \epsilon_{t-1} + \gamma(|\epsilon_{t-1}| - E(|\epsilon_{t-1}|)) + \beta_1 h_{t-1}$

Dynamic Conditional Correlation (DCC-GARCH)

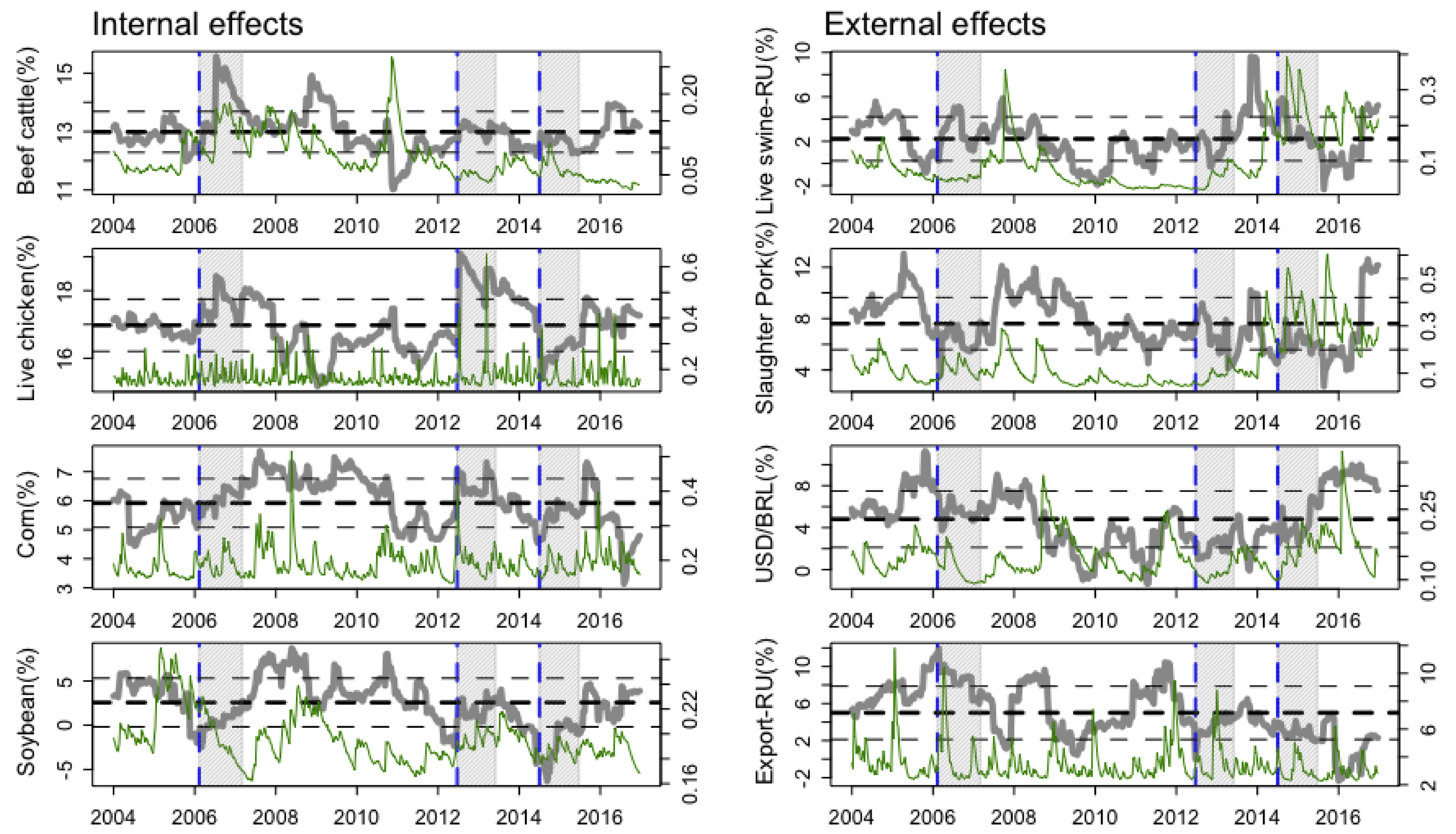
- $H_t = D_t R_t D_t; \quad D_t = diag\{\sigma_1 t, \ldots, \sigma_1 t\}$
- $R_t = diag\{Q_t\}^{-1/2}\, Q_t \, diag\{Q_t\}^{-1/2}$
- $Q_t = (1-\alpha-\beta)\bar{Q} + \alpha(E_{t-1}E'_{t-1}) + \beta Q_{t-1}; \; E_t = D_t^{-1}\, a_t$

