Climate Change, Risk and Economic Behavior

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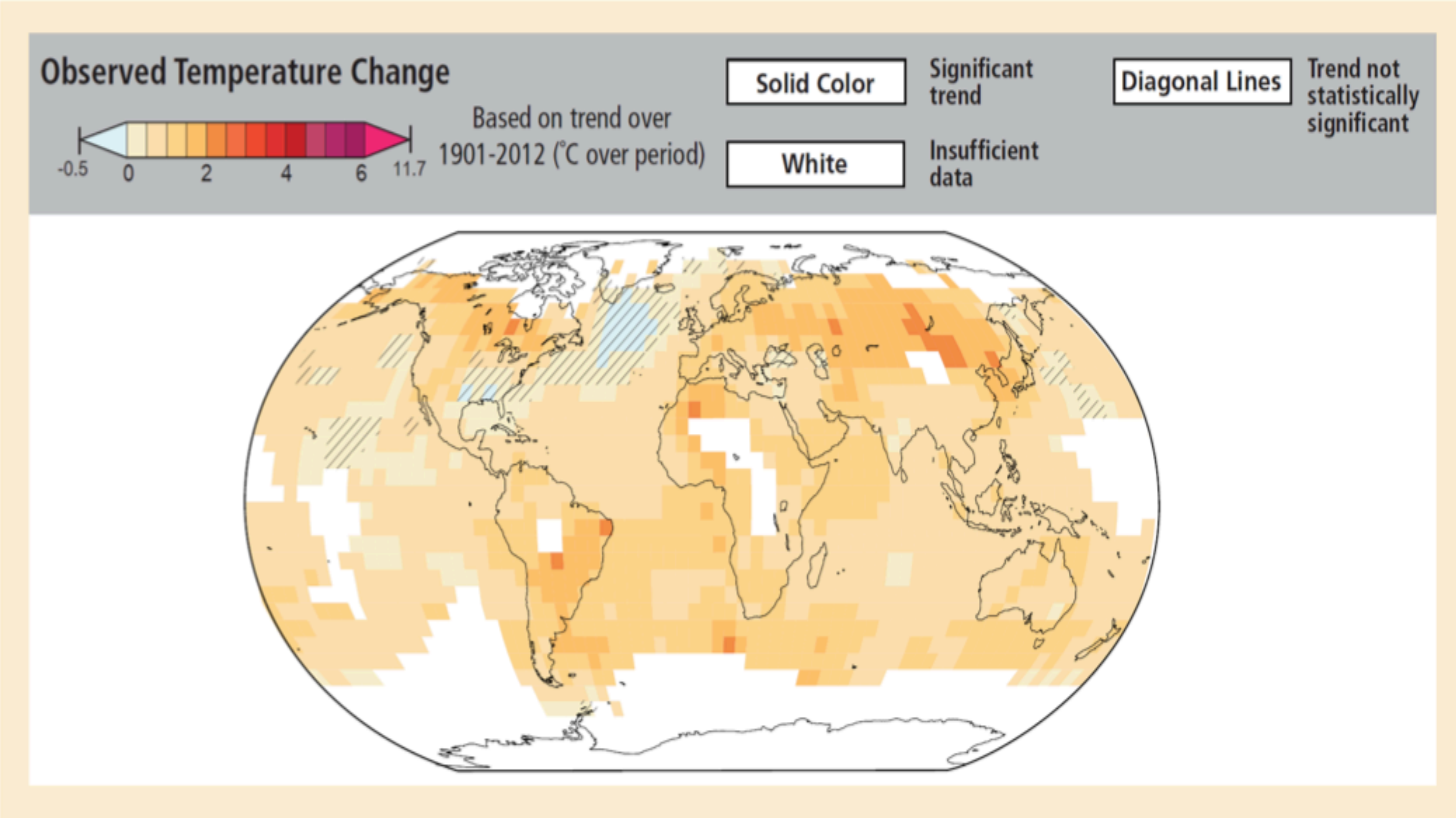
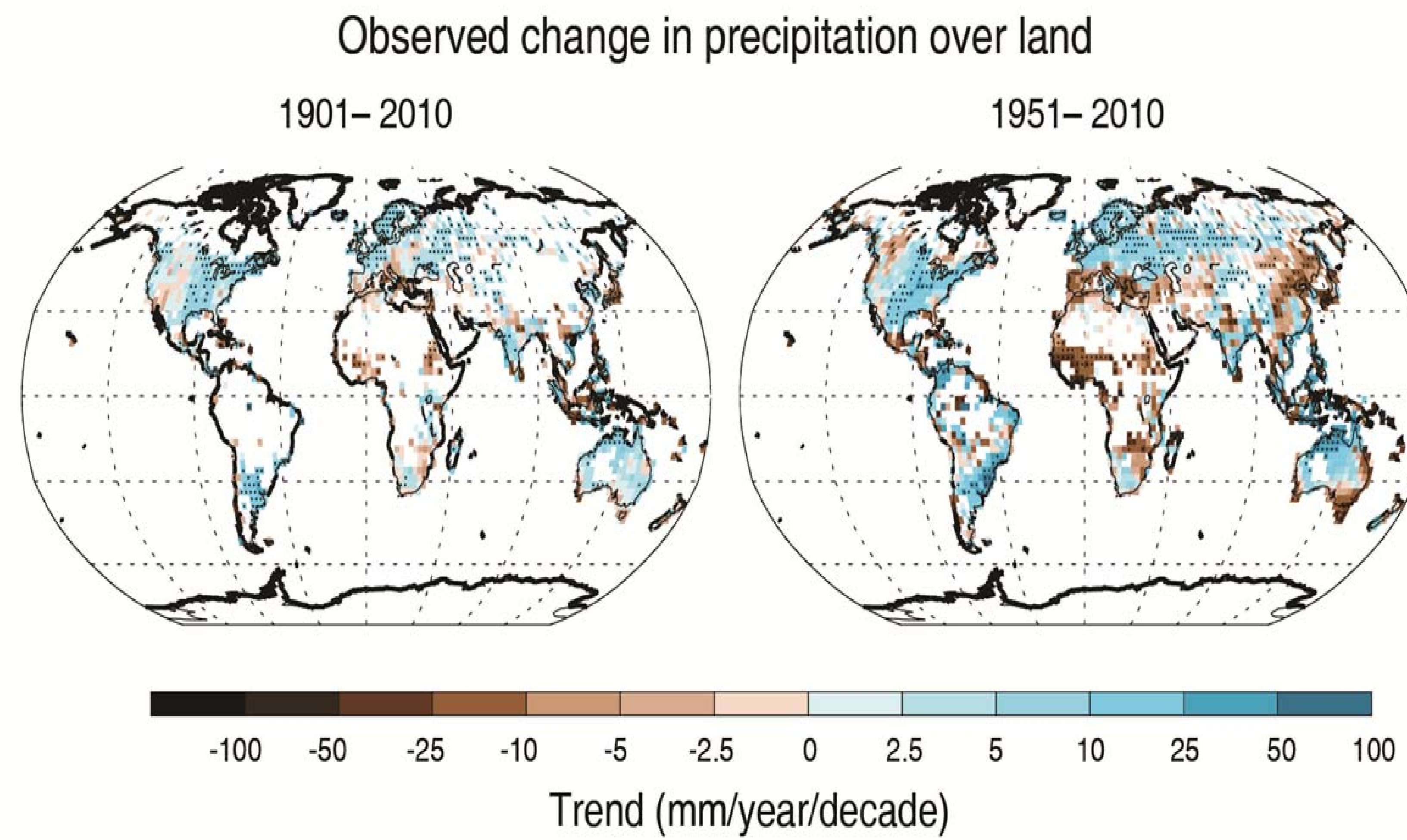
Climate Change(d)

