Evaluating Countries and Products in international trade

An Evolutionary Bipartite Graph Approach

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Two Questions?

In International trade

Which countries do better?

Which products are more “valuable”?

Let’s call them “**Great**” countries and products!

Hypotheses

Criteria for “Great” countries

1) Such countries export many “**Great**” products.

2) Such countries **do not really depend** on any other specific country.

3) Such countries export some products which other “**Great**” countries import.

Hypotheses (cont'd)

Criteria for "Great" products

1) Such products are **imported a lot**.

2) Such products are imported by many "**Great**" countries.

Intuitions

For “Great” countries

1) A country **makes money** by **exporting** products to other countries.

2) A country **spends money** by **importing** products from other countries.

3) “Great” countries **make more** money at last.

For “Great” products

1) “Great” products are **imported** by “Great” countries a lot.

Dataset

Internal dataset Attributes

Finance (1991-2014): Imports/Exports data

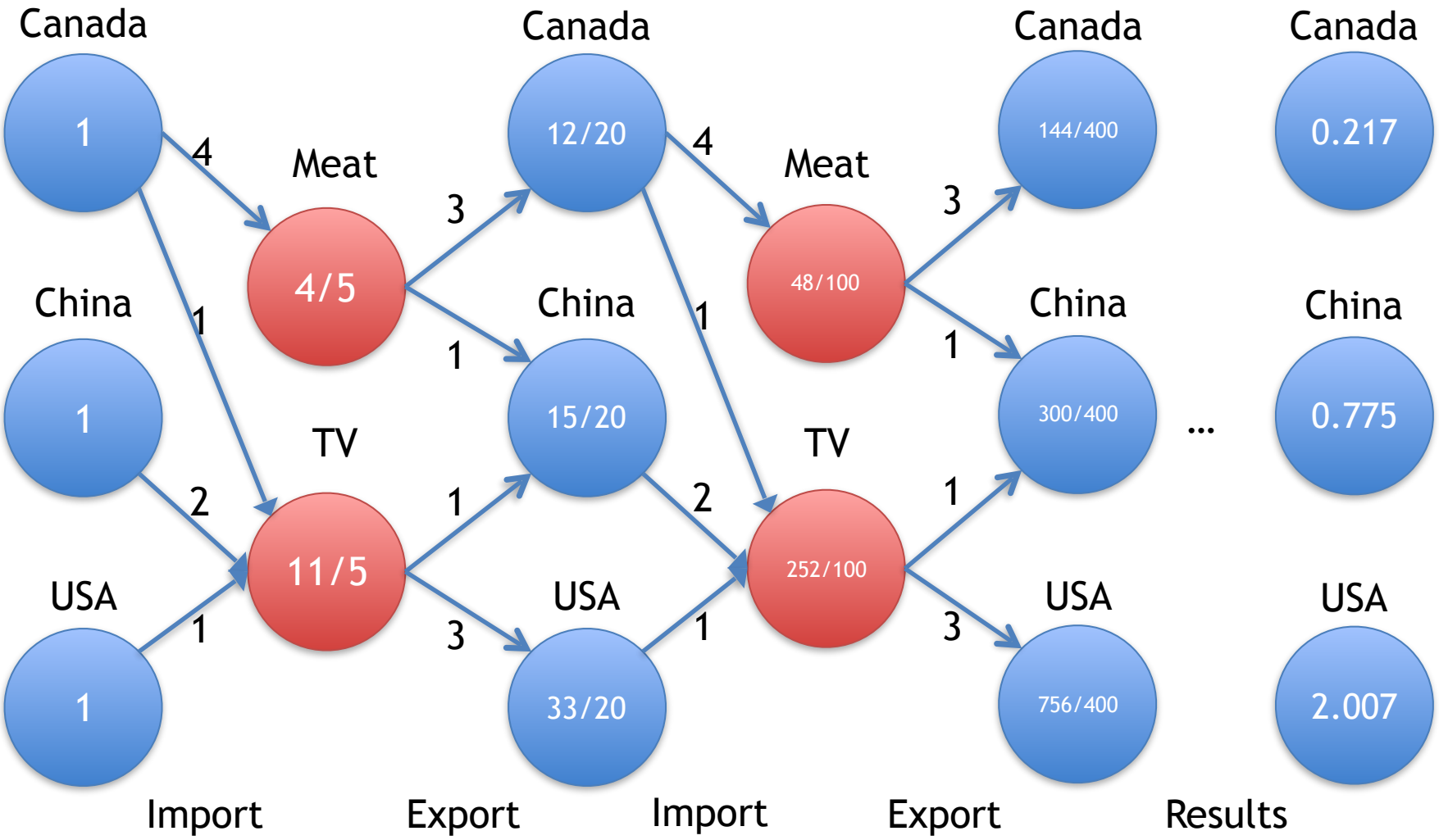
Finance (2004-2014): Imports/Exports data

