

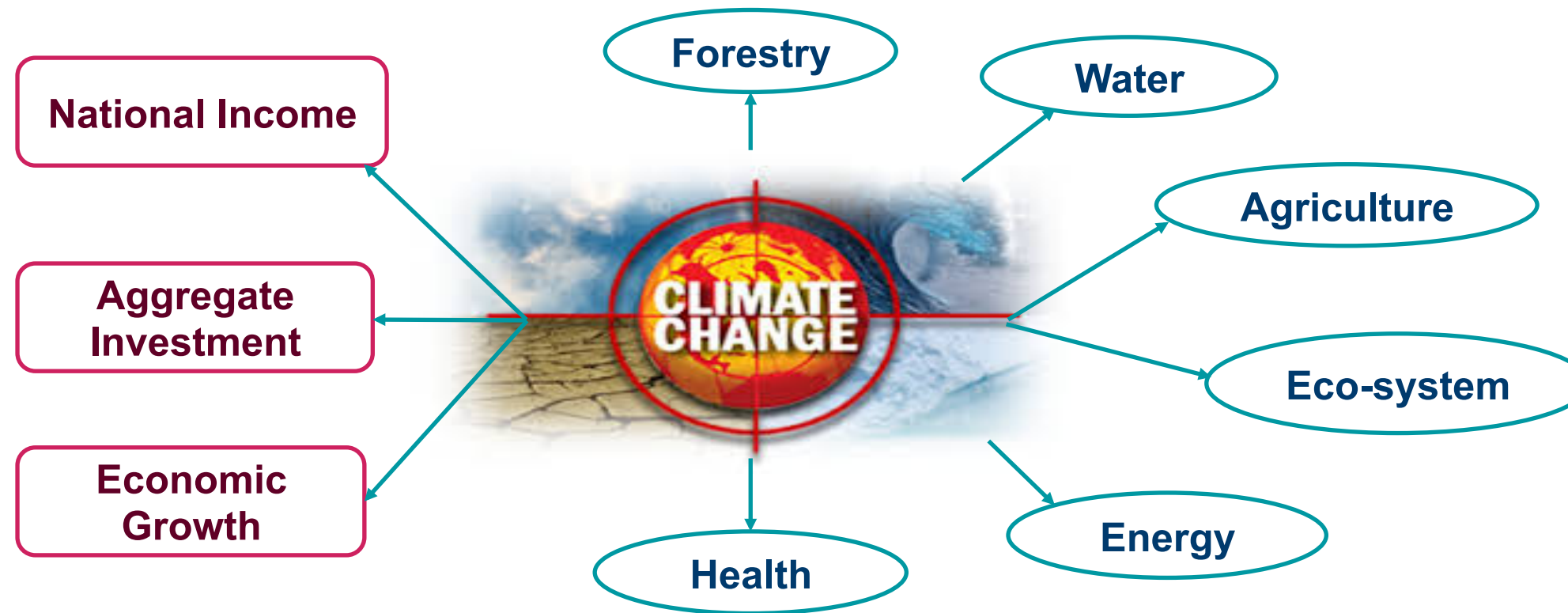
Climate Change Impacts on Agricultural Exports: A Sub-sector, Region and Economic Level Evaluation

Suborna Barua
Ernesto Valenzuela

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Climate Change Impacts: Evidence

(Gallup et al., 1999; Dell et al., 2009:2012; Nordhaus, 2006; Hsiang, 2010; Heal and Park, 2014)



(IPCC, 2007; McCarthy et al., 2001; Stevanović et al., 2016; Deressa and Hassan, 2009; Tol, 2002; Watson et al., 1996)

- Agriculture is one of the most vulnerable sectors; changes in yields, prices, and thereby trade.

