Asymmetric risk spillovers between oil and agricultural commodities

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Outline of presentation

1-Motivations of the study

2- Problem statement

3- Objectives of the study

4- Data description

5- Empirical methodology

6- Main empirical results

7- Conclusions and policy implications

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Motivation-I

- The rise in agricultural commodities prices have not only increased economic and social costs, these may also affect health, education and family ties.

- On the flip-side, World agricultural commodity prices experienced a decline of around fifty-three per cent in real terms (as measured in Euros).

- Concerns on the quality and safety of grain and crop production (Grunert, 2005; Harper and Makatouni, 2002).

Motivation-II

- Global oil prices have correlation with economic growth, which in turn impacts the global demand for commodities.

- Hikes in oil prices increase the cost of essential agricultural inputs such as fertilizer, which in turn increases the overall production costs of agricultural commodities.

WTI crude oil and International Global Agricultural Commodities Index (IGCI)

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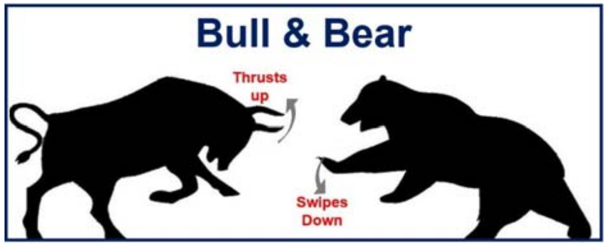
Questions

- ❑ Are there asymmetric tail dependence risks?

- ❑ What are the probable losses arising from spillovers?

- ❑ Is risk spillover symmetric (equal on downside and upside)?



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Objectives of the study

- The main objective of this study is to identify the agricultural commodities with higher exposure to downside and upside risk.

- Dependence structure-based spillover effects stemming from extreme movements in the oil prices.

- Assessment of spillovers under adverse market scenarios (possible contagion effect).

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Data Description-I

Agricultural Commodities Data

Daily WTI oil price

(Datastream International)

- International Global Agricultural Commodities (IGC) Index
- Wheat
- Maize
- Soybeans and
- Rice
- Source: Agricultural Market Information System (AMIS, 2017)

January 4, 2000

June 9, 2017

Data description-II

- Sample period includes two global scale economic and financial events that had an impact (positive or negative) on the international price of oil and agricultural commodities

- The global financial crisis of 2008-009 and
- A sharp price decline, that began around August 2014

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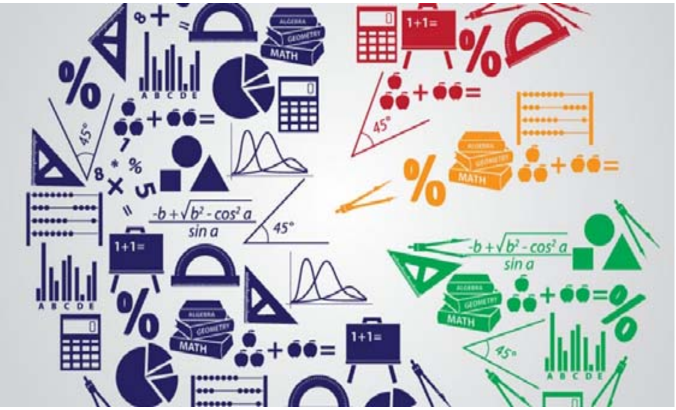

