The Political Economy of Economic Complexity: Theory, Data, Methods

Section 3
Practical exercises and assessment of the CAD

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Outline

1. General introduction & motivation: drivers of economic development

2. Introducing the *Economic Complexity Index* (ECI)

   2.1 Historical genesis

   2.2 How to compute economic complexity

   2.3 Theories underlying economic complexity

   2.4 Advantages and critiques of the measure

3. **Practice: using data from the Atlas of Economic Complexity**

4. Selected applications

5. Outlook: using economic complexity in your own research

Outline

- Now that we understood where the basic measures come from we want to assess its empirical validity

- Later, we also want to discuss its conceptual strengths and weaknesses

- But first we want to learn how to work with the data

- Thus, the plan for this section is the following:

  1. Learn how to use the data visualization tools from the Atlas webpage

  2. Assess the empirical performance of the complexity index and complexity growth projections

  3. Discuss the conceptual validity of the index

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Working with the complexity data

- It is a good exercise to compute the index yourself (see course notes)

- In daily practice its better to use the data as provided by the Atlas of Economic Complexity

    - There is also a `MIT Version', but I find that being less well developed

- There are two major ways to work with the data:

    1. Download the data and process it yourself

    2. Build visualization using the online tools

- Which one to choose depends entirely on your research interest

- We first try out the section option, and return to the first one later

Using the Atlas' visualization techniques

- The Atlas web page is foremost a web-based visualization engine

- Its very useful to look up certain facts about trade data, or build some nice figures

Team task 1: Using stacked charts over time (Europe)

Compare the change in export structure of Greece, Czechia and Germany and present it with data from the economic complexity index. What does it tell you about the catch-up dynamics and what would you expect for the future?

Team task 2: Using stacked charts over time (BRICS)

Compare the BRICS countries with each other: how did the export structure of the archetypical catch-up countries change over time? What would you expect for the future?

Team task 3: Using the product space

Compare the product spaces of selected rich and poor countries and figure out a pattern. What is the central challenge for these countries with regard to technological upgrading?

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The ECI and national income

- It has been shown that the ECI explains much more variance in growth rates than e.g. human capital or a competitive index

- But not all countries fit well the correlation

    ``[...] the complexity of a country's economy is correlated with income and [...] deviations from this relationship are predictive of future growth, suggesting that **countries tend to approach the level of income associated with the capability set available in them** (Hidalgo and Hausmann, 2009, p. 10570).
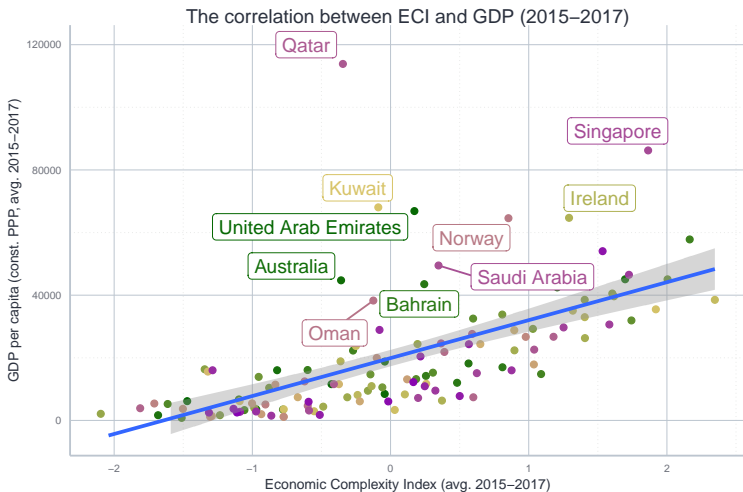
Deviations

The correlation between ECI and GDP (2015–2017)
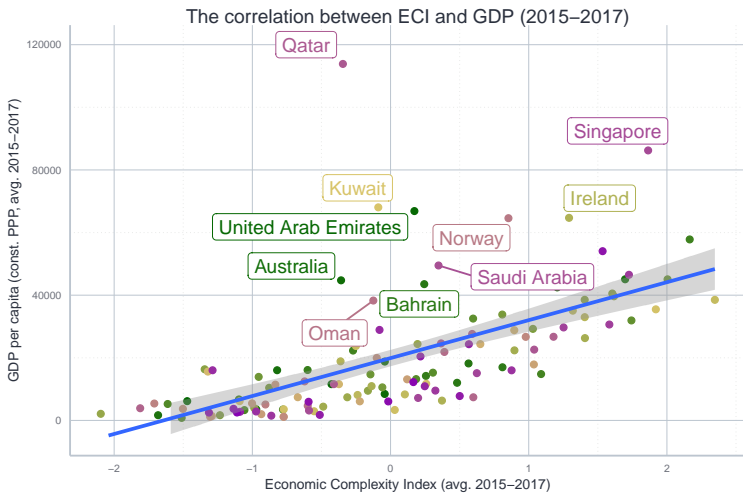
Source: *own calculation based on data from World Bank and Atlas of Econ Complexity*