External dataset Trade Network

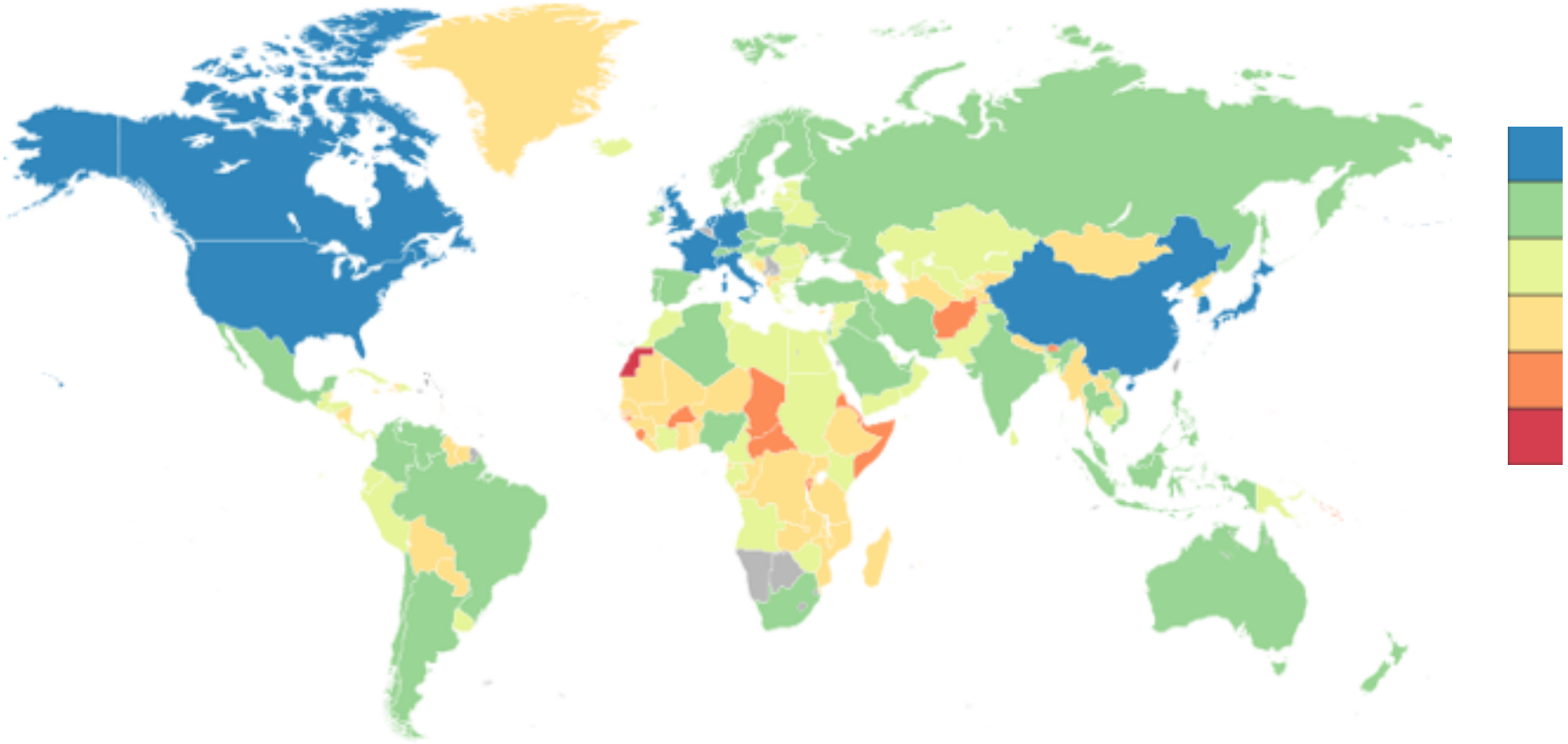
OEC: Imports/Exports data (1962-2014)