Empirical methodology

1. Marginal density – ARMA(p,q)-GARCH(m,n) with skew t distribution

2. Time-varying and static bivariate copula models

3. VaRs, CoVaRs and Delta CoVaRs risk measures

4. KS bootstrapping test, for asymmetry testing, developed by Abadie (2002)

Copula Name	Formula	Parameter	Tail dependence
Normal (N)	$C_N(u,v,\rho) = \Phi(\Phi^{-1}(u), \Phi^{-1}(v))$	$\rho \in [-1\ 1]$	Zero tail dependence: $\lambda_L = \lambda_U = 0$
Student-t (t)	$C_{ST}(u,v,\rho,\upsilon) = T(t_\upsilon^{-1}(u), t_\upsilon^{-1}(v))$	$\rho \in [-1\ 1]$	Symmetric tail dependence: $\lambda_U = \lambda_L = 2t_{\upsilon+1}\left(-\sqrt{\upsilon+1}\sqrt{1-\rho}/\sqrt{1+\rho}\right) > 0$
Clayton (CL)	$C_{CL}(u,v;\delta) = \max\left\{\left(u^{-\delta} + v^{-\delta} - 1\right)^{-1/\delta}, 0\right\}$	$\alpha \in [-1,\infty)\backslash\{0\}$	Asymmetric tail dependence: $\lambda_L = 2^{-1/\delta}, \lambda_U = 0$
Gumbel (Gu)	$C_G(u,v;\delta) = \exp\left(-\left((-\log u)^\delta + (-\log v)^\delta\right)^{1/\delta}\right)$	$\delta \in [1,\infty)$	Asymmetric tail dependence $\lambda_L = 0, \lambda_U = 2 - 2^{1/\delta}$
Rotated Gumbel	$C_{RG}(u,v;\delta) = u + v - 1 + C_G(1-u, 1-v;\delta)$		upper tail independence and lower tail dependence
Frank (F)	$C_F(u,v;\delta) = \delta\log\left(\left[\left(1-e^{-\delta}\right) - \left(1-e^{-\delta u}\right)\left(1-e^{-\delta v}\right)\right] \Big/ \left(1-e^{-\delta}\right)\right)$	0<δ<∞	Zero tail dependence: $\lambda_L = \lambda_U = 0$
Placket	$C_P(u,v;\theta) = \frac{1}{2(\theta-1)}\left(1 + (\theta-1)(u+v)\right) - \sqrt{\left(1+(\theta-1)(u+v)\right)^2 - 4\theta(\theta-1)uv}$	θ	Zero tail dependence: $\lambda_L = \lambda_U = 0$
Joe Clayton	$C_{JC}(u,v;\lambda_U,\lambda_L) = 1 - \left(1 - \left\{\left[1-(1-u)^k\right]^{-\gamma} + \left[1-(1-v)^k\right]^{-\gamma} - 1\right\}^{-1/\gamma}\right)^{1/k}$	$\lambda_L \in (0,1)$ $\lambda_U \in (0,1)$	$\lambda_t^U = \Delta\left(\omega_U + \beta_U\rho_{t-1} + \alpha_U\frac{1}{q}\sum_{j=1}^{q}\lvert u_{t-j} - v_{t-j}\rvert\right)$ $\lambda_t^L = \Delta\left(\omega_L + \beta_L\rho_{t-1} + \alpha_L\frac{1}{q}\sum_{j=1}^{q}\lvert u_{t-j} - v_{t-j}\rvert\right)$

Notes: and denote the lower and upper tail dependence, respectively. For the Normal copula, $\Phi^{-1}(u)$ and $\Phi^{-1}(v)$ are the standard normal quantile functions and Φ is the bivariate standard normal cumulative distribution function with correlation ρ. For the Student-t copula, $t_\upsilon^{-1}(u)$ and $t_\upsilon^{-1}(v)$ are the quantile functions of the univariate

