SICSS Survey

Impact of rainfall variability on security in the Sahel region

econometric study

Dakar, nov 2009

Sahel and West Africa Club
(SWAC/OECD)

Our objectives

1. **Identifying the existence of a link between climate & security in the Sahel region**
2. **Estimating the size of the effect of climate on security**
3. **Building an index of vulnerabilities**

Econometric model

Broad ideas on econometric modelling

Set of statistical tools used by researchers to assess & estimate a relationship from the data

➔ Assuming a reduced-form equation between variables, for example : $\mathbf{Y_t = c + aX_t + \varepsilon_t}$

➔ Testing the existence of this relationship (algorithms)

➔ Output : values for c and a, statistical signifance, explanatory power

Inconvenients

Simple form equations ; *Normality assumptions*

Assumptions in designing a model

- **Focus on climate acting as a trigger of security events rather than long-term trend influence**

  ➔ Resource scarcity variables are not dynamic (Thiesen, Gleditsch)

  ➔ Trigger effect has been statistically significative

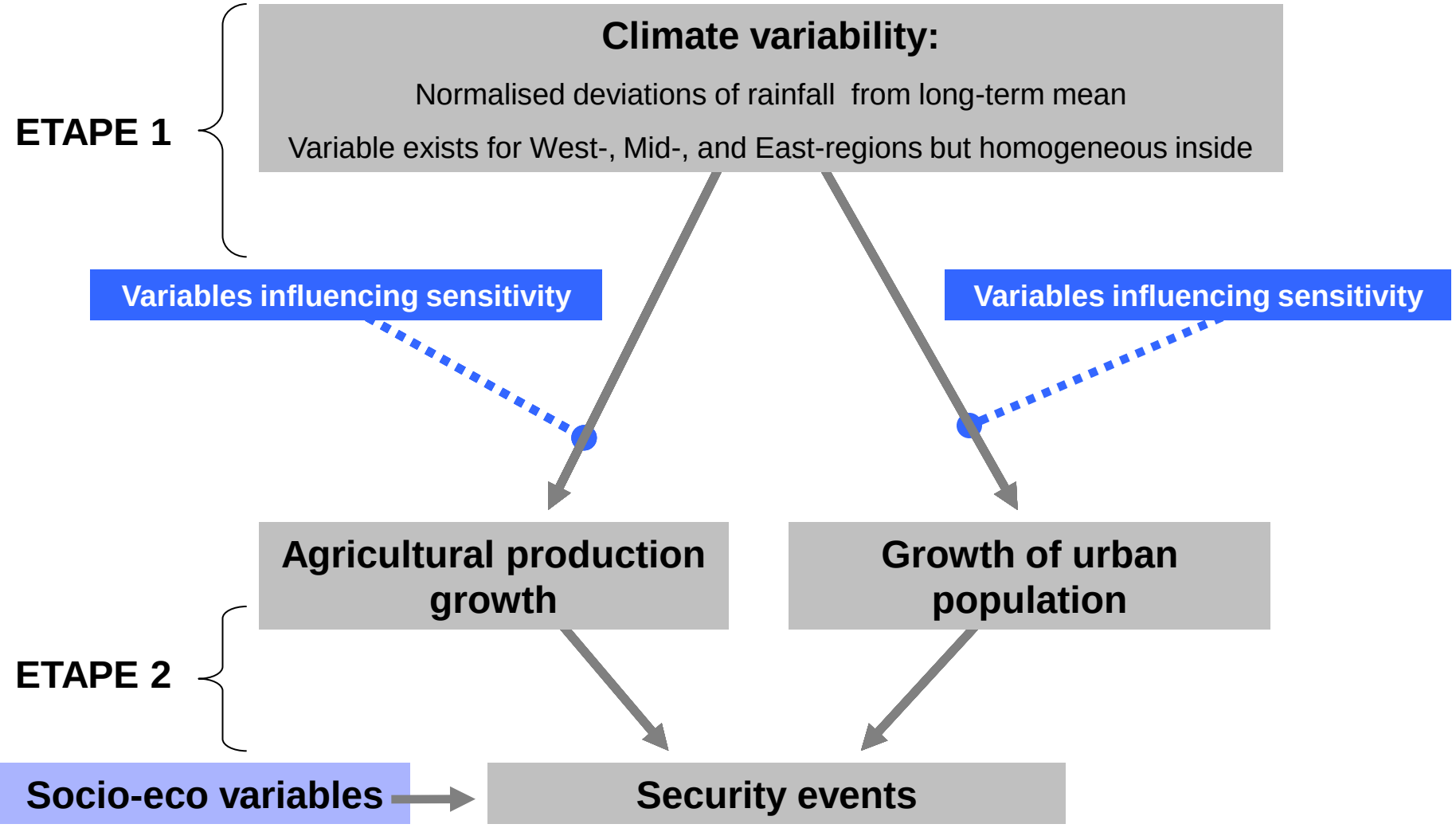
Miguel & al (2004) showed a significant link between rainfall and civil conflict ; Hendrix-Glazer (2008) on rainfall and conflict ; Meier & al (2005) on rainfall and pastoral conflict ;