Climate Change impacts on Trade

- Limited empirical evidence of the impacts of climate change on agricultural trade.
- Jones and Olken (2010)
 - temperature increases reduce exports from poor countries to the 'US' and the 'ROW'.
 - precipitation affects exports from 'the world' to the 'ROW' positively. Negative impacts for 20 products including *cereal and preparations, dairy products and eggs* with some positive for *Dyes' and Hides'*.
- Li et al. (2015): large negative impact of temperature on Chinese exports; precipitation affects them positively.
- Dallmann (2015): temperature increases induce LICs to diversify both their export 'product' and 'country' portfolio more than the higher income ones; no impact of precipitation.
- Stevanović et al. (2016): annual loss of >0.3% of global GDP by this century, if trade is restricted.
- Model-based assessments suggest future negative impacts of rising temperature (e.g., WTO-UNEP, 2009; The World Bank, 2010; Dellink, et al., 2017(OECD))

This paper's objective

- To assess the impact of climate variation, temperature and precipitation, on the pattern of primary agricultural exports.
 - Global, Regional level
 - By sub-sector
 - By income level; Developed vs Developing

Significance of the Research

- Very limited evidence on the impacts of climate change on agricultural trade; only three products examined by Jones and Olken (2010).
- Provision of novel estimates on the impacts of climate change on primary agriculture.
- Insights on the heterogeneous impacts across products, regions, and income groups.

Methodology (1): *Variables and Data*

- 102 countries, covering from 1962 to 2014
- **Exports data**, Source: United Nations Comtrade Database
 - Annual data on primary agricultural export sub-sectors using 2-digit SITC Codes:
 - (i) **Grains (*Cereals and cereal preparations*)**
 - (ii) **Oil-seeds-nuts-kernels**
 - (iii) **Fruits and vegetables,**
 - (iv) **Livestock (*Live animals + meat and meat preparations*), and**
 - (v) **Dairy products and eggs**
 - (vi) **Tropical crops**
(Sugars, sugar preparations and honey + Coffee, tea, cocoa, spices, and manufactures thereof)
 - **Total agricultural exports**

Methodology (2): *Variables and Data*

Climate Variables		
<i>Name</i>	<i>Detail</i>	<i>Source</i>
Temperature	In degree Celsius, mean	NCEP, NOAA/NCAR, USA/ CSIRO (AU)
Precipitation	In millimetre, mean	

Control Variables		
<i>Name</i>	<i>Detail</i>	<i>Source</i>
GDP per capita (<i>lnGDPpc</i>)	Market Size and Potential (at 2010 constant US\$)	WDI, WB
Arable land per capita (<i>aralandpc</i>)	Resource and factor endowments (hectare)	
Agricultural Total Factor Productivity (<i>tfpgr_ag</i>)	Productivity improvement in all factors of production (land, labour and capital) (per cent growth rate)	USDA
Agricultural Nominal Rate of Assistance (<i>NRA_ag</i>)	Farm policy interventions	NRAs, World Bank
WTO Membership (<i>WTO_mem</i>)	Trade liberalization (dummy variable from joining year)	WTO
Climate zone fixed-effects (<i>CZ</i>)	Geo positioning (Dummies for 4 zones: Topical, Sub-tropical, Temperate, and Polar and Sub-polar)	Belda et al. (2014)

