



# **The El Niño Southern Oscillation cycle and growth in the developing world**

Sarah Smith

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# The El Niño Southern Oscillation cycle and growth in the developing world

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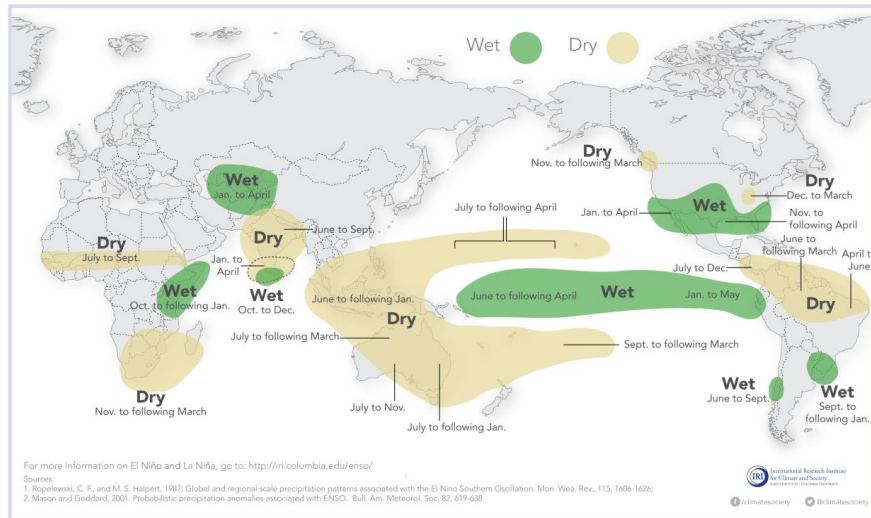


# El Niño Southern Oscillation (ENSO) cycles

## El Niño

### El Niño and Rainfall

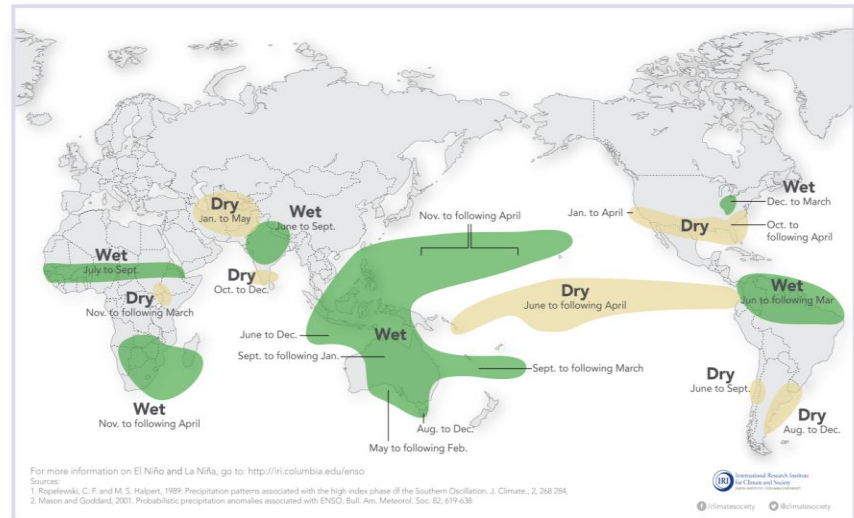
El Niño conditions in the tropical Pacific are known to shift rainfall patterns in many different parts of the world. Although they vary somewhat from one El Niño to the next, the strongest shifts remain fairly consistent in the regions and seasons shown on the map below.



## La Niña

### La Niña and Rainfall

La Niña conditions in the tropical Pacific are known to shift rainfall patterns in many different parts of the world. Although they vary somewhat from one La Niña to the next, the strongest shifts remain fairly consistent in the regions and seasons shown on the map below.