OEC: The Observatory of Economic Complexity

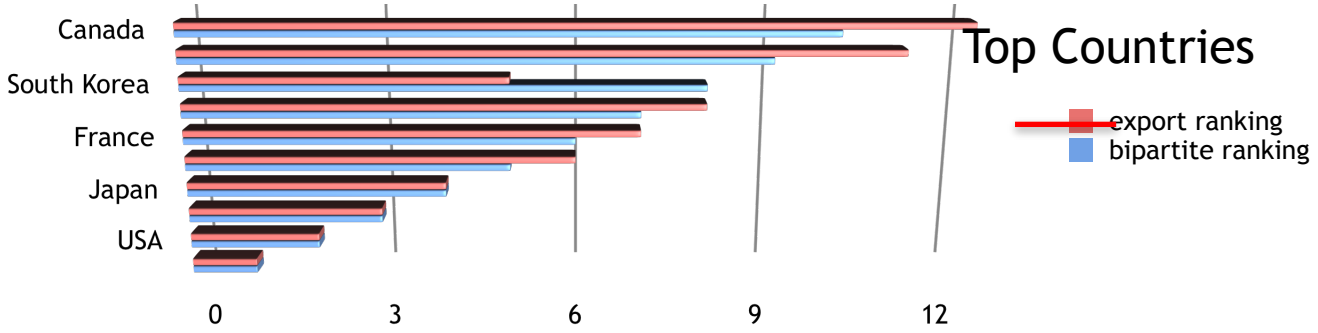
Bipartite Network

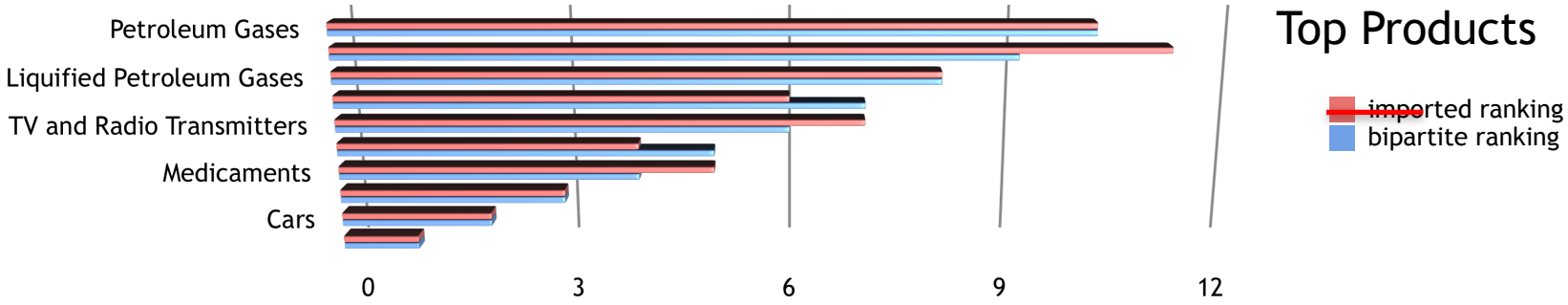


Country Ranking

