Nowcasting using International Futures

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Outline

• Nowcasting and integrated assessment models
• International Futures
• Discussion
Integrated Assessment Models

• Explore the interaction across development systems, traditionally focused on questions related to environmental policy

• But other tools exist that more broadly represent development from an integrated perspective
Space-Time

Country

Space

Grid

Second

Time

Year
International Futures

• Model forecasting hundreds of integrated variables for 186 countries to 2100
• Country level, sub-national, and bilateral models
• Structural model characterized by various quantitative methods connected in algorithmic frameworks
• Barry Hughes is founder—over 40 years of development
Data: WDI, WTO, IMF, etc

Data Pre-Processor:

International Futures (forecasts from 20??-2100)
Data: WDI, WTO, IMF, etc

Data Pre-Processor:

International Futures (forecasts from 20??-2100)

Historical Data | Now | Projection
Data:
WDI, WTO, IMF, etc

Data Pre-Processor:

International Futures (forecasts from 20??-2100)

Historical Data | Last Year of Data | Nowcast | Projection
Data: WDI, WTO, IMF, etc

Data Pre-Processor:

International Futures (forecasts from 20??-2100)

Historical Data

Last Year of Data

Nowcast

Projection
Pre-processor

• How do you initialize a model with 500 variables across multiple issue areas where data converge is inconsistent?
  • Seeding holes where possible
  • Estimating holes where necessary (cross-sectionally)
  • Balancing global sums (sometimes with iteration/optimization)
  • Using flows to calculate and estimate stocks
  • Extrapolation

• See documentation and model code
The IFs Model

pardee.du.edu
International Futures (IFs)

- Gender (Cross-Cutting)
- Governance
- International Politics
  - Education
  - Economics
  - Health
  - Infrastructure
  - Demographics
  - Energy
  - Agriculture
  - Technology (Cross-Cutting)
  - Environment
The IFs Model: Demographics

• Standard age-sex cohort component model
• Endogenous fertility, mortality, migration
The IFs Model: Economics

• Input-output table embedded in social accounting matrix, endogenized productivity across four broad categories

• Bilateral trade by sector, tariffs by sector
The IFs Model: Health

• Mortality and morbidity by age/sex
• Relative risk tables across 21 categories
• Undernutrition, stunting, obesity, smoking, urban air pollution, cookstoves, water and sanitation
The IFs Model: Education

- Enrollment by level by sex
- Quality by level by sex by reading/math
- Connected to government finance

Human Capital Distribution for Switzerland in Year 2018 [Base Case]
The IFs Model: Energy

- Production/consumption by oil, gas, coal, hydro, nuclear, renewable
The IFs Model: Infrastructure

- Supply/demand for electricity production, access, roads (paved/unpaved), water and sanitation, and ICT
- Connected to public/private finance
The IFs Model: Agriculture

- Land use, production (fish, meat, crop), loss, trade
- Connected to food security issues (imports, calories available)
The IFs Model: Environment

- Carbon cycle
- Impacts productivity and agriculture production
- Multiple measures of adaptive capacity to climate change
The IFs Model: Governance

• Conflict (international and domestic)
• Capacity (government revenue, corruption, effectiveness)
• Inclusion (gender, democracy)
Trade, Migration,
Geopolitics
The IFs Model

• Documentation:
  • Wiki: pardee.du.edu/wiki

\[ VADDP_{r,s} = CDA_{r,s,t=1} \times TEFF_{r,s} \times CAPUT_{r,s} \times KSF_{r,s}^{CDALFS_{r,s}} \times LABS_{r,s}^{1-CDALFS_{r,s}} \]

\[ s = 3, 4...nsectr \quad \text{or} \quad s = 1, 2...nsectr \]
Validation from 95-15
Example 1: Severe Acute Malnutrition

• Data exist across multiple sources
• Many nulls
• Temporal coverage varies significantly
## Estimate drivers

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
<th>Model 6</th>
<th>Model 7</th>
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<tr>
<td>Education</td>
<td>-0.155**</td>
<td>-0.177***</td>
<td>-0.176**</td>
<td>-0.187***</td>
<td>-0.168***</td>
<td>-0.0983</td>
<td>-0.103**</td>
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<td>(0.000)</td>
<td>(0.003)</td>
<td>(0.000)</td>
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<td>Gender Gap</td>
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<td>Transparency</td>
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<td>-0.290*</td>
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<td>-0.306**</td>
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<td>R²</td>
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<td>-410.6</td>
<td>-594.8</td>
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</tr>
</tbody>
</table>

*p-values in parentheses

* p < 0.05, ** p < 0.01, *** p < 0.001
Need to estimate IVs:

- Education: connected to the education pipeline
- Transparency: Simple relationship with GDP per capita
- Conflict: driven by variables identified in the quantitative literature (Goldstone et al 2010)
Example 2: Yemen during conflict
**FIGURE 4** | Illustration of a “conflict-attributable” difference in this analysis. The “conflict-attributable” impact on a particular indicator is the difference between the indicator value in the No Conflict scenario and a scenario that includes conflict.
<table>
<thead>
<tr>
<th>2019 IMPACT</th>
<th>If the conflict were to end in 2019, it would account for:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>233,000 DEATHS</strong></td>
<td>1 CHILD DEATH every 11 minutes and 54 seconds in 2019</td>
</tr>
<tr>
<td>(0.8 per cent of the 2019 population) with 102,000 combat deaths and 131,000 indirect deaths due to lack of food, health services and infrastructure</td>
<td></td>
</tr>
<tr>
<td><strong>140,000</strong> deaths of children under the age of five</td>
<td></td>
</tr>
<tr>
<td><strong>13.4M YEARS</strong> years of the population living with malnutrition (17 per cent of the total population in 2019)</td>
<td>44M YEARS of people living in extreme poverty (40 per cent of the 2019 population)</td>
</tr>
<tr>
<td><strong>1.6M YEARS</strong> of children living with malnutrition (14 per cent of the 2019 child population)</td>
<td></td>
</tr>
<tr>
<td><strong>10.3M YEARS</strong> of children without access to schools (36 per cent of school-aged children in 2019)</td>
<td></td>
</tr>
<tr>
<td><strong>US $89B</strong> loss in economic output &amp; <strong>US $2,000</strong> reduction in Gross Domestic Product (GDP) per capita (at Purchasing Power Parity (PPP))</td>
<td></td>
</tr>
</tbody>
</table>
Example 3: SDGs
Results:
Discussion

Uncertainty and epistemological limits:

“...all models are wrong but some are useful”
-Someone Smart
Conclusion

• Open and transparent tool: pardee.du.edu
• Academic research center
• Collaborations with lots of international organizations, UN and AU
• Lots of data and model-based resources to share
• Next model steps focus on forecasting networks and sub-national analysis

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