- › Biggest source of year-on-year climate variability
- › Together, define the large scale, medium frequency climate phenomena known as ENSO Cycle

- › Unsurprisingly, ENSO induced climate variability impacts **agricultural production** (Funk et al. 2008; Battisti and Naylor 2009; Naylor et al. 2001)
- › These climate-driven supply shocks have consequences for **world commodity and food prices** (Brunner 2002; Ubilava and Holt 2013; Chen et al. 2008)

Consequences for the macroeconomy?

- › Brunner (2002) found economic growth in the G7 economies to rise by up to half a percentage point in reaction to an El Niño event, but only significant at 10%
- › Berry and Okulicz-Kozaryn (2008) found no evidence of ENSO in inflation and growth in the United States of America
- › Focus on developed economies

- › Equation 1:

$$Y_t = \alpha + \beta Y_{t-1} + \delta_0 ENSO_t + \delta_1 ENSO_{t-1} + \mu_t$$

- › Y is GDP per capita growth, ENSO is SOI or SST, repeated for 78 developing countries

- › Equation 1:

$$Y_t = \alpha + \beta Y_{t-1} + \delta_0 ENSO_t + \delta_1 ENSO_{t-1} + \mu_t$$

- › Y is GDP per capita growth, ENSO is SOI or SST, repeated for 78 developing countries
- › Finds the combined rather than net effect of ENSO

- › Equation 2: Structural change

$$Y_t = \alpha + \beta Y_{t-1} + \delta_0 ENSO_t + \delta_1 ENSO_{t-1} + \left( \tilde{\beta} Y_{t-1} + \tilde{\delta}_0 ENSO_t + \tilde{\delta}_1 ENSO_{t-1} \right) \cdot D + \mu_t$$

- › D dummy variable equal to zero until reach optimal year for structural break after which D is one



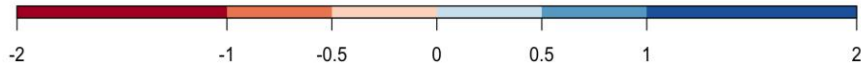
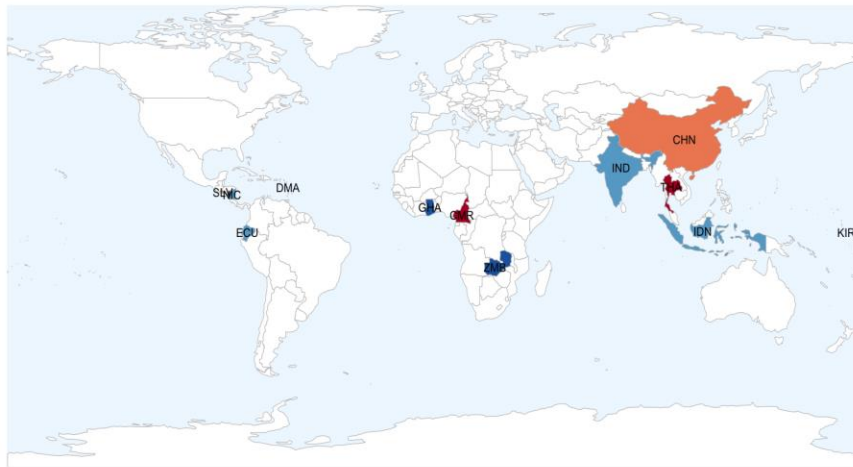
› Equation 2: Structural change

