New Metrics for Economic Complexity: Measuring the Intangible Growth Potential of Countries

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GROWTH AND INNOVATION POLICY-MODELLING: APPLYING NEXT GENERATION TOOLS, DATA, AND ECONOMIC COMPLEXITY IDEAS

COORDINATOR: *Luciano Pietronero*

4 TEAMS

ROME (Institute for Complex Systems – CNR)

LONDON + OXFORD (LIMS + INET@Oxford)

FRIBURG (Univ. of Friburg)

HANGZHOU (Alibaba Business School)

STARTING DATE: October 1st, 2013

"It is the great multiplication of the productions of all the different arts, in consequence of the division of labour, which occasions, in a well-governed society, that universal opulence which extends itself to the lowest ranks of the people."

Adam Smith – The Wealth of Nations

The paradigm of specializiation – part 1

THE BIGGER THE MARKET THE MORE ITS PARTICIPANTS CAN **SPECIALIZE**

The paradigm of specializiation – part 2

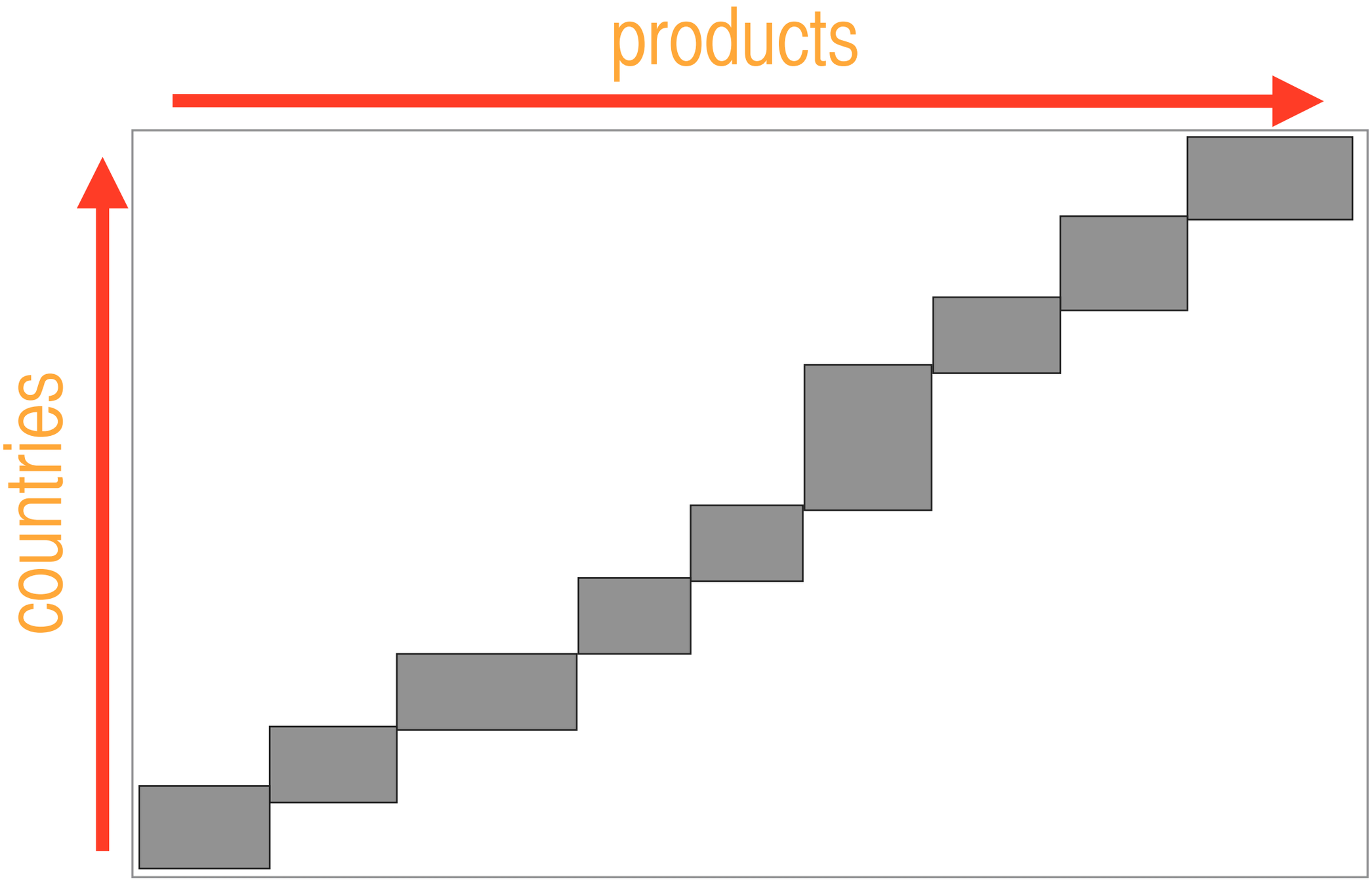
A COUNTRY SHOULD **SPECIALIZE** ONLY ON THE PRODUCT IN WHICH IT HAS THE HIGHEST COMPARATIVE ADVANTAGE

