The Geographical Origins of the Tower of Babel: The Economic Causes and Consequences of Linguistic Structures

Oded Galor, Ömer Özak and Assaf Sarid

AEA Meeting, January 2016
Culture and Development

- Geographic Origins of Culture
Culture and Development

- Geographic Origins of Culture
  - Agricultural origin of time preference
Culture and Development

- Geographic Origins of Culture
  - Agricultural origin of time preference
  - Plow and gender attitudes
Culture and Development

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  - Agricultural origin of time preference
  - Plow and gender attitudes
  - Climatic variability and trust
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- Persistence of cultural traits
  - Vertical (intergenerational) transmission
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  - Agricultural origin of time preference
  - Plow and gender attitudes
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- Persistence of cultural traits
  - Vertical (intergenerational) transmission
  - Reinforced by horizontal transmission
Culture and Languages

- Culture classified by language
Culture and Languages

- Culture classified by language
  - Cultural diversity ⇔ linguistic diversity
Culture and Languages

- Culture classified by language
  - Cultural diversity $\iff$ linguistic diversity
  - Cultural distance $\iff$ linguistic distance
Culture and Languages

- Culture classified by language
  - Cultural diversity $\iff$ linguistic diversity
  - Cultural distance $\iff$ linguistic distance
  - Ethnic fractionalization $\iff$ linguistic fractionalization
Research Agenda

Explore

Causes and consequences of linguistic structures
Co-evolution of languages and the process of development
Do languages merely reflect past experience of society?
Do es linguistic structure partly encode existing cultural traits?
Do es linguistic structure affect economic behavior?
Do es linguistic structure affect the economy's future trajectory?
Explore

- Causes and consequences of linguistic structures
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The presence of a future tense
The Causes and Consequences of the Future Tense

The presence of a future tense

- Causes
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- Causes
  - Geographical determinants
The Causes and Consequences of the Future Tense

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- Consequences
The Causes and Consequences of the Future Tense

The presence of a future tense

- Causes
  - Geographical determinants
- Consequences
  - Contemporary economic outcomes at the individual level
Main Hypothesis

- The likelihood of the presence of a future tense within a language reflects...
Main Hypothesis

- The likelihood of the presence of a future tense within a language reflects
  - Historical return to agricultural investment within the linguistic region
Main Hypothesis

The likelihood of the presence of a future tense within a language reflects:

- Historical return to agricultural investment within the linguistic region
- Time preference within the linguistic region
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  - The association between future tense and economic outcomes
Main Hypothesis

- The likelihood of the presence of a future tense within a language reflects
  - Historical return to agricultural investment within the linguistic region
    - Time preference within the linguistic region
  - The existence of a future tense is associated with economic development reflecting
    - The association between future tense and economic outcomes
      - Partly reflects the effect of time preference
Main Results – Origins of a Future Tense

- Origins of future tense:
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Origins of future tense:

- Exogenous variation in the natural historical return to agricultural investment is associated with the existence of future tense.
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    - Saving
Main Results – Origins of a Future Tense

**Origins of future tense:**

- Exogenous variation in the natural historical return to agricultural investment is associated with the existence of future tense

**Consequences of the future tense:**

- Future tense is associated with contemporary individual economic outcomes
  - Saving
  - Education
Structure of the presentation

1. Introduction
2. The Future Tense
3. Data
4. Empirical Analysis
5. Conclusions
Languages differ in the structure of the future tense.
The Future Tense

Languages differ in the structure of the future tense

- Strong future tense
Languages differ in the structure of the future tense

- Strong future tense
  - Obligatory change in verb structure
The Future Tense

Languages differ in the structure of the future tense

- Strong future tense
  - Obligatory change in verb structure
- Weak future tense
The Future Tense

Languages differ in the structure of the future tense

- Strong future tense
  - Obligatory change in verb structure
- Weak future tense
  - Absence or non-compulsory use of the future tense
Example – Strong vs. Weak Future

- In English, no distinction between the two:
  1. I \textit{am giving} a talk at the moment.
  2. I \textit{am giving} a talk tomorrow.
Example – Strong vs. Weak Future

- In English, no distinction between the two:
  1. I *am giving* a talk at the moment.
  2. I *am giving* a talk tomorrow.