- What distinguishes the outliers from the rest?

    - For most of them it is not their complexity that makes them `rich'...

    - ...but their natural resources - at least for now

    - ...or their role as international tax havens

- Personally, I found deviations from the ECI-GDP relationship often more illustrative than the fits

- These deviations force us to think about a story that is usually very interesting

- A good exercise is to control for some variable, e.g. oil exports, and then see whether some outliers got eliminated

Deviations

The correlation between ECI and GDP (2015–2017)

Source: *own calculation based on data from World Bank and Atlas of Econ Complexity*

Deviations - oil countries removed
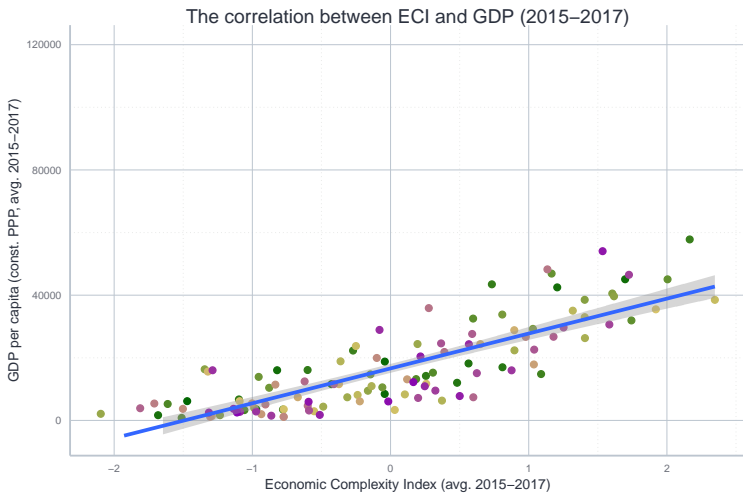
Source: *own calculation based on data from World Bank and Atlas of Econ Complexity*

Growth projections

- The Atlas also forms the basis for the *growth projections* published by the Harvard CID

- A prediction of how much a country will grow

- Built upon four main factors:

  1. The current ECI

  2. The Complexity Outlook Index

  3. The current level of income

  4. The expected growth in the value of natural resource exports per capita.
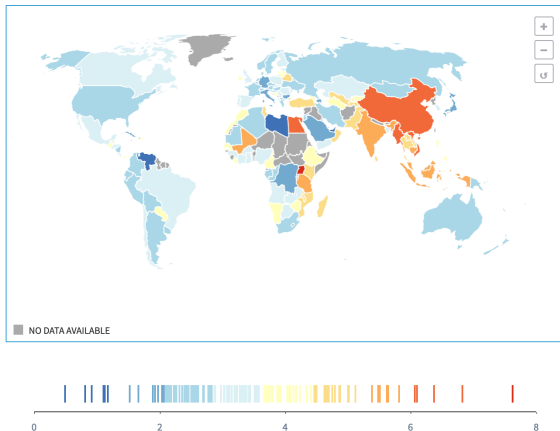
Economic Complexity Outlook Index

- Within the product space it was better to be nearby many products

- The COI measures how many complex products are nearby the current position in the product space

- A low COI indicates that the country is in a technological dead-end

- Formally, the COI is defined as:

$$COI_c = \sum_p \left(1 - \phi_{cp}\right) \left(1 - M_{cp}\right) PCI_p \tag{1}$$

- Thus, growth projections are just elaborated versions of the claim that deviations from the level of income predicted by the ECI are usually meaningful for future development

Working with the Atlas
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Empirical validity
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Conceptual discussion
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Taking stock
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References

Example for growth projections

Source: The Atlas of Economic Complexity

Group work: ECI and income (10 minutes)

