A probabilistic method for reconstructing the FDI network in search of ultimate host economies

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Foreign Direct Investments (FDI) and CDIS database

FDI: When an investor of one economy makes an investment in an enterprise of another economy, that allows to have control or a significant degree of influence. *[Source: IMF]*

The Coordinated Direct Investment Survey (CDIS)

- Promoted by IMF, annual and voluntary
- Inward FDI (investments received) and Outward FDI (investments made) by counterpart economy

Investments hubs and tax havens: facilitate transit of investments due to favourable tax regimes and off-shore services.

economies ⇒ **Goal of MultiNational Enterprises:** Tax optimization by channeling investments through several

Ultimate investing economy and Ultimate host economy

Difficult to interpret FDI statistics by immediate partner economy as it does not show the ultimate sources and destinations of FDI.

Ultimate investing economy (UIE): where the investment originated

Ultimate host economy (UHE): final recipient of the investment

- who ultimately controls the investments/ultimate destination
- reveals the financial connections between economies
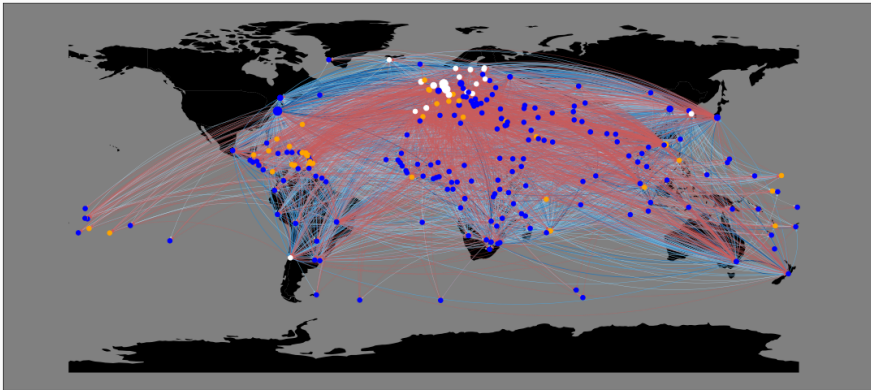- info on businesses using offshore centers

   Difficult to collect/provide data on UHE (no data available).

The Outward FDI Network

246 countries represented by their capitals. Reporting countries: 89
Orange: Tax havens, **White**: investment hubs, **Blue**: all the others

Red links: Confidential data. The import of the investment is censored ($\sim 24.7\%$ of the reported data)

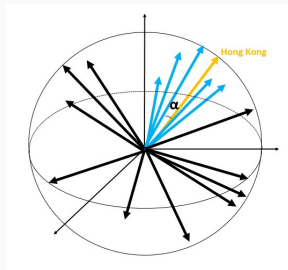Imputation of confidentials and adding missing links:

- **Mirroring the Inward FDI database**:
  Outward of A by counterpart B = Inward of B by counterpart A

Imputation of remaining confidentials:

- **Clustering techniques**: "countries that are *similar* have the same outward ratios"

1. We cluster the countries according to how similar their outward FDI ratio are;

2. If the FDI of country A towards B is confidential, we impute it by averaging the FDI towards B of the first N_{close} countries of A that report such data.

We simulate the investment process on the FDI network following the investment from the investor to the final recipient.[1]

We allow for a **conduit component** $q_c(j)$ in each country $j = $ % of FDI received passing through it:

$$q_c(j) = \frac{SPE_{out}(j)}{FDI_{out}(j)}$$

[*OECD statistics, average over 3 years.*]

Tax haven: $q_c(j) = 1$.
All the investments pass through, no real investment is made in such countries.