Observative question

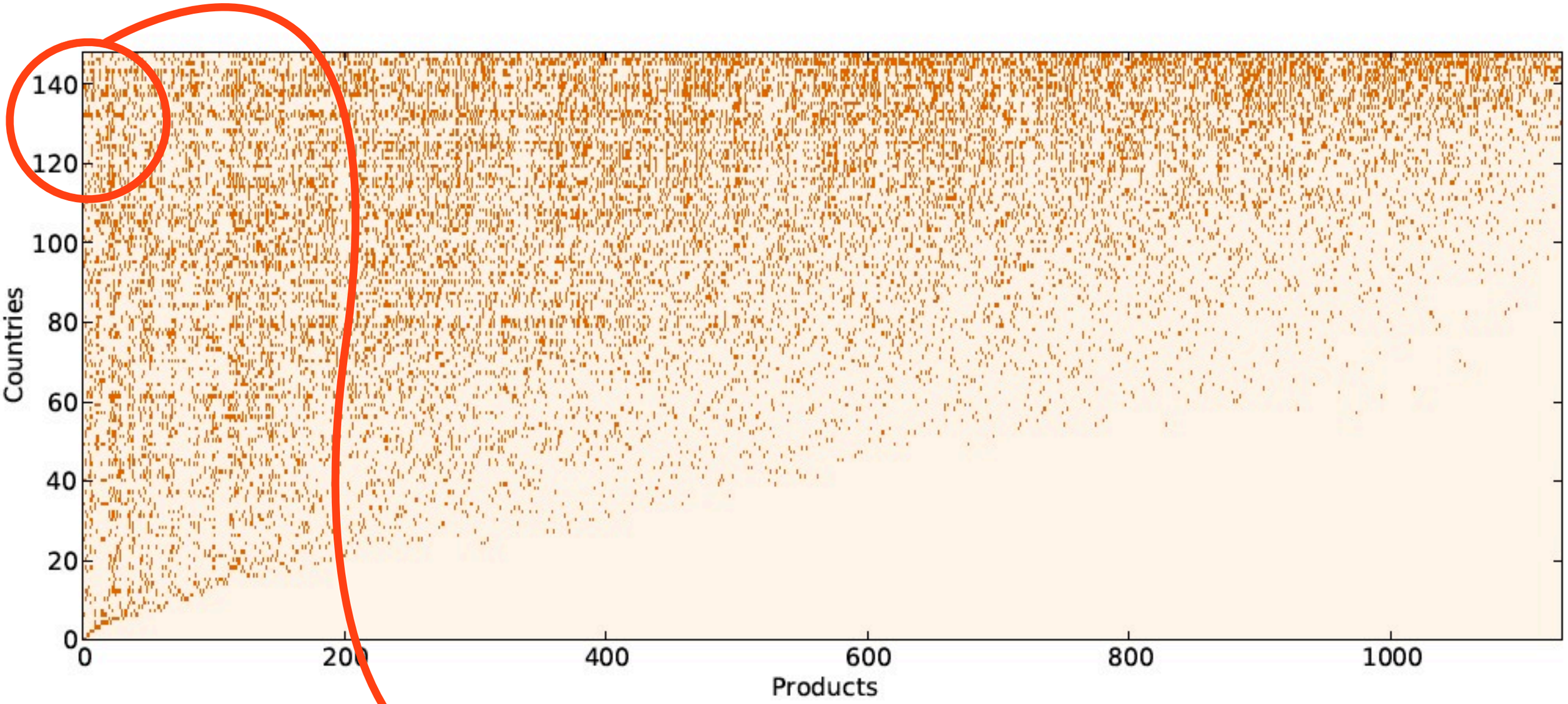
IN TODAY'S **GLOBALIZED** MARKET:

IS THE MORE SPECIALIZED ALSO THE RICHEST?