(A)



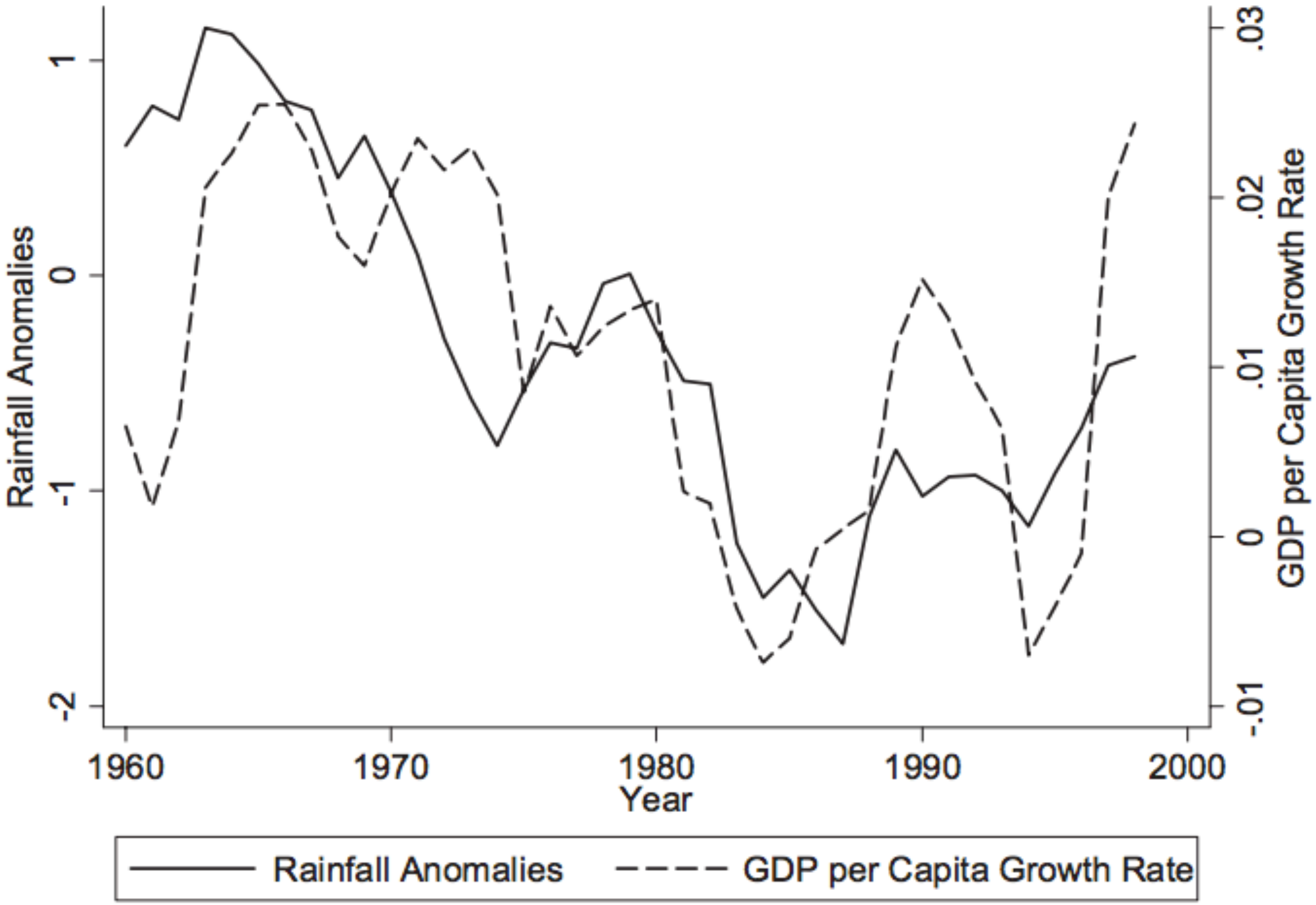
IPCC, 2013

IPCC 2013


Observed change in precipitation over land
1901– 2010
1951– 2010
-100
-50
-25
-10
-5
-2.5
0
2.5
5
10
25
50
100
Trend (mm/year/decade)