- In Spanish, the distinction between today and tomorrow is clear:
  1. Yo *estoy dando* una charla en este momento.
  2. Yo *daré* una charla mañana.
Should existence of future tense and long-term orientation be related?
Time Preference and Future Tense

Should existence of future tense and long-term orientation be related?

Long-term orientation can be conducive to either

- Strong future tense
Should existence of future tense and long-term orientation be related?

Long-term orientation can be conducive to either

- Strong future tense
- Weak future tense
Time Preference and Future Tense

High LTO $\implies$ strong future tense
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- Planning for the future requires linguistic technology
Time Preference and Future Tense

High LTO $\implies$ strong future tense

- Planning for the future requires linguistic technology
- Future tense allows to talk about future events
The Future Tense

Time Preference and Future Tense

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- Planning for the future requires linguistic technology
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- Explanations (linguistics):
Time Preference and Future Tense

High LTO $\Rightarrow$ strong future tense

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  - Future tense allows to talk about future events
- Explanations (linguistics):
  - Expressiveness
Time Preference and Future Tense

High LTO $\implies$ strong future tense

- Planning for the future requires linguistic technology
  - Future tense allows to talk about future events
- Explanations (linguistics):
  - Expressiveness
    - Extend range of meaning
Time Preference and Future Tense

High LTO $\Rightarrow$ strong future tense

- Planning for the future requires linguistic technology
  - Future tense allows to talk about future events

- Explanations (linguistics):
  - Expressiveness
    - Extend range of meaning
      - Number of words for ice/snow among Eskimo-languages
Time Preference and Future Tense

High LTO $\implies$ weak future tense
Time Preference and Future Tense

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- Long-term oriented individuals distinguish less between present and future
Time Preference and Future Tense

High LTO $\implies$ weak future tense

- Long-term oriented individuals distinguish less between present and future
  - Lower discounting of future events
Time Preference and Future Tense

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- Long-term oriented individuals distinguish less between present and future
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  - Future Tense $\approx$ Present tense
Time Preference and Future Tense

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- Explanations (linguistics):
Time Preference and Future Tense

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- Explanations (linguistics):
  - Efficiency
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Explanations (linguistics):
- Efficiency
  - Structures that are most used disappear along time
High LTO $\Rightarrow$ weak future tense

- Long-term oriented individuals distinguish less between present and future
  - Lower discounting of future events
  - Future Tense $\approx$ Present tense

Explanations (linguistics):
  - Efficiency
    - Structures that are most used disappear along time
      - Case structure in all daughter languages of Latin
Future and Present – Pretty Close…

“Even though the future seems far away, it is actually beginning right now.”

– Mattie Stepanek

“The future starts today, not tomorrow.”

– Pope John Paul II
Linguistic Data – Existence of Future Tense

World Atlas of Language Structures (WALS)
Linguistic Data – Existence of Future Tense

World Atlas of Language Structures (WALS)

- Most comprehensive source of language structures
Linguistic Data – Existence of Future Tense

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- Most comprehensive source of language structures
- Report the presence or the absence of a future tense
Linguistic Data – Existence of Future Tense

World Atlas of Language Structures (WALS)

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- Report the presence or the absence of a future tense
  - 222 languages
Linguistic Data – Existence of Future Tense

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- Most comprehensive source of language structures
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  - 222 languages
  - 208 non-extinct languages (can be mapped to Ethnologue)
Linguistic Data – Existence of Future Tense

World Atlas of Language Structures (WALS)

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  - 208 non-extinct languages (can be mapped to Ethnologue)
  - 75 language families
Linguistic Data – Existence of Future Tense

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- The variation in the existence of future tense exists:
Linguistic Data – Existence of Future Tense

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- Most comprehensive source of language structures
- Report the presence or the absence of a future tense
  - 222 languages
  - 208 non-extinct languages (can be mapped to Ethnologue)
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- The variation in the existence of future tense exists:
  - across and within language families
Linguistic Data – Existence of Future Tense

World Atlas of Language Structures (WALS)

- Most comprehensive source of language structures
- Report the presence or the absence of a future tense
  - 222 languages
  - 208 non-extinct languages (can be mapped to Ethnologue)
  - 75 language families
- The variation in the existence of future tense exists:
  - across and within language families
  - across and within all regions on the globe
## Future Tense in Different Regions in the World