- **Model designed to test through which channels climate is acting on security :**

➔ 2 channels : Agricultural production growth & Urbanisation growth (additional part of urbanisation related to climate)

- **Definition of the security variable is modified :**
  Extended to security events rather than conflicts only
  Coded as 1 when a security event begins and 0 otherwise

Framework


ETAPE 1
Climate variability:
Normalised deviations of rainfall from long-term mean
Variable exists for West-, Mid-, and East-regions but homogeneous inside
Variables influencing sensitivity
Variables influencing sensitivity
Agricultural production growth
Growth of urban population
ETAPE 2
Socio-eco variables
Security events

Results

Rainfall – agriculture growth channel

Estimated equation:

$$Agr = 3.5 + Rain^{*}(26.8 - 0.85IRR - 0.1VA) + 0.23LS + 0.19Crop \quad (R^2 = 0.24)$$

(0.8) (6.3) (0.5) (0.02) (0.1) (0.03) (standard error)

Time-dependent sensitivity of agricultural production to rainfall

IRR = % of land irrigated

VA = Added-value of agriculture per worker

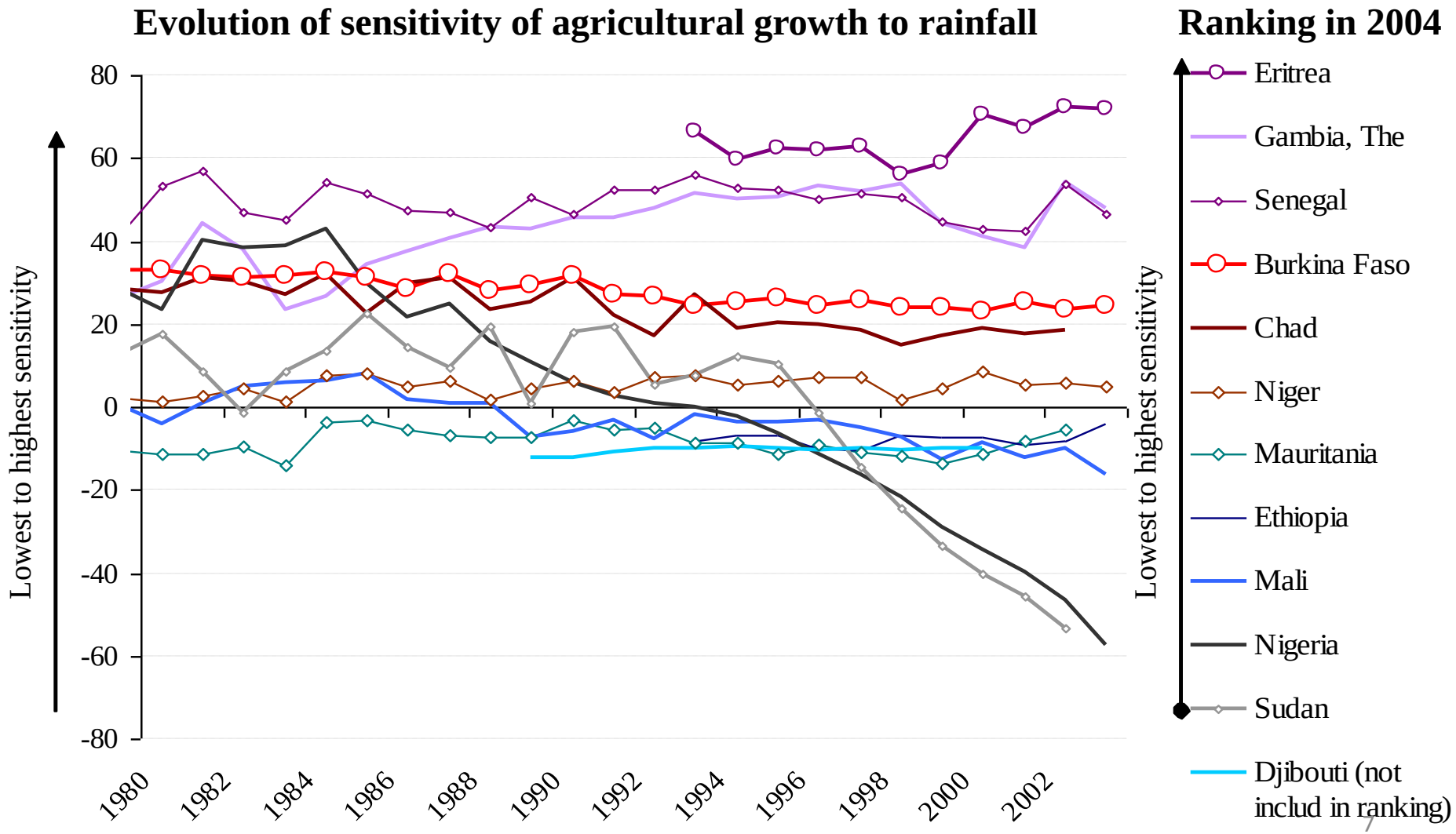
Set of control variables

LS = Production growth of livestock

Crop = Production growth of crop

Results

Rainfall – agriculture growth channel



Results

Rainfall – urbanisation growth channel

Estimated equation:

$$Urb = 0.91 + Rain^{*}(-1.22 - 0.17GAP + 0.04DENS) + 0.1Pop + 0.03GAP - 0.03UShar$$

(0.8) *(0.4)* *(0.1)* *(0.02)* *(0.04)* *(0.01)* *(0.0)*

($R^2 = 0.18$)