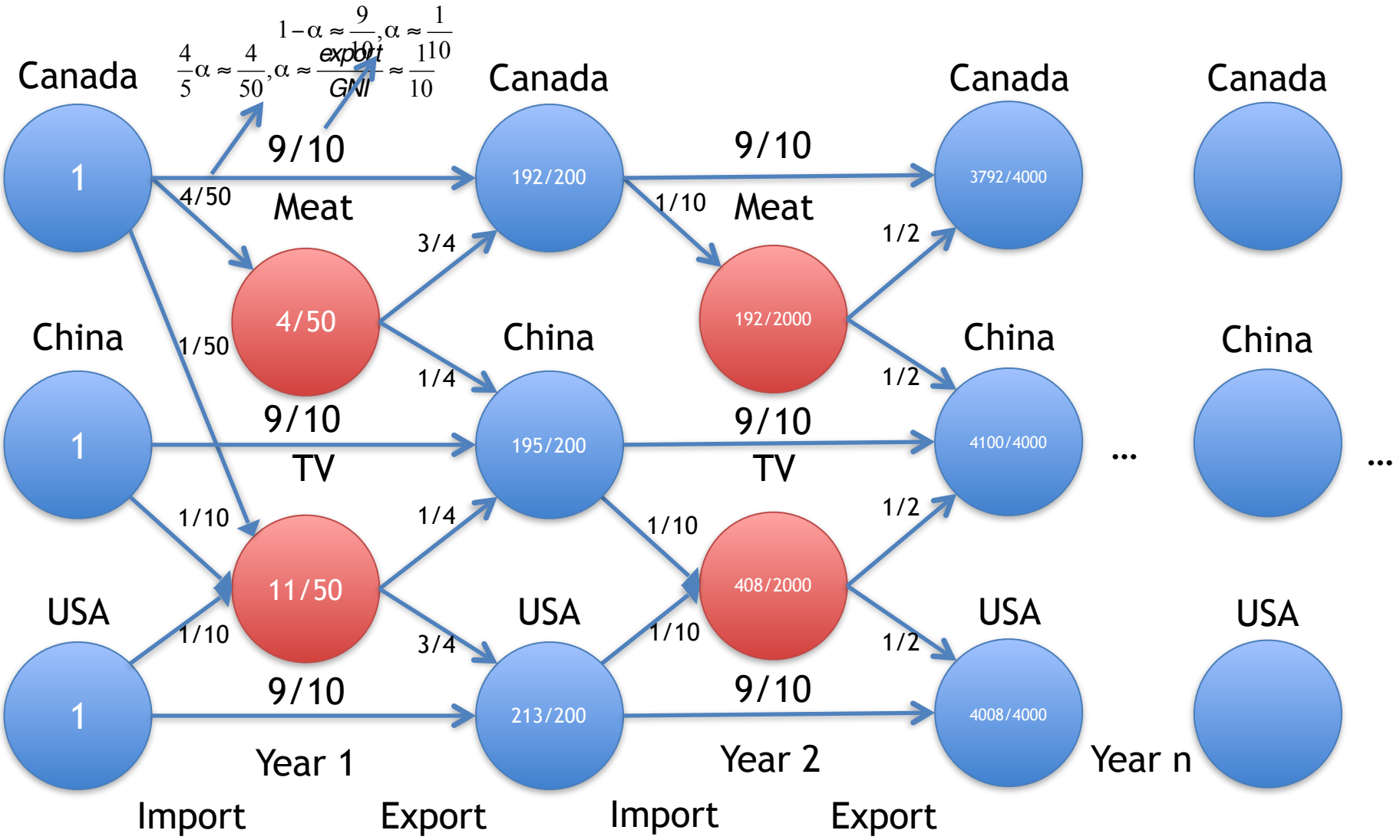


Ranking

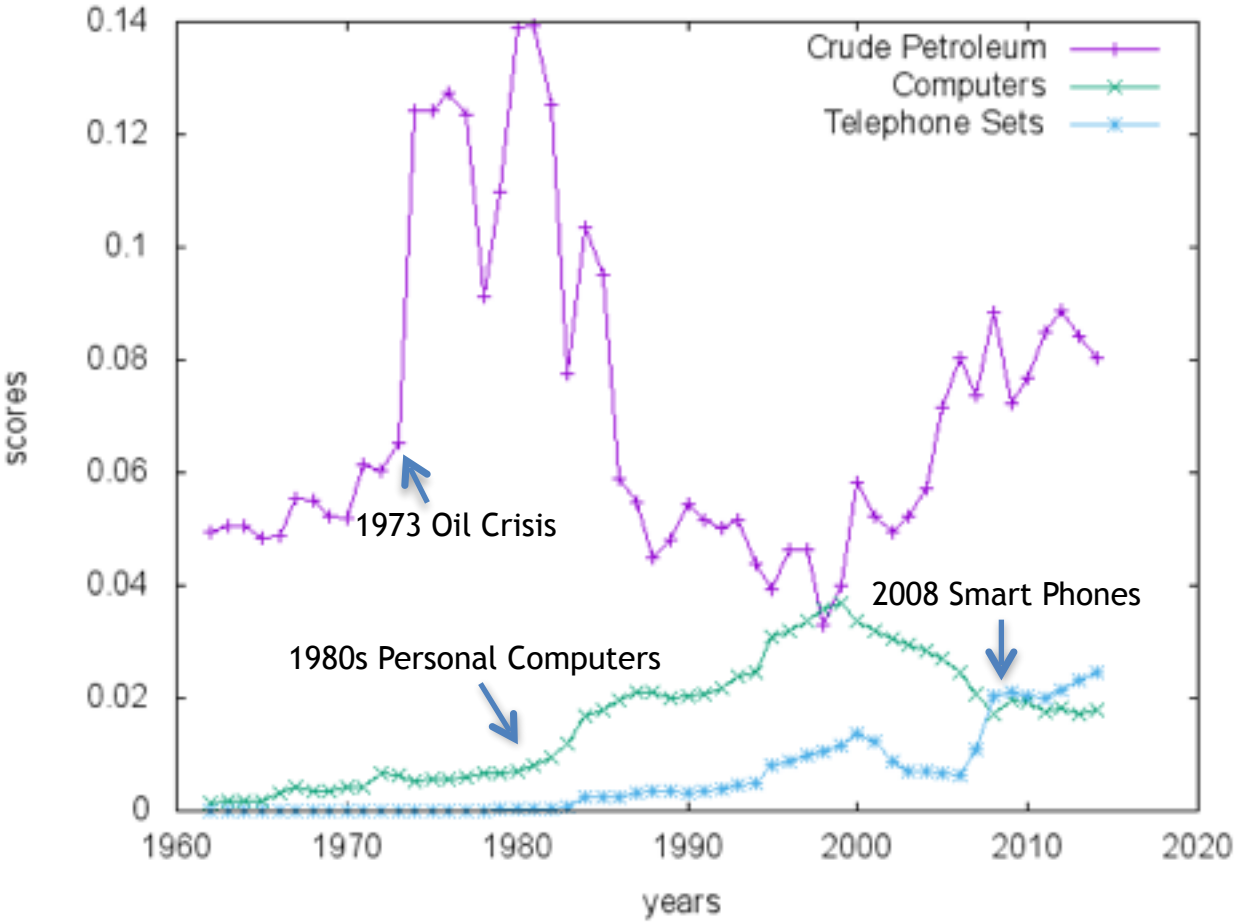

Canada
South Korea
France
Japan
USA
0
3
6
9
12
Top Countries
export ranking
bipartite ranking


Petroleum Gases
Liquified Petroleum Gases
TV and Radio Transmitters
Medicaments
Cars
0
3
6
9
12
Top Products
imported ranking
bipartite ranking