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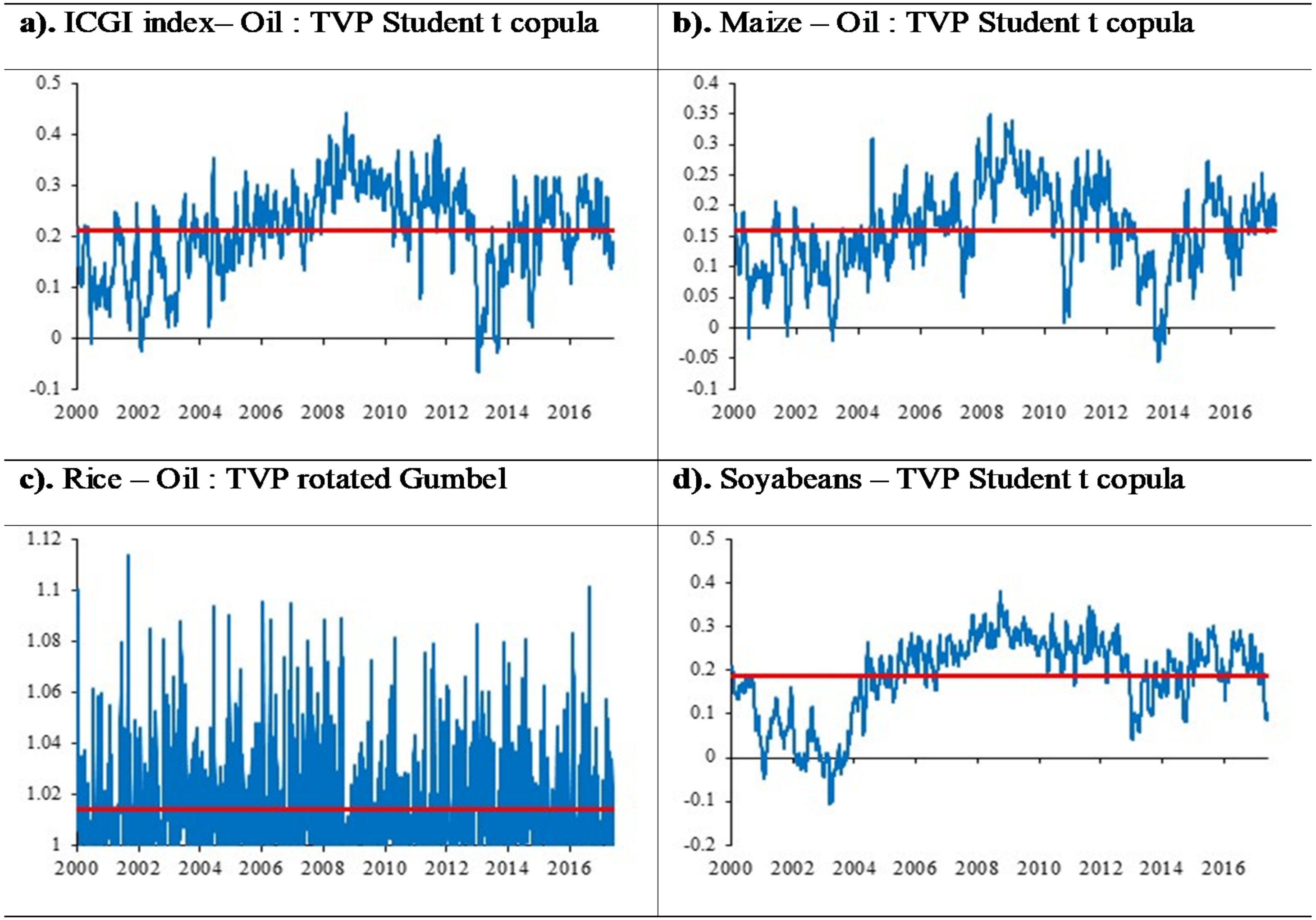