With wide reaching implications

- GDP per capita growth rates track rainfall in sub-Saharan African countries

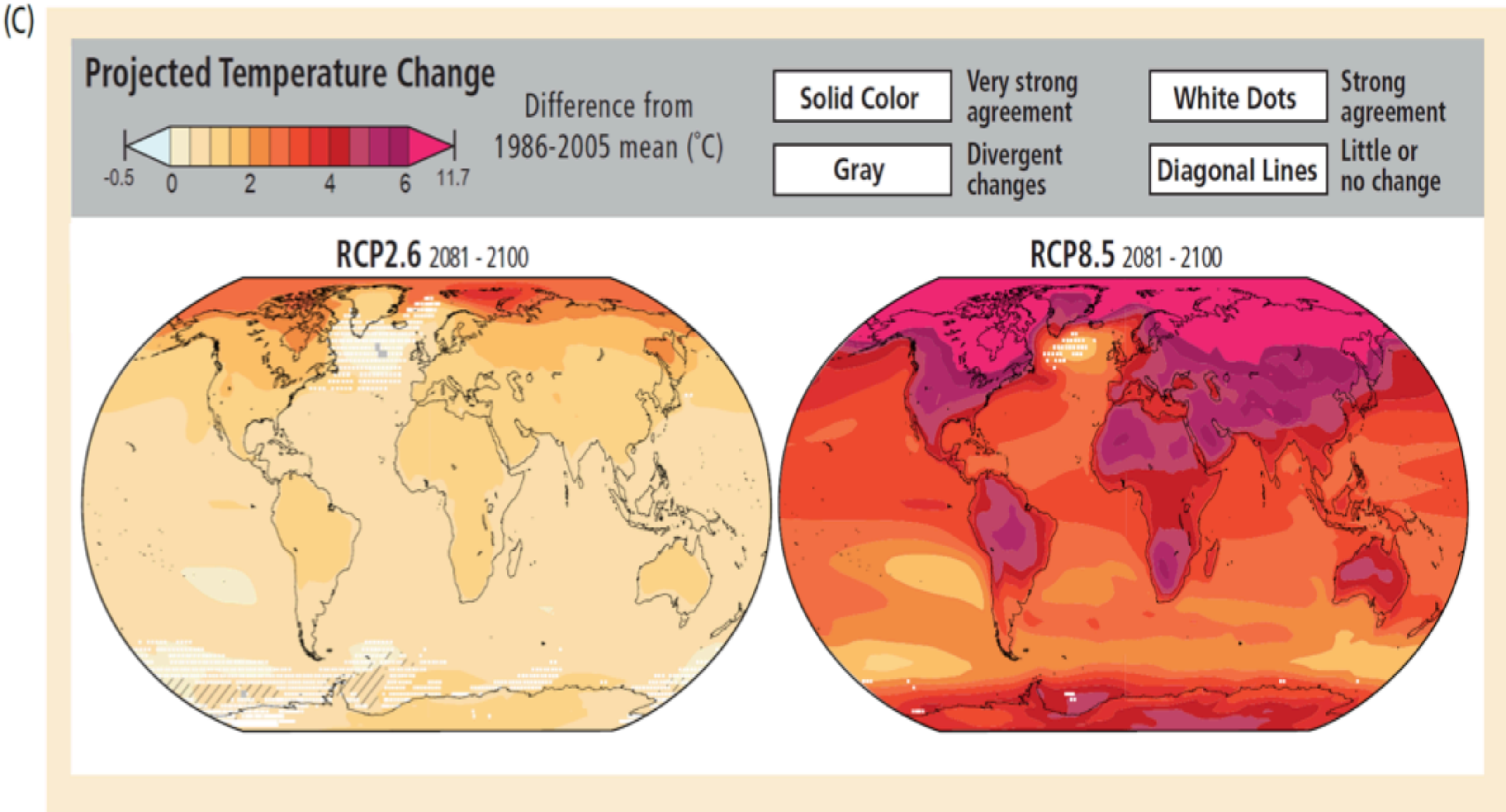


Barrios et al., 2010

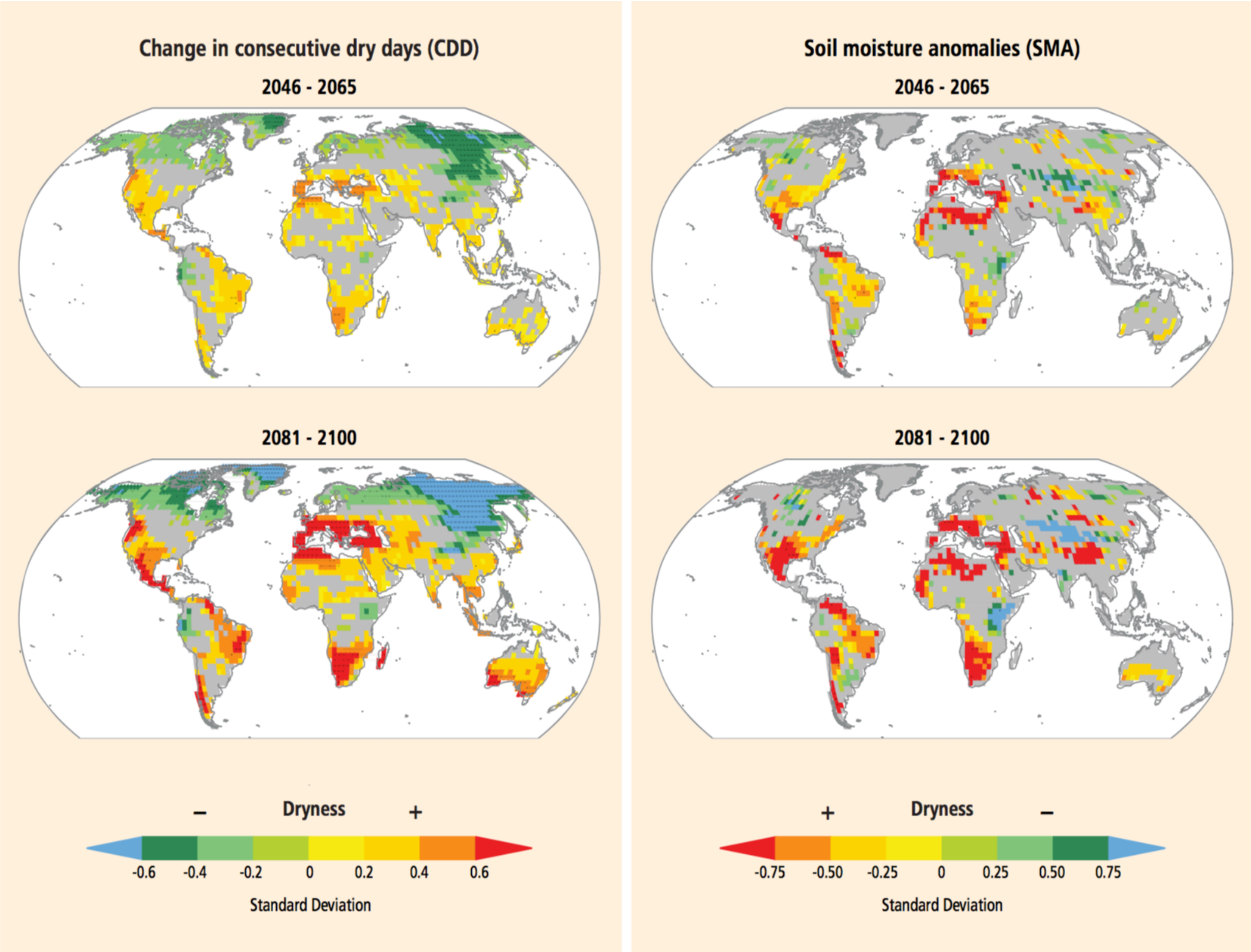
El Niño-Southern Oscillation (ENSO) cycle on world prices and economic activity

- Significant effects on commodity prices
- It appears to account for almost 20 percent of commodity price inflation movements over the past several years
- And it is changing too