Time-dependent sensitivity of urbanisation growth to rainfall

GAP = Income gap Urban/rural

Dens = Variation of rural density

Set of control variables

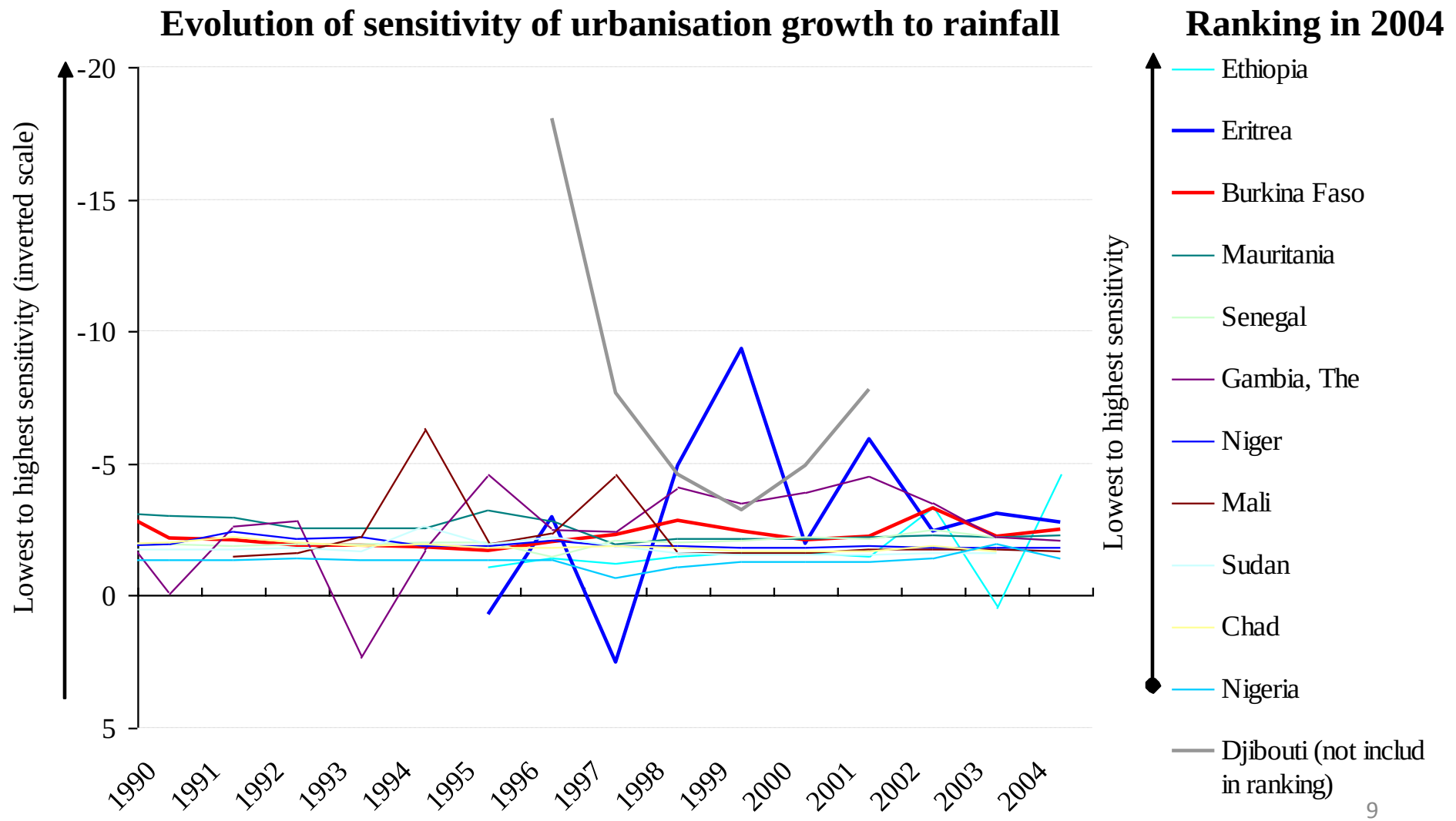
Pop = Population total (log)