**Otherwise** $q_c(j) = 0$: no investment passes through.

Country	q_c (perc)
Luxembourg	94.42%
Hungary	80.92%
Netherlands	59.83%
Austria	17.33%
Lithuania	12.21%
Denmark	11.66%
Switzerland	10.68%
Portugal	9.08%
Belgium	7.72%
Spain	7.48%
Estonia	7.33%
Iceland	6.73%
Norway	3.45%
Sweden	3.37%
Poland	2.42%
Chile	2.11%
Finland	0.14%
South Korea	0.01%
Hong Kong	78.00%
Ireland	65.00%
Singapore	57.00%
United Kingdom	21.00%

[1]see also B. Casella, *Looking through conduit FDI in search of ultimate investors*, UNCTAD

In search of UHE: the Markov chain model

We simulate the investment process on the FDI network following the investment from the investor to the final recipient.

1. Starts from country i: the investment has a probability of (%FDI from i to j) to be invested in country j;

2. it either stays in j (j is the UHE of i) with prob $(1 - q_c(j))$ or it passes through to another country with prob $q_c(j)$ (j behave as a conduit);

3. Reiterate steps 1. and 2. from j.
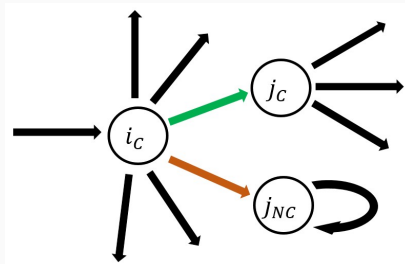
(%FDI of country i towards country j)*(prob country j acts as a conduit)

(%FDI of country i towards country j)*(prob country j does not act as a conduit)

Eventually the investment chain (random walk) will end up in one non-conduit node, which will be the final recipient economy (UHE).

$\Rightarrow$ Absorbing Markov chain.
We can retrieve the final FDI distribution by UHE for each country.

Theorem

Starting country

$$P = \begin{matrix} \text{abs} \\ \text{trans} \end{matrix} \begin{matrix} \text{abs} & \text{trans} \\ \begin{bmatrix} I & 0 \\ R & Q \end{bmatrix} \end{matrix} \xrightarrow[\text{as } n \to \infty]{} P^* = \begin{matrix} \text{abs} \\ \text{trans} \end{matrix} \begin{matrix} \text{abs} & \text{trans} \\ \begin{bmatrix} I & 0 \\ (I-Q)^{-1}R & 0 \end{bmatrix} \end{matrix}$$

UHE distribution

Comparison between Italian FDI bilateral data (blue) and the estimated distribution of Italian FDI by UHE (green), sorted in decreasing order by bilateral data. Only values over 1% are displayed.
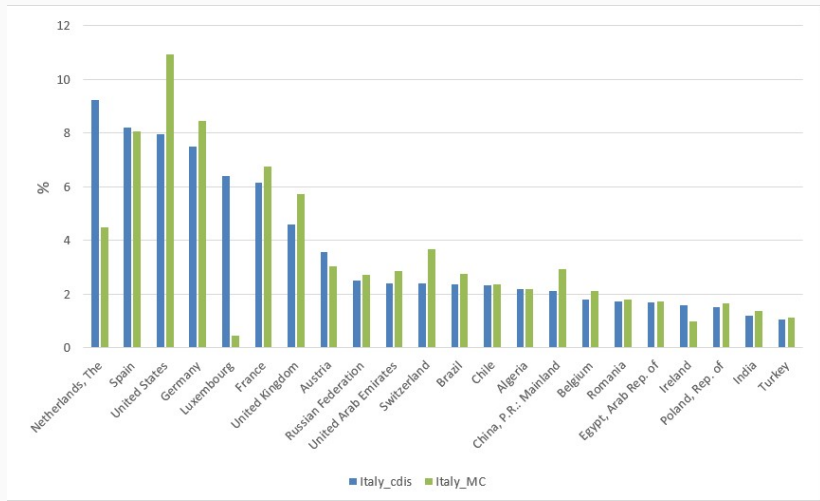
Thank you for your attention!

Questions?