### Table: Summary Statistics by Region

<table>
<thead>
<tr>
<th>Region</th>
<th>Observations</th>
<th>Mean</th>
<th>Std. Dev.</th>
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</thead>
<tbody>
<tr>
<td>Sub-Saharan Africa</td>
<td>44</td>
<td>0.455</td>
<td>0.504</td>
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<tr>
<td>Middle East and North Africa</td>
<td>7</td>
<td>0.429</td>
<td>0.535</td>
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<tr>
<td>Europe and Central Asia</td>
<td>27</td>
<td>0.519</td>
<td>0.509</td>
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<tr>
<td>South Asia</td>
<td>13</td>
<td>0.769</td>
<td>0.439</td>
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<tr>
<td>East Asia and Pacific</td>
<td>67</td>
<td>0.463</td>
<td>0.502</td>
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<tr>
<td>North America</td>
<td>21</td>
<td>0.619</td>
<td>0.498</td>
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<tr>
<td>Latin America</td>
<td>29</td>
<td>0.482</td>
<td>0.509</td>
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<tr>
<td>Total</td>
<td>208</td>
<td>0.505</td>
<td>0.501</td>
</tr>
</tbody>
</table>

*Future = 1, No Future = 0*
Global Distribution of the Presence of Future Tense

Legend
Future
- 1 Inflectional future exists
- 2 No inflectional future
Global Distribution of Language Families
Pre-1500CE Crop Return Data

Caloric Suitability Index (CSI)
## Pre-1500CE Crop Return Data

### Caloric Suitability Index (CSI)

- Potential caloric yield and growth cycles
Pre-1500CE Crop Return Data

Caloric Suitability Index (CSI)

- Potential caloric yield and growth cycles
- Potential Crop Yield
Pre-1500CE Crop Return Data

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  - Calories per hectare per year of the most productive crop
Pre-1500CE Crop Return Data

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- Reflecting early stages of development
Pre-1500CE Crop Return Data

Caloric Suitability Index (CSI)

- Potential caloric yield and growth cycles
  - Potential Crop Yield
    - Calories per hectare per year of the most productive crop
  - Potential Crop Growth Cycles
    - Average of days elapsed from planting to harvesting for the most productive crop
- Reflecting early stages of development
- Unaffected by human intervention
Pre-1500CE Crop Return Data

Potential Crop Return
Pre-1500CE Crop Return Data

- Potential Crop Return
  - Calories per day per hectare of the most productive crop
Pre-1500CE Crop Return Data

- Potential Crop Return
  - Calories per day per hectare of the most productive crop

$$\text{Potential Crop Return} = \frac{\text{Potential Crop Yield}}{\text{Potential Crop Growth Cycle}}$$
Potential Crop Return Pre-1500CE

Data

Galor, Özak and Sarid

Geographical Origins of the Tower of Babel

AEA - 2016
Identification Strategy

Potential Concerns:

Reverse causality:
Future Tense (Time Preference) $\Rightarrow$ actual return to agricultural investment
Choice of crops
Choice of technology

Remedy:
Exploit variation in potential (rather than actual) return to agricultural investment
Identification Strategy

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  - Choice of technology

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- Exploit variation in potential (rather than actual) return to agricultural investment
Identification Strategy

Potential Concerns:

Future Tense Potential Crop Return

Remedy:

Account for the confounding effects of:

Geographical characteristics (e.g., absolute latitude, elevation, roughness, distance to waterways, etc.)
Identification Strategy

Potential Concerns:

- Omitted Variable:
Identification Strategy

Potential Concerns:

- Omitted Variable:
  - Geography
    - Future Tense
    - Potential Crop Return
Identification Strategy

Potential Concerns:

- Omitted Variable:

  Geography

  Future Tense

  Potential Crop Return
Identification Strategy

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  - Future Tense
  - Potential Crop Return

Remedy:

- Account for the confounding effects of:
  - Geographical characteristics
    (e.g., absolute latitude, elevation, roughness, distance to waterways, etc.)
  - Continental FE
Future}_i = \beta_0 + \beta_1 \text{crop return}_i + \beta_2 X_i + \delta_c \Delta_i + \epsilon_i,