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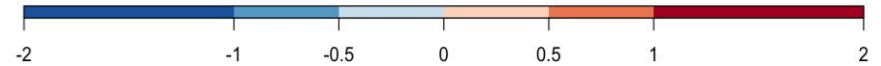
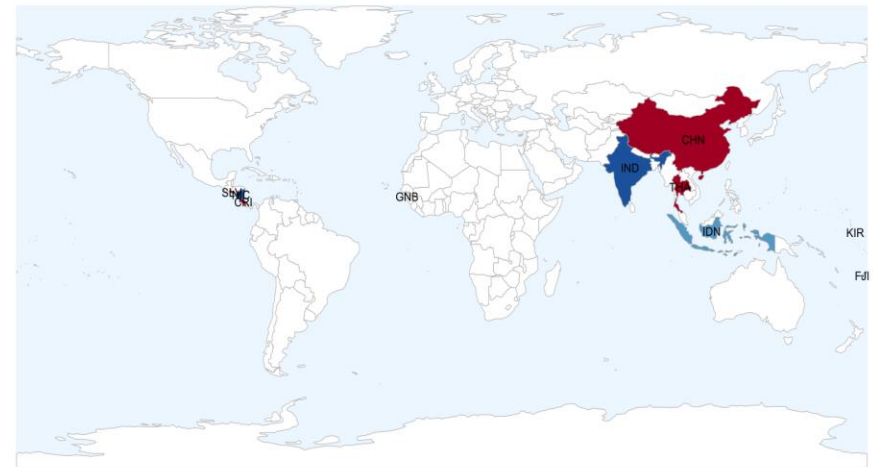
- › D dummy variable equal to zero until reach optimal year for structural break after which D is one
- › Motivation:
- › Industrialisation and diversification
  - › Technology advancements in the mechanisation of agriculture and improved agricultural productivity
  - › Integration of food and commodity markets
  - › ENSO better understood and forecasted



SOI Impact on GDP Per Capita Growth

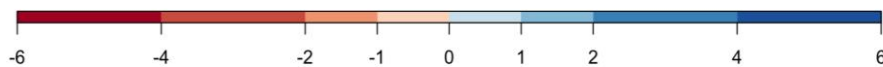
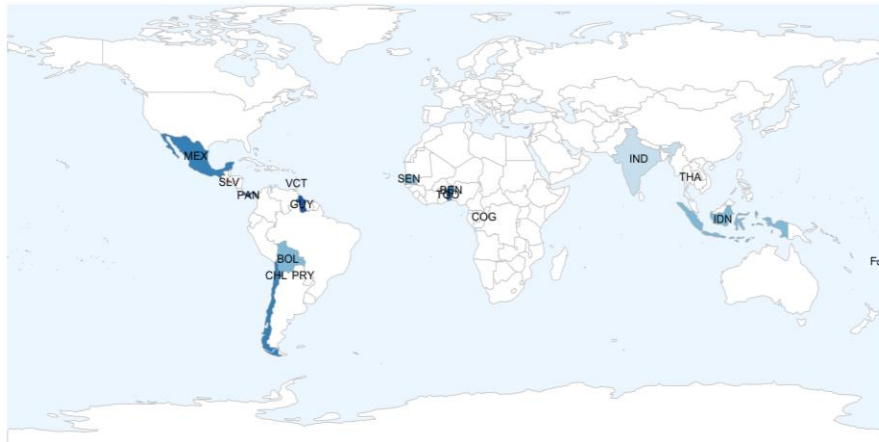