GAP = Income gap Urban/rural

UShar = Share of urban population

3. Results

Rainfall – urbanisation growth channel



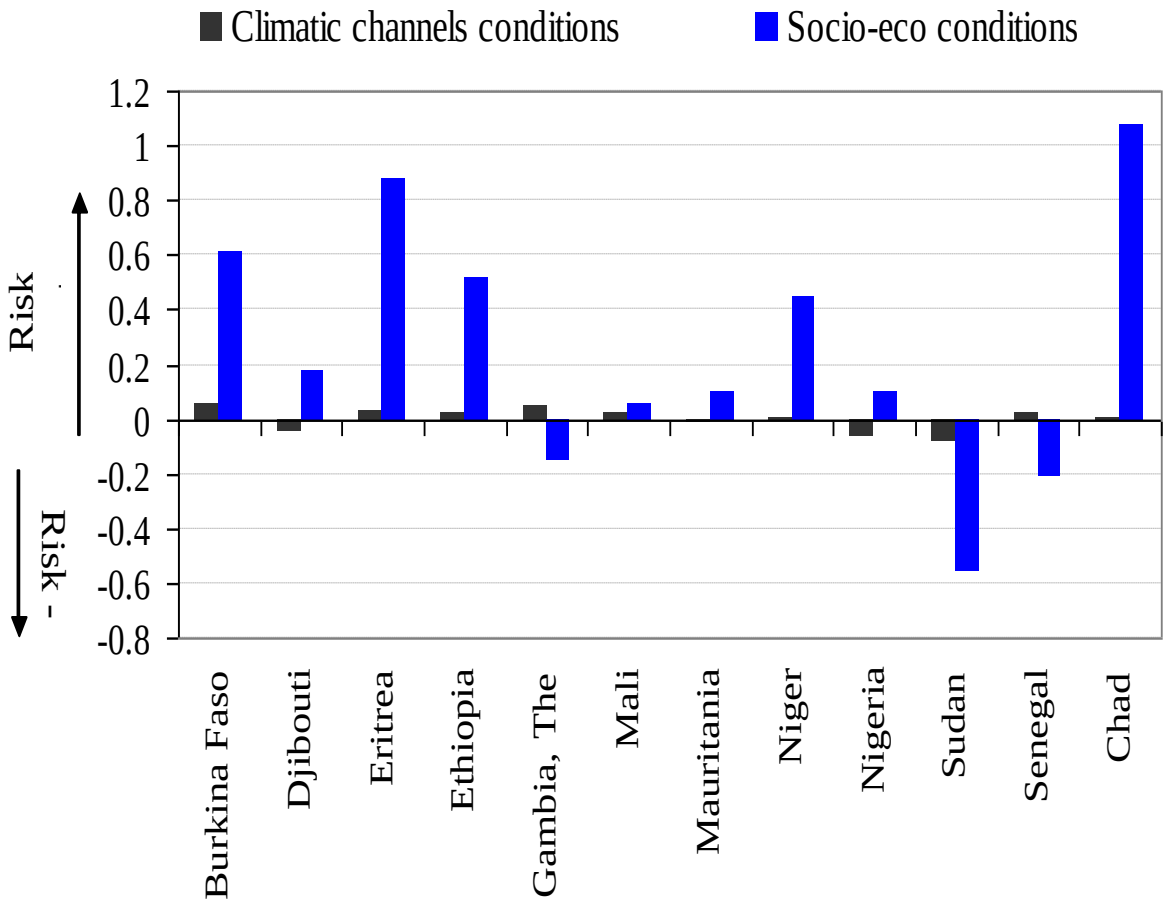
Results

Agriculture and urbanisation to security events

Estimated equation

Variable	Coefficient	*Std. Erro*
Drought event	0.020295ns	*0.01*
Agri channel (-2)	-0.0137	*0.00*
Urb channel (-2)	0.0218	*0.01*
Population total (-2) log	0.004782ns	*0.01*
Aid per cap (-2) log	0.0237	*0.01*
GDP per cap (-2) log	-0.1289	*0.05*
Literacy rate (constant)	0.0022	*0.00*
Trade openness (-2)	-0.0008	*0.00*
Stab politique (Polity IV)	-0.0015	*0.00*
c	0.6898	*0.56*
R^2 aj	0.09	

Security vulnerabilities in each country in 2004



Conclusion

- **Statistically significative link between climate and security**

- **Role of socio-eco factors is determinant in explaining vulnerabilities**

- **Several caveats**
  - Use of interaction terms produce time-variant sensitivities, but not constrain below zero ➔ Inconsistent results for some countries
  - Poor robustness of the estimated coefficents : temporal sensitivity, low explanatory power, non-linearity issues, variable geo-resolution data depending on conflict analyzed.

Annex

Normalised deviation of rainfall from long-term mean