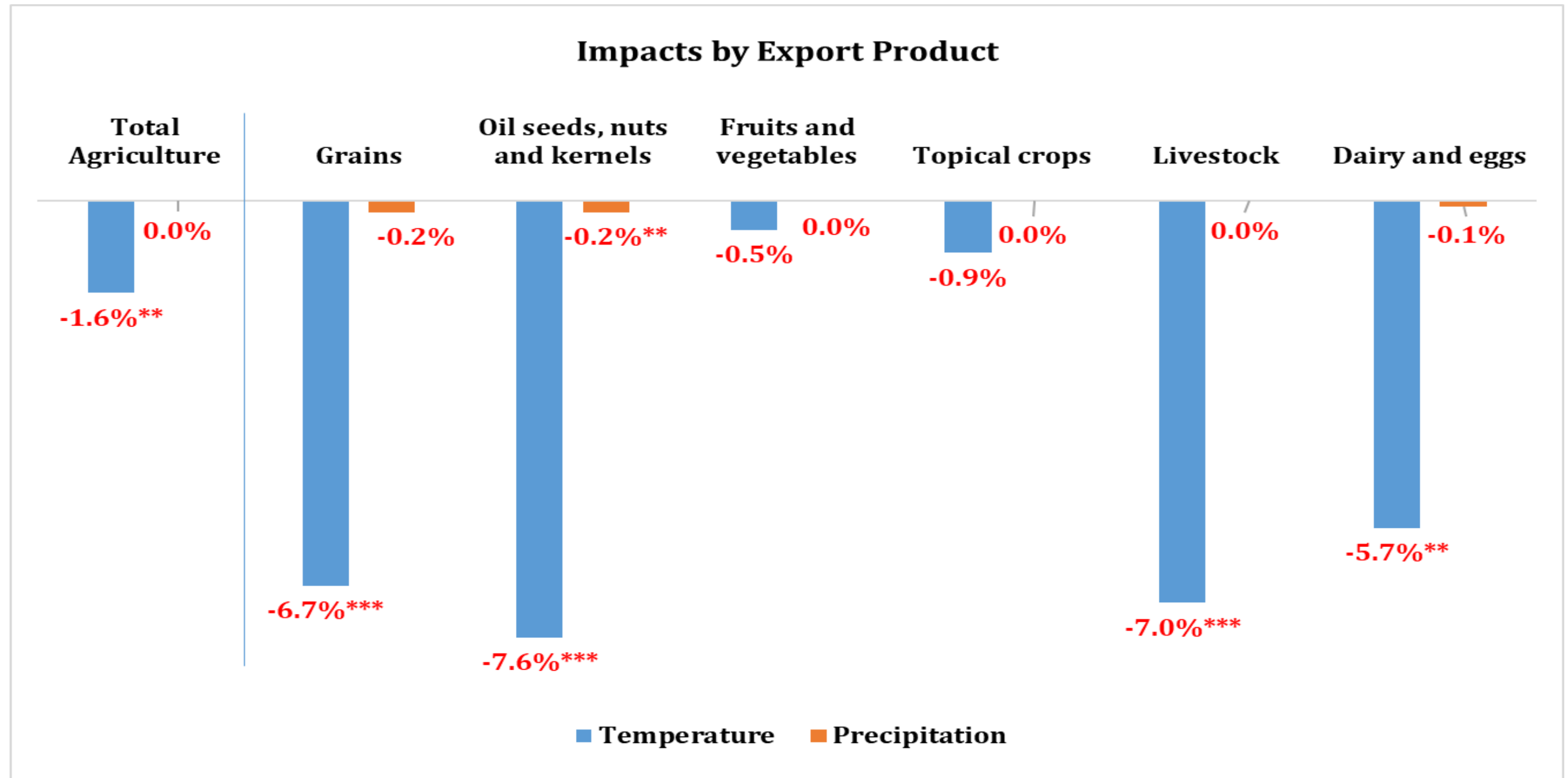
Methodology (3): Estimation Process

$$\ln \text{agriexp}_{it} = \alpha_i + \beta_1 \ln \text{GDPpc}_{it} + \beta_2 \text{aralandpc}_{it} + \beta_3 \text{tfpgr_ag}_{it} + \beta_3 \text{nra_ag}_{it} + \beta_4 \text{WTO_mem}_{it} + \beta_5 \text{Step Estimation}_{it} + \beta_6 \text{Climate}_{it} + \beta_7 \text{prec}_{it} + \beta_8 \text{CZ}_i$$

Using regression with **Prais Winsten Panel Corrected Standard Errors (PCSE)**; accounting for Heteroskedasticity, Serial correlation, Cross-section dependence and Multicollinearity