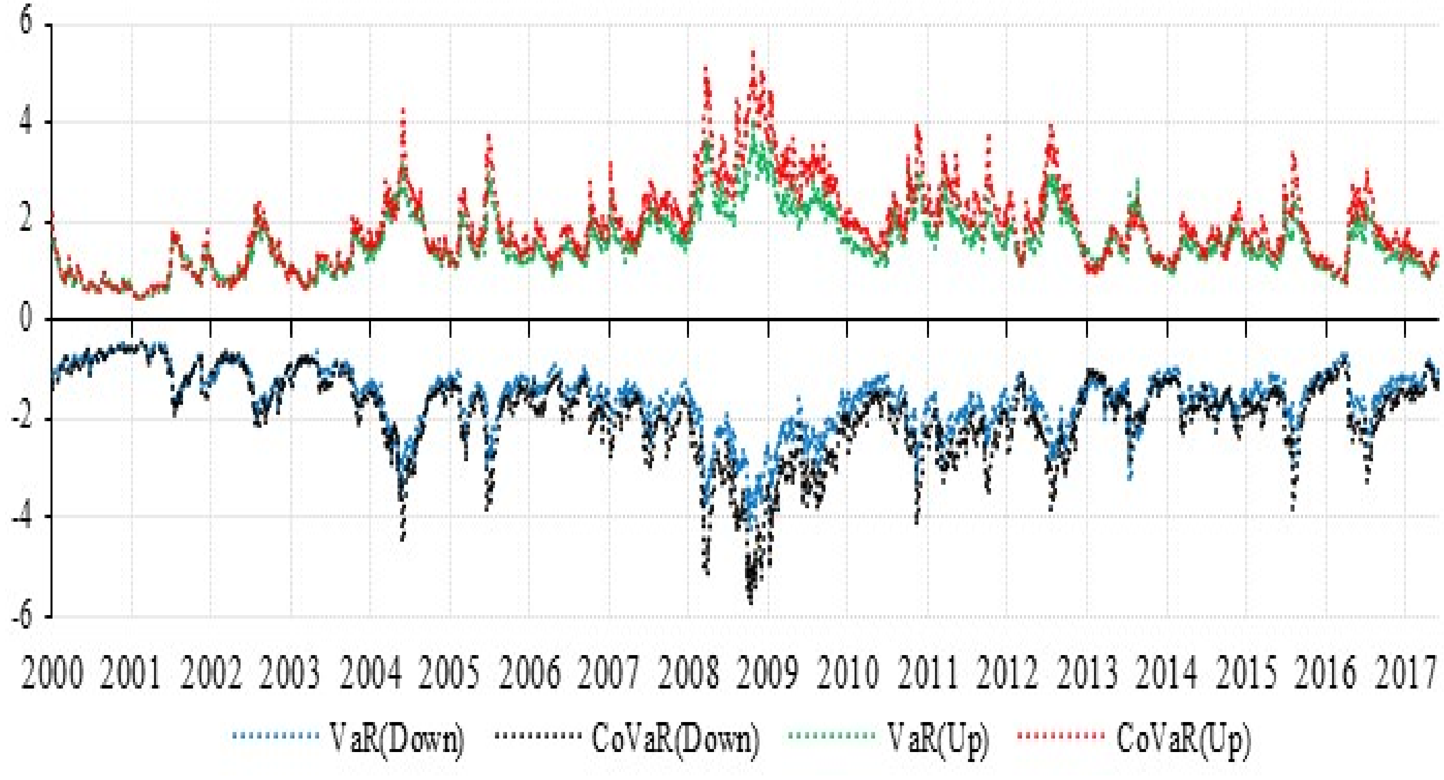
Main empirical results-A