Future climate change will happen



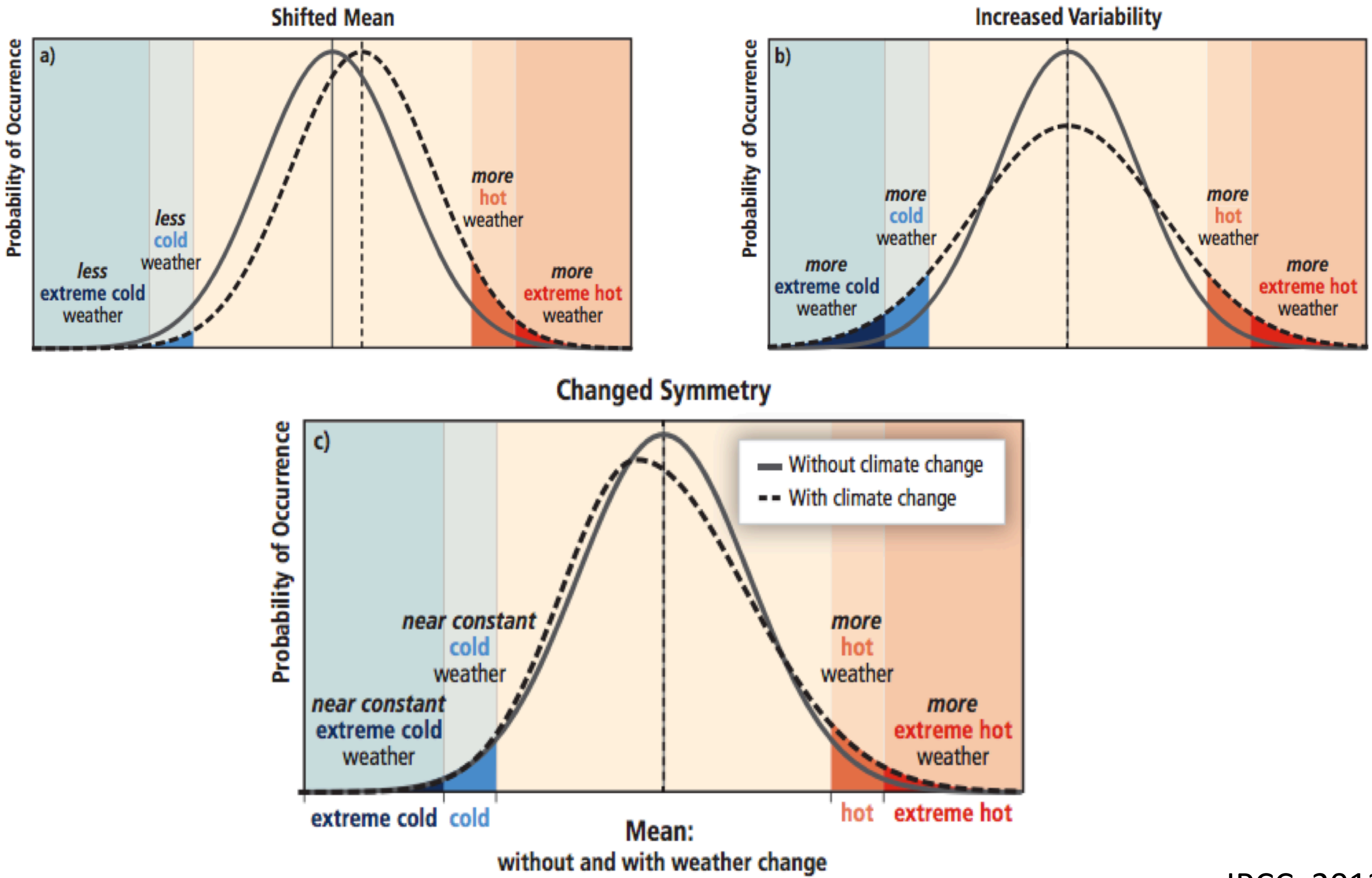
IPCC, 2013



Change in consecutive dry days (CDD)
2046 - 2065
2081 - 2100
–
Dryness
+
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
Standard Deviation
Soil moisture anomalies (SMA)
2046 - 2065
2081 - 2100
+
Dryness
–
-0.75
-0.50
-0.25
0
0.25
0.50
0.75
Standard Deviation

IPCC, 2012

We must adapt to the risk of extremes



IPCC, 2012

What are the implications for value creation?

- Declining productivity of agricultural commodities
- Declining quality of raw materials

Moreover

- Impacts on energy resources and shipping (physical damage and business interruption)
- Shifts and heterogeneity in the regulatory environment
- Lower efficiency of operations
- Price volatility and quantity risk