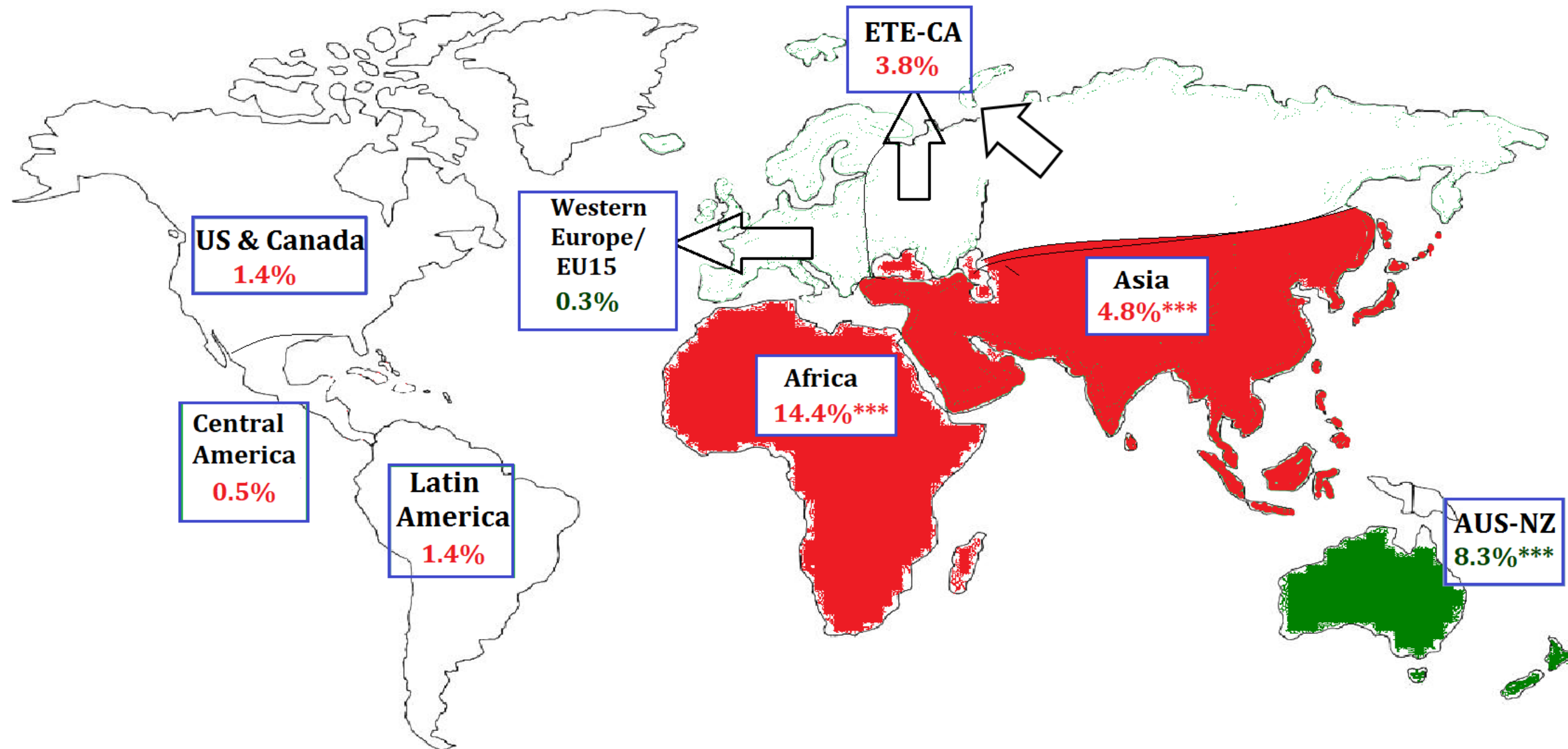
1. World	2. By Sub-sector	3. By Region	4. By Economic Levels
All Countries	(i) Grains (ii) Oil-seeds-nuts-kernels (iii) Fruits and vegetables, (iv) Livestock (v) Dairy products and eggs (vi) Tropical crops	(i) USA-Canada (ii) Central America (iii) Latin America (iv) Western Europe/EU-15 (v) ETE-Central Asia (vi) Africa (vii) Asia (viii) Australia-New Zealand	(i) Developed Countries (HICs) (ii) Upper Middle Income Countries (UMICs) (iii) Lower Middle Income Countries (LMICs) (iv) Low Income Countries (LICs)