Impact of Russian trade policies

- **GARCH-X (1,1) model:** $\sigma_t^2 = \alpha_o + \sum_{i=1}^{p} \alpha_i a_{t-i}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 + \sum_{k=1}^{k} \delta z_t$

5. Results

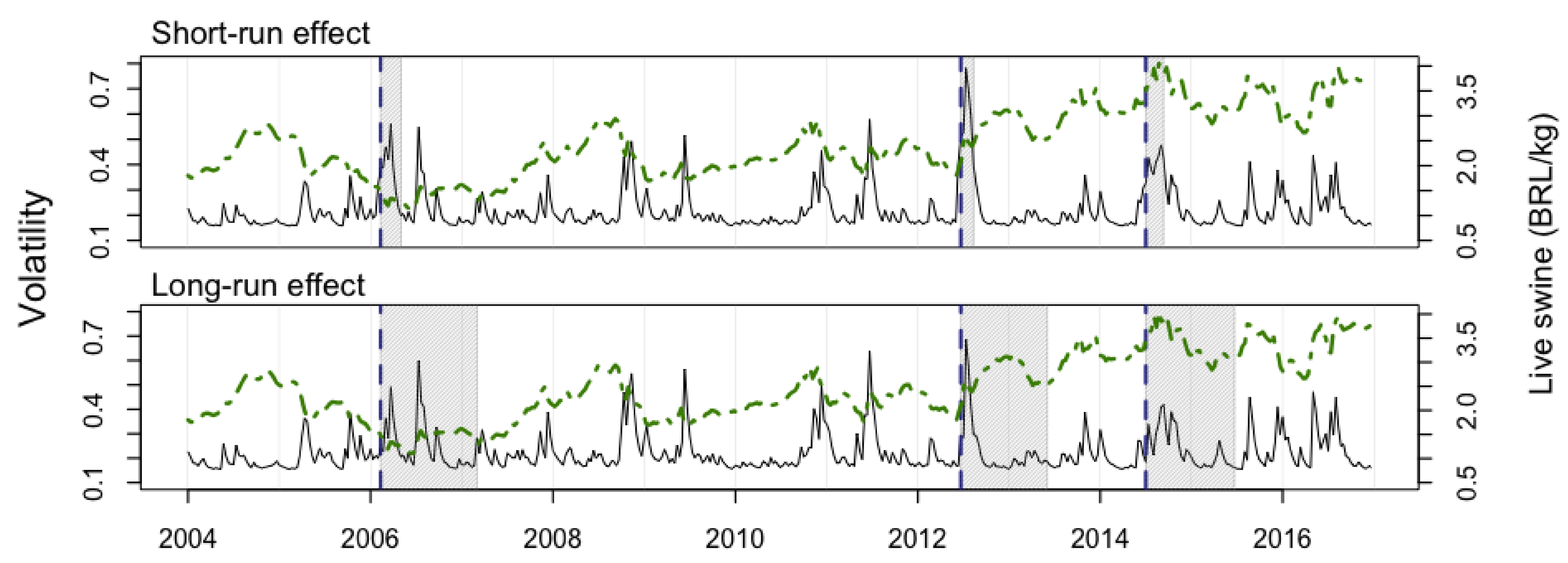
5.1 Dynamic Conditional Correlation (DCC-GARCH)



Note: The green line represents the price volatility whereas the grey line denotes the dynamic conditional correlation in percentage. Beef cattle, live chicken and corn are estimated by the EGARCH (1,1) model.

5.2 Impact of Russian trade policies

- Impact on the conditional variance: FMD (112%), WTO (223%) and WC (90%)



Note: The dotted blue vertical lines represent the Russian trade policy interventions: Foot Mouth Disease import ban (FMD), WTO accession, and Western Countries import ban (WC)
Source: Own estimation.

6. Conclusions

- Domestic Brazilian markets show higher price volatility than external factors.
- Brazilian beef and corn react stronger to positive shocks than to negative; indicating the use of "market power".
- Russian trade policies have significantly increased Brazilian live swine price volatilities in the short-run (two months).
- Volatility spill-over across the analysed markets are found. Internal effects have a stronger effect on the live swine price volatility.
- Pork substitutes increase the Brazilian live swine price volatility more than the input markets.
- The correlation between feed grains and live swine is low but the literature suggest that changes in input prices affect producer profitability directly.
- Russian trade policies have affected the price volatility transmission in live chicken, corn and soybean markets.

7. References

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