Producers responses

- Micro level (independent) on farm responses




Case study: Ethiopia Nile river basin

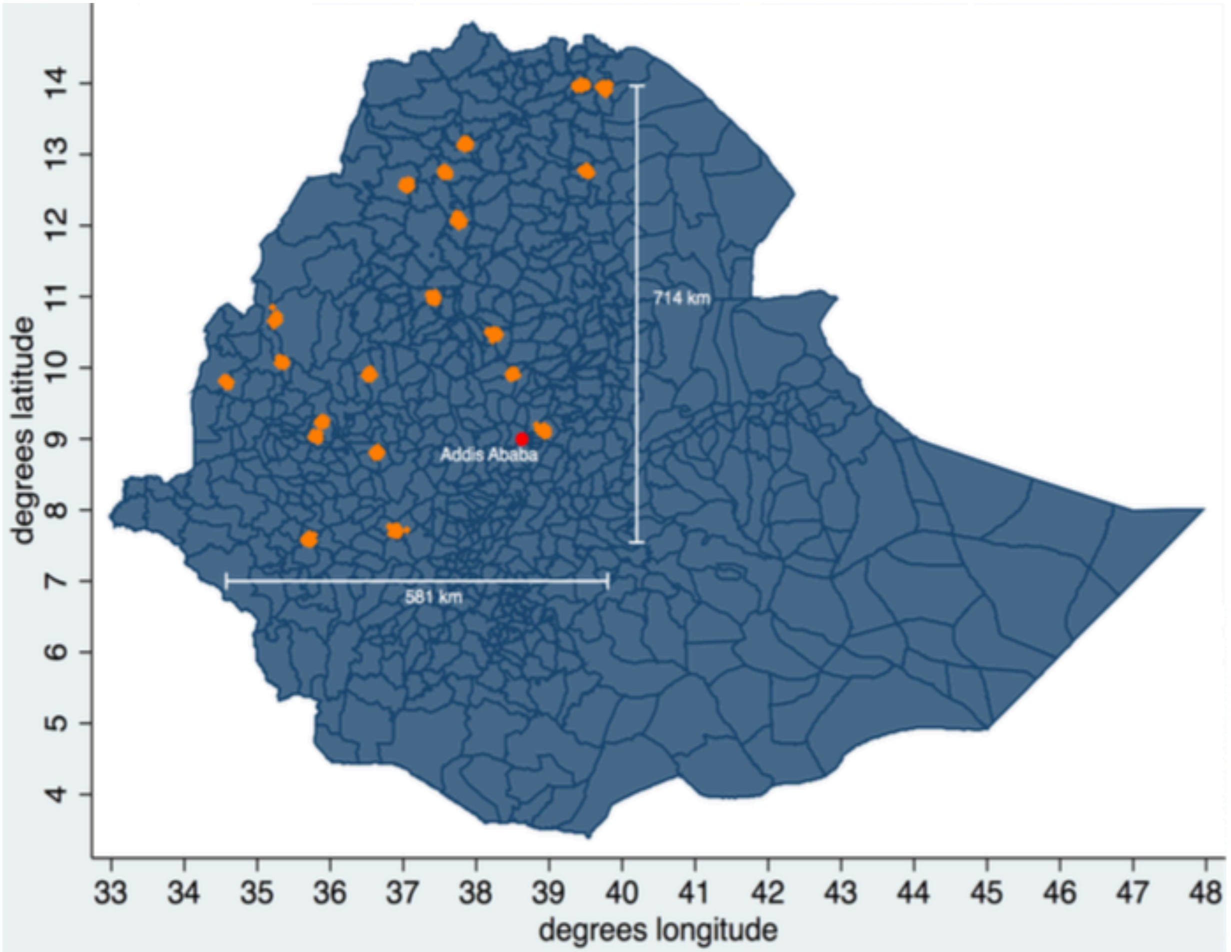


Figure 1: Geographical location of samples in Ethiopia
Geographical location of sampled households in Ethiopia. The capital, Addis Ababa, is indicated purely as a point of reference. The outlined areas map Woredas (administrative districts), which were randomly selected in the first stage of the stratified design.

Table 1. Climate change adaptation strategies

	Frequency	%
Soil conservation	1,397	72.27
Changing crop varieties	1,186	61.36
Water strategies		
Building water harvesting scheme	309	15.99
Water conservation	82	4.24
Irrigating more	279	14.43
Other strategies		
Early-late planting	176	9.11
Migrating to urban area	23	1.19
Finding off-farm job	132	6.83
Leasing the land	3	0.16
Changing from crop to livestock	71	3.67
Reduce number of livestock	121	6.26
Adoption of new technology	26	1.35

Measuring Risk Exposure: Stochastic Production Function Approach

$$g(\mathbf{x}, \boldsymbol{\upsilon}) = f_1(\mathbf{x}, \boldsymbol{\gamma}_1) + u$$

$$f_1(\mathbf{x}, \boldsymbol{\gamma}_1) \equiv E\left[g(\mathbf{x}, \boldsymbol{\upsilon})\right]$$

$$g(\mathbf{x}, \boldsymbol{\upsilon}) \quad u = g(\mathbf{x}, \boldsymbol{\upsilon}) - f_1(\mathbf{x}, \boldsymbol{\gamma}_1)$$

$$E\left\{\left[g(\mathbf{x}, \boldsymbol{\upsilon}) - f_1(\mathbf{x}, \boldsymbol{\gamma}_1)\right]^k |\mathbf{x}\right\} = f_k(\mathbf{x}, \boldsymbol{\gamma}_\mathbf{k})$$

- An increase in skewness => reduction in downside risk exposure