RESULTS (1): World and Subsector-wise impacts



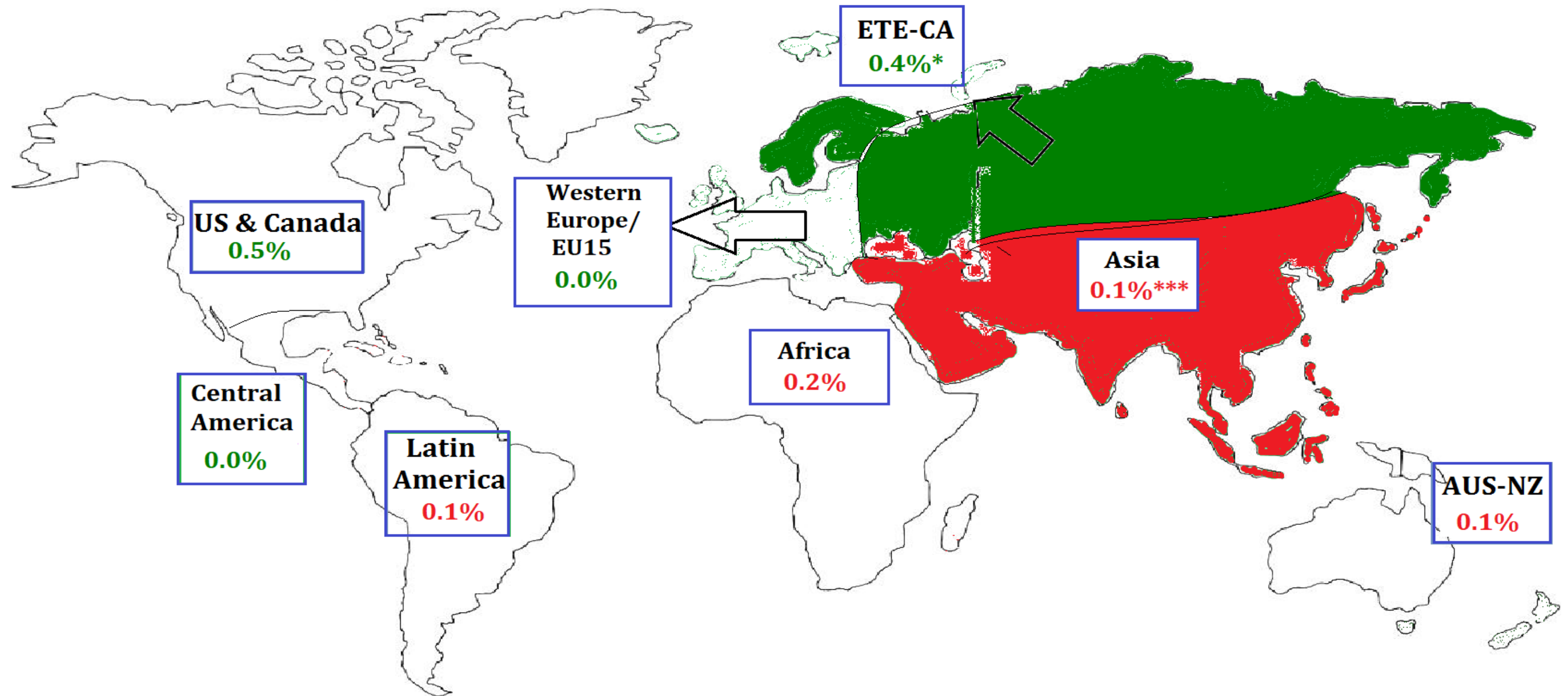
RESULTS (2): Regional Impacts of Temperature

Colour Codes: **GREEN**: Positive Impacts; **RED**: Negative Impacts
Significance Levels: *** = 1%, ** = 5%, and * = 10%
Only significant regions are shaded