Time series plots for parameter estimates of the best copula fit



Main empirical results-B

From Oil and ICGI Index



Main empirical results-C

From Oil and ICGI Index

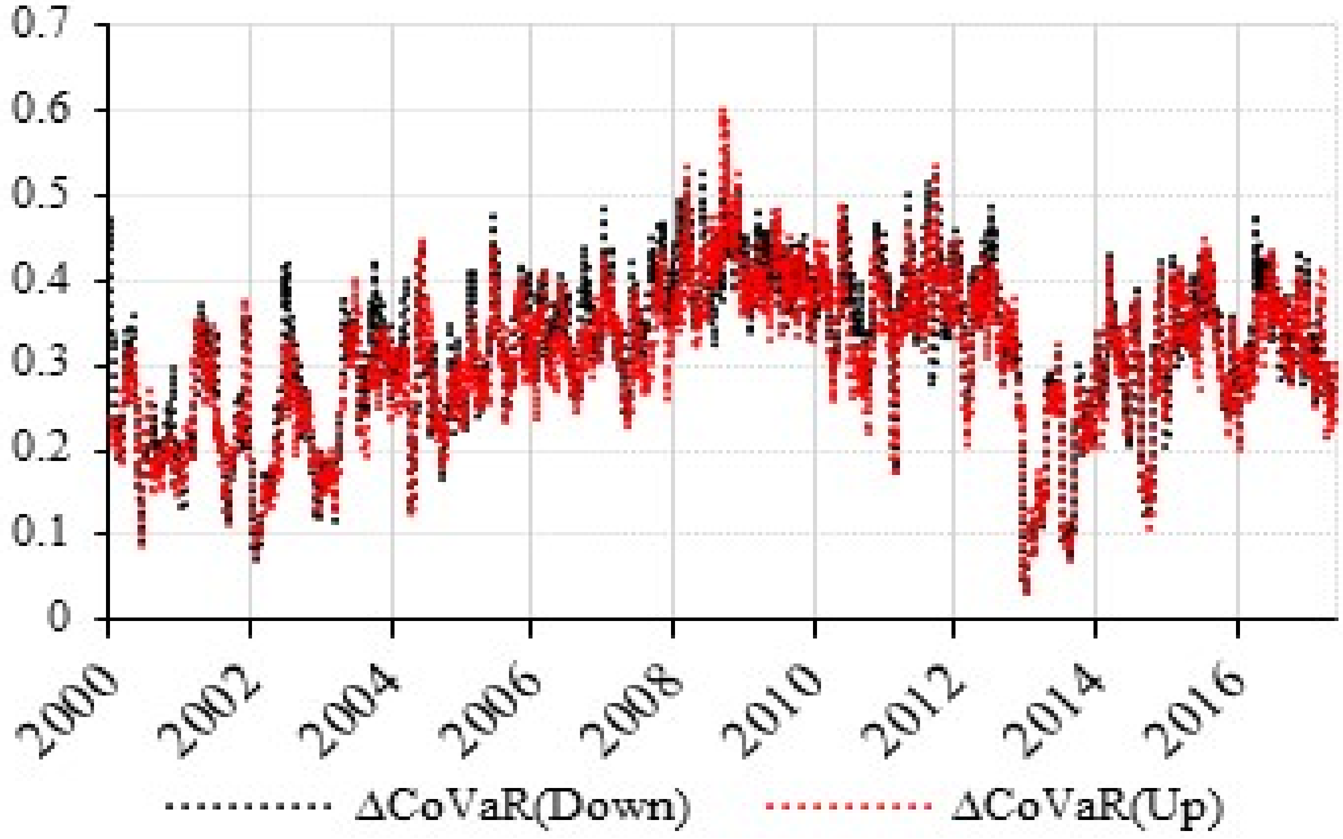


Table 6: Asymmetric downside-upside risk spillover effects

	From oil to commodities	From Commodities to Oil
	$H_0: \frac{CoVaR}{VaR}(Down) = \frac{CoVaR}{VaR}(Up)$ $H_0: \frac{CoVaR}{VaR}(Down) > \frac{CoVaR}{VaR}(Up)$	$H_0: \frac{CoVaR}{VaR}(Down) = \frac{CoVaR}{VaR}(Up)$ $H_0: \frac{CoVaR}{VaR}(Down) > \frac{CoVaR}{VaR}(Up)$
ICGI index	0.1056***	0.0007
	[0.0000]	[0.9980]
Maize	0.0000	0.0000
	[1.0000]	[1.0000]
Rice	0.4176***	0.0000
	[0.0000]	[1.0000]
Soyabeans	0.3352***	0.0000
	[0.0000]	[1.0000]
Wheat	0.0000	0.0123
	[1.0000]	[0.4993]

Note: p-values for the Kolmogorov-Smirnov (KS) statistic are in squared brackets.

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Conclusions and policy implications-I

- In this study, We examine the downside and upside spillover effects, tand the tail dependence risk of oil and agricultural commodities by implementing Value-at-Risk (VaR), conditional VaR (CoVaR), Delta conditional VaR (ΔCoVaR), and time-varying and static bivariate and vine copulas models.

- Higher asymmetric downside/upside spillover effects exist from oil to agricultural commodities.

Conclusions and policy implications-II

- ❑ Most marked bilateral or bidirectional spillover effects occur between the oil and maize and soybean markets

- ❑ A pronounced trend in the spillovers is detected during financial turmoil periods rather than in periods of economic prosperity

- ❑ Higher spillover transmissions during crisis period lead us to believe that both market dependencies and spillover effects should be considered to build better portfolios strategies that may protect investors and agricultural producers against downside risk propagation


THANKS
FOR
LISTENING