- Reducing downside risk means decreasing the asymmetry of the risk distribution toward high outcome, holding both means and variance constant (Menezes, Geiss, and Tessler 1980)

Multinomial Switching Regression Model
(Di Falco and Veronesi, 2013)

Two stages procedure:

1. We estimate the probability of choosing a particular strategy (selection model where a representative farm household chooses to implement a specific strategy)
2. The information stemming from the first step is then used on farm revenue or other outcomes (and other control variables as well as fixed effects)

Expected Downside Risk Exposure; Treatment and Heterogeneity Effects

	Decision Stage		
Sub-samples	**To Adapt**	**Not to Adapt**	**Treatment Effects**
Farmers that adapted	(a) 0.871 (0.045)	(c) -0.477 (0.003)	TT = 1.348*** (0.045)
Farmers that did not adapt	(d) 1.880 (0.059)	(b) 0.072 (0.002)	TU = 1.808*** (0.059)
Heterogeneity effects	BH_1 = -1.009*** (0.080)	BH_2= -0.549*** (0.005)	TH = -0.460*** (0.079)

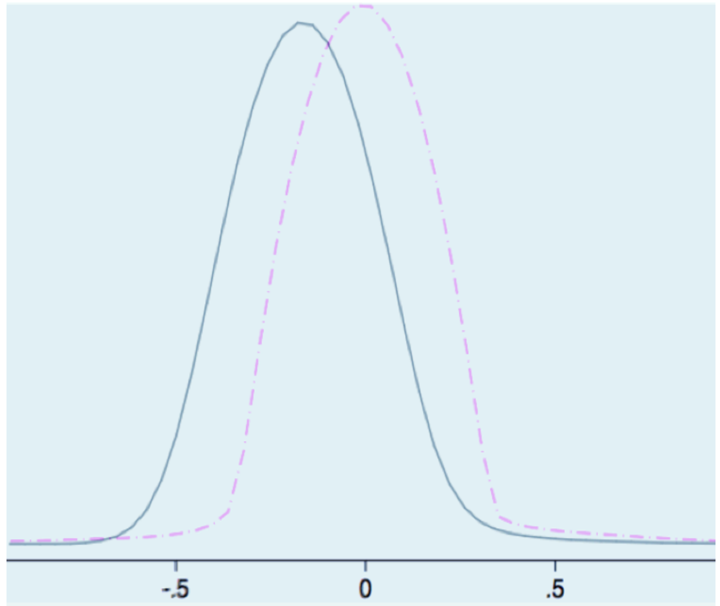
- TT: the effect of the treatment (i.e., adaptation) on the treated
- TU: the effect of the treatment (i.e., adaptation) on the untreated
- BH: the effect of base heterogeneity for farm households that adapted (i = 1), and did not adapt (i = 2); - TH = (TT - TU)

An Ethiopian example: wheat

Managing risk in the presence of climate change

(Di Falco and Veronesi, 2014):

- Producers are facing: poor soils, declining yields and higher risk of crop failure
- Climate change has exacerbated the situation
- Solution: diffusing better soil and water management practices in combination with new seeds has reduced the likelihood of crop failure



Distribution of yields with and without best practice

Recursive?