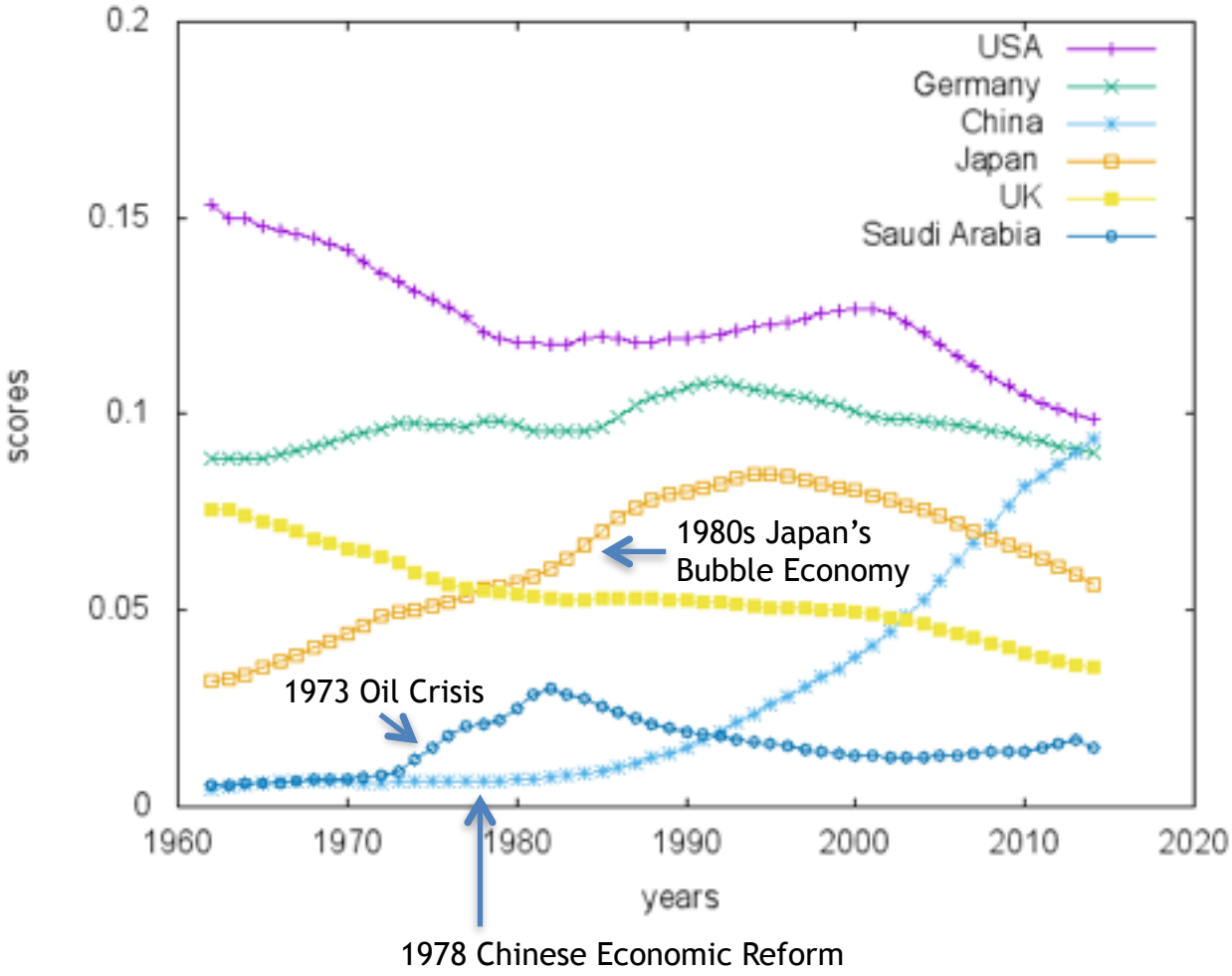
Evolutional Model



Product Value



National Wealth



Technical details

Country-to-Product transition matrix

$$U = \begin{bmatrix} w_{11} & w_{12} & w_{13} & \cdots & w_{1m} \\ w_{21} & w_{22} & w_{23} & \cdots & w_{2m} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ w_{n1} & w_{n2} & w_{n3} & \cdots & w_{nm} \end{bmatrix}$$

Product-to-Country transition matrix

$$V = \begin{bmatrix} v_{11} & v_{12} & v_{13} & \cdots & v_{1n} \\ v_{21} & v_{22} & v_{23} & \cdots & v_{2n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ v_{m1} & v_{m2} & v_{m3} & \cdots & v_{mn} \end{bmatrix}$$

Country-to-Country transition matrix

$$M = U \cdot V$$

Technical details (cont'd)

Bipartite Model

Denote $\vec{a}$ as the 1-by-n **country score** vector.

M is the **Country-to-Country** transition matrix. Note that it's also a **right stochastic matrix**

Do **power iterations** as follows:

$$\vec{a}' = \vec{a} \cdot M$$

Note that we are **guaranteed** to get a converged $\vec{a}^*$

which is an approximation of the **largest eigenvector** of matrix M

Furthermore, we can easily get the converged **product score** vector which is denoted as $\vec{b}^*$

$$\vec{b}^* = \vec{a}^* \cdot U$$

Technical details (cont'd)

Evolutionary Model

What if we want to apply our model into **a period of time** rather than a single year?

Cumulative transition matrix!

$$M = M_1 \cdot M_2 \ldots M_t$$

Then do the same thing as we did before.

$$\vec{a}' = \vec{a} \cdot M \qquad \vec{b}^* = \vec{a}^* \cdot U$$

To make our evolutionary model more accurate, we allow each country only use **a** α **factor of earnings** to import products which works well in practice.

Open Questions & Future Work

Are our bipartite and evolutionary models **general** enough?

More data, **more** experiments!

Is doing well in exports a **necessary** condition to win in international trad

Yes!!? **Big** question, go **deeper**!