SST Impact on GDP Per Capita Growth

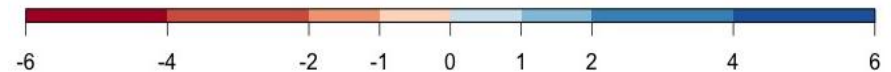




### SOI Impact on GDP Per Capita Growth Before Structural Change Split

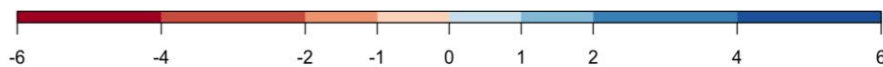
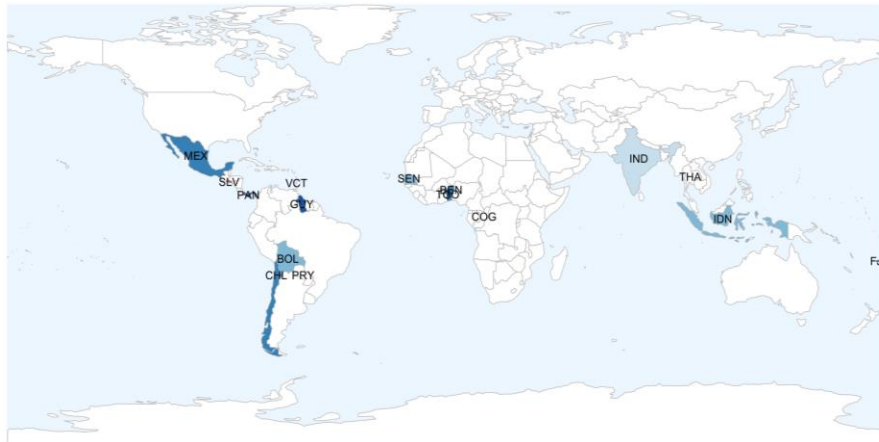


### SOI Impact on GDP Per Capita Growth After Structural Change Split

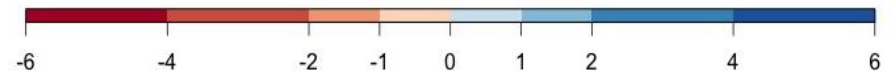




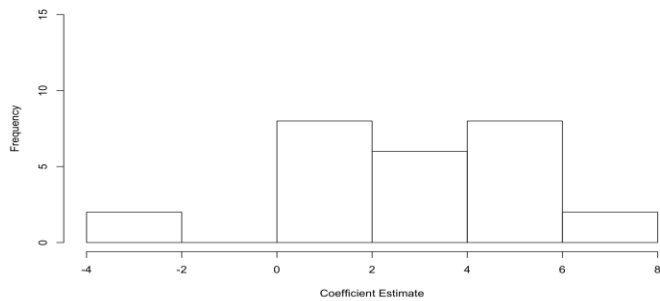
### SOI Impact on GDP Per Capita Growth Before Structural Change Split



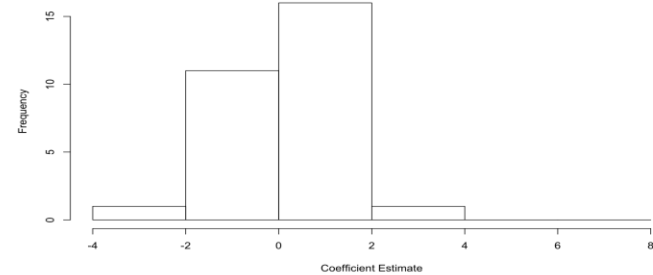
### SOI Impact on GDP Per Capita Growth After Structural Change Split



### Histogram of Estimated Coefficients Before Structural Change



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- › Explicitly consider ENSO in macroeconomic decisions

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- › Reduce climate vulnerability by communicating ENSO forecasts
  - › Decreases uncertainty
  - › Affected parties can take beneficial and timely action

- › Not all low-income countries are affected by ENSO on the macroeconomic scale
- › Those that are directly impacted by ENSO tend to react negatively to dry events and positively to wet events
- › Allowing the reaction of growth to ENSO to change through time uncovered 18 new countries
- › A majority of these have experienced a decreased sensitivity to ENSO in line with economy diversification, industrialisation and international market integration
- › Possible gains from forecast communication

	<b>Coefficient estimate</b>	<b>P-value</b>	<b>Percentage point change for El Niño<sup>1</sup></b>	<b>US\$ per person foregone</b>
Equation 1	0.6	0.017	1.48	\$17 (1997)
Equation 2 before split	1.41	0.005	3.47	\$20 (1982)
Equation 2 after split	0.32	0.048	0.79	\$10 (2009)

<sup>1</sup> El Niño event defined as 2 standard deviation shock in SOI