Do climatic anomalies affect behaviour?

- Behavioural parameters explain adaptation decisions
- Adopting new varieties or soil conservation (Liu and Wang; Bekele and Holden)
- Risk aversion prevents the undertaking of potentially profitable investments where these entail more risk (Rosenzweig and Binswanger, 1983)
- More impatient people more present oriented, less prone to capital accumulation and therefore invest less or adopt fewer productivity enhancing technologies (Cardenas and Carpenter, 2013; Tanaka, Camerer and Nguyen, 2010; Duflo, Kremer and Robinson, 2011)

New insights

- Mainstream economic view: preferences are fixed and stable in the short medium run (Harrison et al., 2002)
- Exposure to shocks can affect outlook on life
- "Malleable preferences" (Voors et al., 2012)
- Endogenous behavioural preferences
- Krupka and Stephens (2013), Carvalho et al., (2014), Dean and Sautmann (2014)
- Climatic shocks, risk and discounting the future
- Elicited via experiments or general survey questions

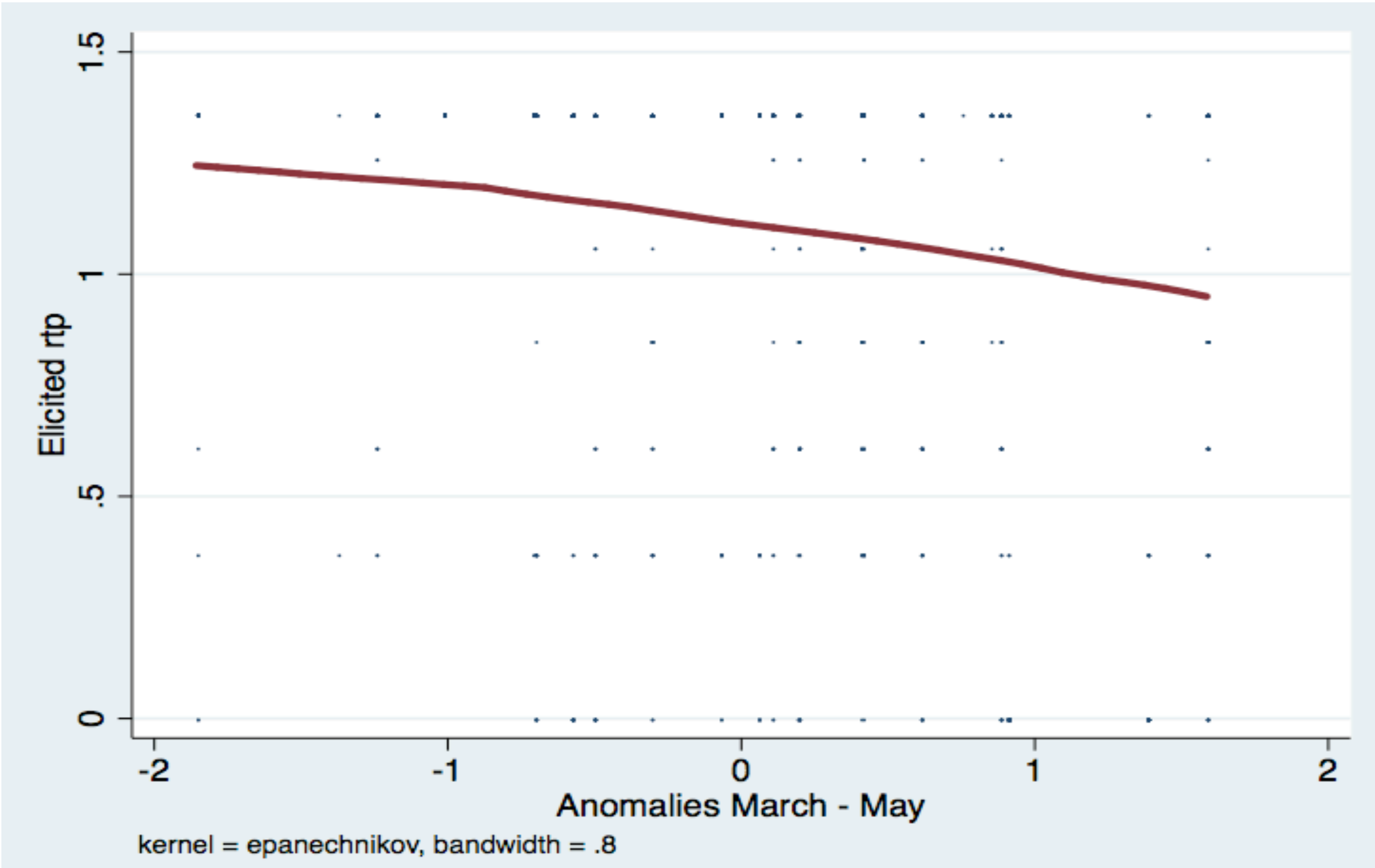
- In developing countries exposure to negative income shocks affects many dimensions of people's lives
- How they discount their future?
- Poorer individuals may not be able to afford to forgo current (smaller) income for future (larger) income (Becker and Mulligan, 1997; Fehr, 2002)
- Discounting the future varies with income