- \text{Future}_i \equiv \text{Existence of future tense in language } i
- X_i \equiv \text{Geographical controls}
- \Delta_i \equiv \text{Continental FEs}
<table>
<thead>
<tr>
<th></th>
<th>Column 1</th>
<th>Column 2</th>
<th>Column 3</th>
<th>Column 4</th>
<th>Column 5</th>
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<th>Column 7</th>
<th>Column 8</th>
<th>Column 9</th>
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<tr>
<td>Crop Return (pre-1500CE)</td>
<td>-0.07**</td>
<td>-0.10**</td>
<td>-0.10***</td>
<td>-0.10***</td>
<td>-0.09**</td>
<td>-0.10**</td>
<td>-0.09**</td>
<td>-0.10**</td>
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<td>Absolute Latitude</td>
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<td>-0.13**</td>
<td>-0.13**</td>
<td>-0.10*</td>
<td>-0.11</td>
<td>-0.10</td>
<td>-0.15</td>
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<tr>
<td>Precipitation (std)</td>
<td>-0.10***</td>
<td>-0.04</td>
<td>-0.04</td>
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<td>Precipitation Volatility</td>
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<tr>
<td>Precipitation Spatial Correlation</td>
<td>-0.02</td>
<td>-0.83**</td>
<td>-0.79**</td>
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<td>Temperature</td>
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<td>Temperature Volatility</td>
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<tr>
<td>Temperature Spatial Correlation</td>
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<td>(0.34)</td>
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<tr>
<td>Crop Winter (pre-1500CE)</td>
<td>-0.07*</td>
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<tr>
<td>Continental FE</td>
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<td>0.08</td>
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## Crop Return and Other Linguistic Structures

<table>
<thead>
<tr>
<th>Linguistic Structure</th>
<th>Temporal Structures</th>
<th>Non-Temporal Structures</th>
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<tbody>
<tr>
<td></td>
<td>Future (1)</td>
<td>Past (2)</td>
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<tr>
<td>Crop Return (pre-1500CE)</td>
<td>-0.12*** (0.04)</td>
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</tr>
<tr>
<td>All Geographic Controls</td>
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<td>Yes</td>
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<tr>
<td>Continental FE</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Adjusted-$R^2$</td>
<td>0.08</td>
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<td>Observations</td>
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## Future Tense across Language Families

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<th>Existence of Future Tense (median)</th>
<th>Full Sample</th>
<th>≥ 2 Languages</th>
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<tr>
<td>Crop Return (pre-1500CE)</td>
<td>-0.22***</td>
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<td>(0.05)</td>
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<tr>
<td>Main Geographical Controls</td>
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<td>No</td>
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<tr>
<td>Precipitation Controls</td>
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Language Family Analysis – contd.

(a) All language families
Pre-1500CE Crop Return & Patterns of Subsistence

Diagram:

- **Time Preference**
- **Future Tense**
- **Crop Return**
- **Pattern of Subsistence**

Arrows indicate relationships between these concepts.
Ethnographic Subsistence Patterns

- Ethnic groups’ subsistence strategies
Ethnographic Subsistence Patterns

- Ethnic groups’ subsistence strategies
  - Hunting
Ethnographic Subsistence Patterns

- Ethnic groups’ subsistence strategies
  - Hunting
  - Gathering
Ethnographic Subsistence Patterns

- Ethnic groups’ subsistence strategies
  - Hunting
  - Gathering
  - Fishing
Ethnographic Subsistence Patterns

- Ethnic groups’ subsistence strategies
  - Hunting
  - Gathering
  - Fishing
  - Animal Husbandry
Ethnographic Subsistence Patterns

- Ethnic groups’ subsistence strategies
  - Hunting
  - Gathering
  - Fishing
  - Animal Husbandry
  - Agriculture
Ethnographic Subsistence Patterns

- Ethnic groups’ subsistence strategies
  - Hunting
  - Gathering
  - Fishing
  - Animal Husbandry
  - Agriculture

- Hunter-gatherer ethnic group
Ethnographic Subsistence Patterns

- Ethnic groups’ subsistence strategies
  - Hunting
  - Gathering
  - Fishing
  - Animal Husbandry
  - Agriculture

- Hunter-gatherer ethnic group
  - Hunting + Gathering $\geq 50\%$ of subsistence
Ethnographic Subsistence Patterns