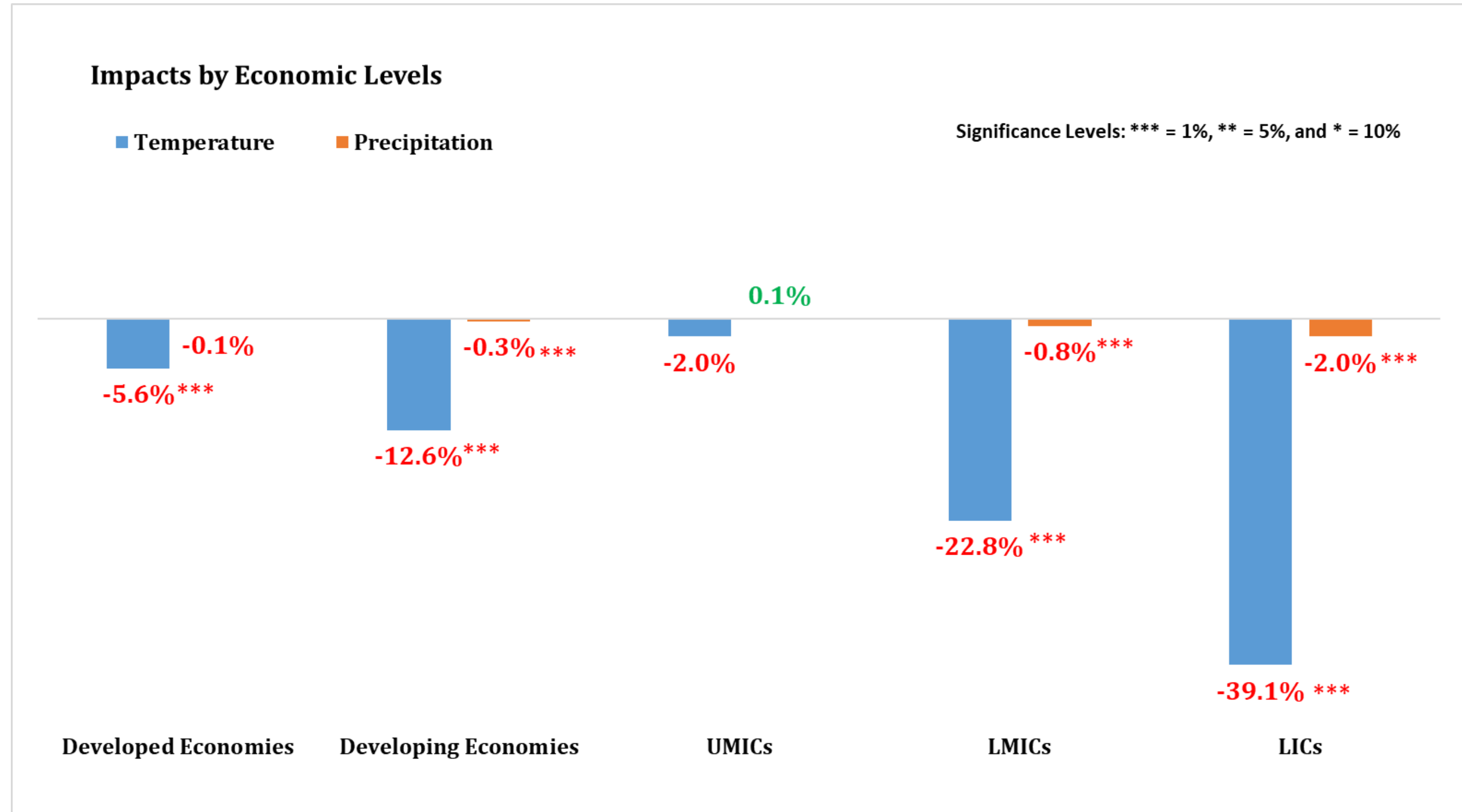


RESULTS (3): Regional Impact of Precipitation

Colour Codes: **GREEN**: Positive Impacts; **RED**: Negative Impacts
Significance Levels: *** = 1%, ** = 5%, and * = 10%
Only significant regions are shaded



RESULTS(4): Impact by Economic Levels



Findings

- Rising temperature has significant negative impacts on world agriculture exports.
- Four Agricultural sectors - grains, oil seeds-nuts-kernels, livestock, and dairy and eggs are significantly vulnerable to temperature increases.
- Exports from two major agriculture producing regions – Asia and Africa are the most susceptible to rising temperature; while Australia-New Zealand appear to benefit from it.
- Both developed and developing economies are affected by temperature increases. Developing economies, particularly poorer ones (LMICs and LICs) are more vulnerable.
- Precipitation changes have weak and limited impacts; vulnerability of developing economies

Conclusion

- Climate change impacts agricultural exports; support previous evidence on the adverse climate on agricultural yield and prices.
- Impacts are heterogeneous across regions; these show that cold-temperate regions experience greater positive changes in their agricultural trade.
- Exports from developing countries (especially the poorer ones) are more vulnerable
- Differential impacts could make many countries or regions lose in the international market and worsen their economic performance; especially the agriculture dependent/developing ones.
- Differentiated policy frameworks across sectors, regions and economic levels may be useful in building resilience.
- World agricultural exports vulnerability may create risk for global food supply.

Thank you for listening



QUESTIONS



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