Pender, 1996; Frederick et al. 2002; Tanaka et al., 2010; Spears, 2011; Haushofer et al., 2013; Krupka and Stephens Jr., 2013; Dean and Sautman, 2014, Chuang and Schechter, 2014; Tanaka and Munro, 2014

Elicitation of impatience at two different points in time

- Spatial and temporal variation
- Di Falco et al. (2015) a set of lab in the field experiments in 2005 and 2007 in the Highlands of Ethiopia
- Ethiopia large rural and poor population dependent upon rain fed agriculture
- Small holders farmers
- Persistent food insecurity and among the highest rates of soil nutrient depletion in Africa
- Soils that lack nutrients do not adequately support plants growth
- (FAO 2001; Shiferaw and Holden, 1997)

39% of individuals changed their elicited impatience



Models

$$discount_{ht} = \beta_0 + \beta_1\, rainfall\ shocks_{ht-1} + u_{ht}\ (1)$$

$$discount_{ht} = \beta_0 + \beta_1\, rainfall\ shocks_{ht-1} + \beta_2 \boldsymbol{W}_{ht} + \beta_3 year_t + u_{ht}\ (2)$$

Use dummies to capture different intensity of anomalies

Negative and positive shocks	Dummy -2	See text for description. -3< Rainfall anomaly <=-2	15%
	Dummy -3	See text for description. -Rainfall anomaly <=-3	23%
	Dummy + 2	See text for description. 2=< Rainfall anomaly <3	8.8%
	Dummy +3	See text for description. 3=< Rainfall anomaly	36%

Results

Dependent Variable: Discounting		
	No controls	With controls
	(1)	(2)
Dummy - 2	0.100	0.0741
	(0.0619)	(0.0640)
Dummy – 3	0.956***	0.918***
	(0.0751)	(0.0794)
Dummy + 2	0.0287	0.0228
	(0.0918)	(0.0882)
Dummy + 3	-0.847***	-0.834***
	(0.101)	(0.0989)

Investment implications?

- Heavy discounting of the future may in principle push individuals towards myopic economic decisions (Fuchs, 1992, Card, 1995, Chavas 2013).
- As result farmers may be less likely to undertake profitable and crucial investment and therefore perpetuate their condition of poverty (Haushofer and Fehr, 2014)

Correlation

- Key agricultural investments and discounting factor
- Take advantage of the panel structure of our data set and include individual, time and crop fixed effects to control for many possible sources of heterogeneity
- In the absence of a ‘trusted’ source of exogenous variation that is not also related to investment we cannot establish any causal link

Table 3. Investment and discounting

	Investment in Oxen		Investment in Soil	
	No Controls	With Controls	No Controls	With Controls
	(1)	(2)	(3)	(4)
Discounting	-0.138*	-0.134*	-0.140***	-0.123***
	(0.0707)	(0.0696)	(0.0365)	(0.0376)

A simplified supply chain

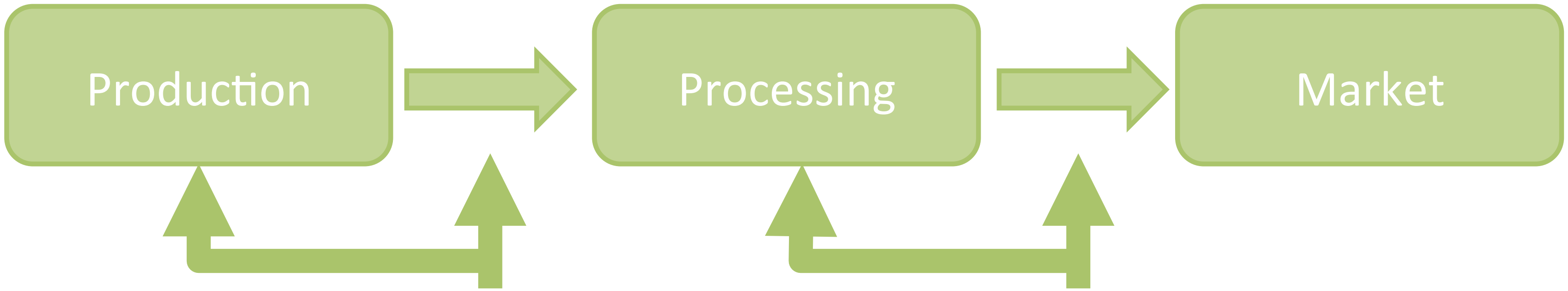
The role of traders:

- Transfer raw material from its origin to the markets
- Know the products and institutional and regulatory contexts
- Manage prices and operational risks
- Organise the whole value chain

Sustainability in the supply chain

- The commodity chain is managed to create and protect long-term economic, environmental, and social value for all agents involved
- Management of the environmental impacts of the chain

A simplified sustainable supply chain



The role of traders:

- Transfer raw material from its origin to the markets
- Know the products and institutional and regulatory contexts
- Manage prices and operational risks
- Organise the whole value chain
- Facilitate and feedback the adoption of best practices
- Support the harmonisation of regulatory environments

Achieving a sustainable supply chain

- Identify and diffuse best practices
  - What are the best responses that different actors can put in place to face the multitude of challenges?
  - Behavioral dimension of shocks exposure
  - How robust are these responses and how can we scale them up?
  - Synergies among different actors

Conclusions

- Micro responses are a valuable and effective
- Future patterns of change => more extreme=> farmers discounting.
- Negative rainfall anomalies during the growing season increase impatience
- Tentative evidence on the role of discounting on soil investments

Thank you

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