- Get together in small groups
- Go to the Atlas of Economic Complexity and download data on economic complexity
  - Use HS data on the one digit level (called `section' data)
- Go to the course homepage and download data on GDP
- Check the correlation between a country's income with its ECI
- Test whether changing time horizons changes the results
- After 10 minutes, shortly present your results to the others

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References

Advantages & disadvantages I

Group work (10 minutes)

- Get together in small groups
- Discuss the potential advantages & disadvantages of the complexity approach introduced so far
- How does it align with development theories you know about? Are their complementarities such that they can address their mutual shortcomings?
- After 10 minutes, shortly present your results to the others

Disadvantages

- **Ambiguous concept of `capabilities'**
    - No full-fledged theory of capabilities backing the indicator
    - Capabilities include diverse aspects such as human and physical capital, national institutions, organizational capacities to coordinate diverse teams, ...
    - It is recognized that capabilities come in both embodied and disembodied form, in tacit and codified versions, and that they relate both to the creation and dissemination of knowledge

- **No distinction between technological and productive capabilities**
    - Prevents us from answering question of how an increase of technological capabilities impacts on the productive capabilities of an economy Archibugi, Denni, and Filippetti (2009, see e.g.)

- **Measurement problems**
    - SITC codes used for long-term evolution of the ECI have problems in accommodating new products, such as smartphones
    - As for HS categories, weird things happen after updates:
    - In 2007, a new version has been released and some products were dropped in the new version
    - Some countries stopped reporting such products also in the HS92
    - This has lead to an apparent drop in the production of some products, and a corresponding rise in complexity for, e.g. tin products.

- **Only considers final exports**
    - No explicit consideration of trade-in-value-added
    - Problematic values for tax havens

Advantages I

- **Outcome-based measure**

    - Directly measures what countries make of their situation, rather than considering their institutional or geographical conditions with regard to their benefit for technological change.

    - Facilitates cross-country comparisons compared to composite indicators based on institutional data:

        - a law that works in one country does not necessarily work in another, which is why a comparison of countries in terms of their legal frameworks can be misleading if one is ultimately interested in their technological capabilities.

    - Comparing the capabilities directly is probably a better choice.

- **Excellent coverage**

    - Available for almost all UN countries from 1963

Working with the Atlas
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Empirical validity
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References

Advantages II

- **Few degrees of freedom**

    - Many composite indicators aggregate the information from various sources.

    - During the aggregation procedure, the various ingredients usually get weighted -- a source of subjectivity and variation.

    - For the ECI, on the other hand, there are not many ways to compute it.

    - Aside from the 'method of reflections' I am aware only of the alternative method of Tacchella et al. (2013) to derive the index.

- **Intuitive interpretation and good predictor for economic growth**

    - The interpretation of the ECI is straightforward.

    - Complex countries have many and sophisticated capabilities.

    - They tend to be rich because they can transform inputs to outputs in fancy ways.

    - Less complex products do not have these capabilities, which is why they are less developed.

    - Also, the complexity and relatedness of products can be illustrated very nicely through the *product space*

Taking stock

- The ECI is a measure for the collective knowledge present in an economy (or a region, ...)

- It is successful because the ECI index correlates strongly with income levels...

- ...and ``deviations [...] are predictive of future growth, suggesting that **countries tend to approach the level of income associated with the capability set available in them**.'' (Hidalgo and Hausmann, 2009, p. 10570)

- However, many questions remain controversial:

  - How are capabilities accumulated?
  - How can one accelerate the collective learning of countries?
  - What are the political economy issues involved in capability accumulation?
  - What is the precise interpretation of the index?
  - What exactly is the relation of the ECI to diversity and other network measures?

- Many of these questions are worth working on, so see them as motivation rather than obstacle

- Also, little research has been done on the political economy of the product space

References I

Daniele Archibugi, Mario Denni, and Andrea Filippetti. "The technological capabilities of nations: The state of the art of synthetic indicators". In: *Technological Forecasting and Social Change* 76.7 (Sept. 2009), pp. 917–931.

C A Hidalgo and R Hausmann. "The building blocks of economic complexity". In: *Proceedings of the National Academy of Sciences* 106.26 (2009), pp. 10570–10575.

A Tacchella et al. "Economic complexity: Conceptual grounding of a new metrics for global competitiveness". In: *Journal of Economic Dynamics and Control* 37.8 (Aug. 2013), pp. 1683–1691.