- Ethnic groups’ subsistence strategies
  - Hunting
  - Gathering
  - Fishing
  - Animal Husbandry
  - Agriculture
- Hunter-gatherer ethnic group
  - Hunting + Gathering ≥ 50% of subsistence
- Agriculturalist ethnic group
Ethnographic Subsistence Patterns

- Ethnic groups’ subsistence strategies
  - Hunting
  - Gathering
  - Fishing
  - Animal Husbandry
  - Agriculture

- Hunter-gatherer ethnic group
  - Hunting + Gathering ≥ 50% of subsistence

- Agriculturalist ethnic group
  - Animal husbandry + Agriculture ≥ 50% of subsistence
## Principal Components of Subsistence Pattern

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Hunter-Gatherers – High First PC
Agriculturalists – Low First PC

![Box plot showing the distribution of the first principal component of patterns of subsistence and agriculturalism between agriculturalists and non-agriculturalists. The plot indicates a lower first principal component for non-agriculturalists compared to agriculturalists.](image)
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# Patterns of Subsistence and Future Tense

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</table>
Crop Return, Future Tense and Contemporary Individual Behavior

- Explore whether language has a direct impact on
Crop Return, Future Tense and Contemporary Individual Behavior

- Explore whether language has a direct impact on
  - Saving
Crop Return, Future Tense and Contemporary Individual Behavior

- Explore whether language has a direct impact on
  - Saving
  - Education level
Crop Return, Future Tense and Contemporary Individual Behavior

- Explore whether language has a direct impact on
  - Saving
  - Education level
- Use World Value Survey (all waves)
Crop Return, Future Tense and Contemporary Individual Behavior

- Explore whether language has a direct impact on
  - Saving
  - Education level
- Use World Value Survey (all waves)
  - Individual level analysis
Crop Return, Future Tense and Contemporary Individual Behavior

- Explore whether language has a direct impact on
  - Saving
  - Education level
- Use World Value Survey (all waves)
  - Individual level analysis
  - Individual controls
Crop Return, Future Tense and Contemporary Individual Behavior

- Explore whether language has a direct impact on
  - Saving
  - Education level
- Use World Value Survey (all waves)
  - Individual level analysis
  - Individual controls
- Use language to identify individual’s cultural ancestry
Crop Return, Future Tense and Contemporary Individual Behavior

- Explore whether language has a direct impact on
  - Saving
  - Education level

- Use World Value Survey (all waves)
  - Individual level analysis
  - Individual controls

- Use language to identify individual’s cultural ancestry
  - Ancestry-adjustment of geographical characteristics similar to Putterman-Weil
Crop Return, Future Tense and Contemporary Individual Behavior

- Explore whether language has a direct impact on
  - Saving
  - Education level
- Use World Value Survey (all waves)
  - Individual level analysis
  - Individual controls
- Use language to identify individual’s cultural ancestry
  - Ancestry-adjustment of geographical characteristics similar to Putterman-Weil
  - Within-country and within age-gender-group variation
## Empirical Analysis

### Crop Return, Future Tense and Savings

<table>
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<th>Has the Family Saved Last Year</th>
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<td><strong>Future Tense</strong></td>
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<td><strong>Country FE</strong></td>
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## Crop Return, Future Tense and Education Level

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Preliminary Conclusions

- The likelihood of the presence of a future tense within a language reflects...
The likelihood of the presence of a future tense within a language reflects:

- Historical return to agricultural investment within the linguistic region
Preliminary Conclusions

- The likelihood of the presence of a future tense within a language reflects
  - Historical return to agricultural investment within the linguistic region
- The existence of a future tense is associated with economic development reflecting
Preliminary Conclusions

- The likelihood of the presence of a future tense within a language reflects
  - Historical return to agricultural investment within the linguistic region
- The existence of a future tense is associated with economic development reflecting
  - The association between future tense and economic outcomes
The Geographical Origins of the Tower of Babel: The Economic Causes and Consequences of Linguistic Structures

Oded Galor, Ömer Özak and Assaf Sarid

AEA Meeting, January 2016
## Basic Result – OLS

### Existence of Future Tense

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Example – Strong vs. Weak Future

In French, the distinction between today and tomorrow is clear:

1. Il *fait* froid aujourd’hui.
2. Il *fera* froid demain.

In German, no distinction between the two:

1. Heute *ist* es kalt.
2. Morgen *ist* es kalt.