Classic Theories (Smith, Ricardo)
Efficiency and Specialization



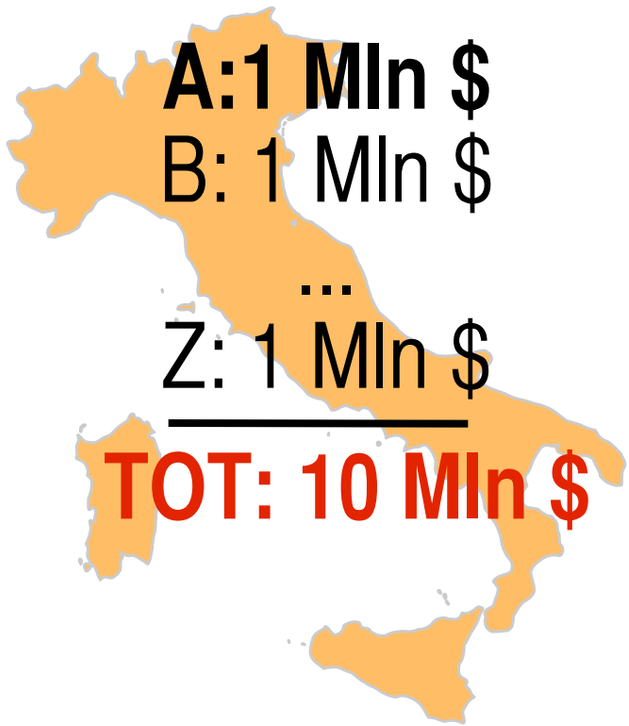
Most diversified countries are the most competitive countries!



Germany, USA, China, Italy, UK,
France, Spain, India, Japan, ...

Database COMTRADE
Year 2010

Evidence for leading role of **DIVERSIFICATION** with respect to competitive advantage (specialization)



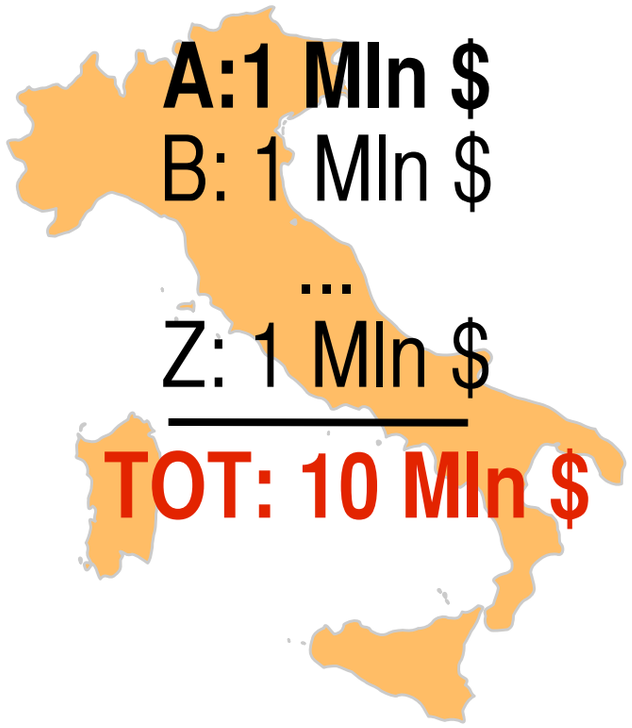
A:1 Mln $
B: 1 Mln $
...
Z: 1 Mln $

TOT: 10 Mln $

A:10 Mln $

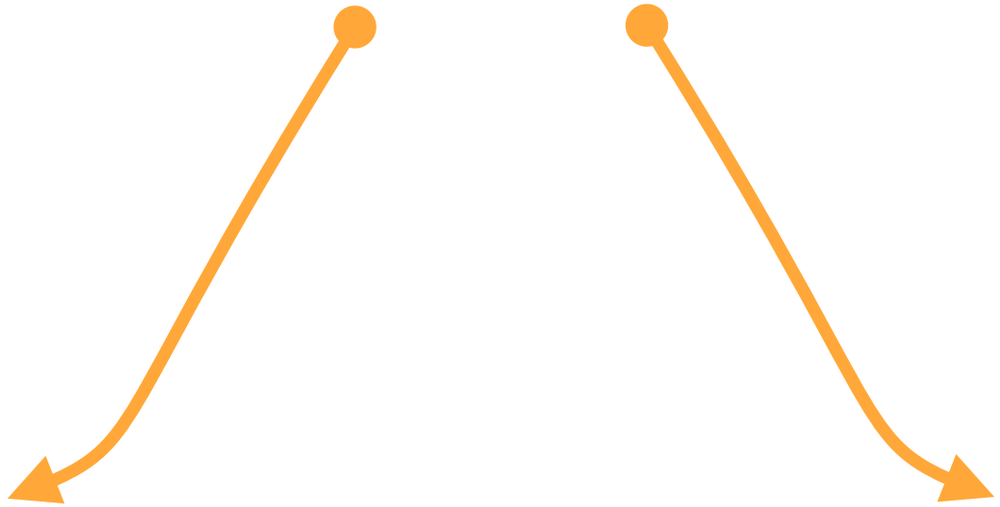
TOT: 10 Mln $

BIO: Adaptation, Ecosystems, Evolvability



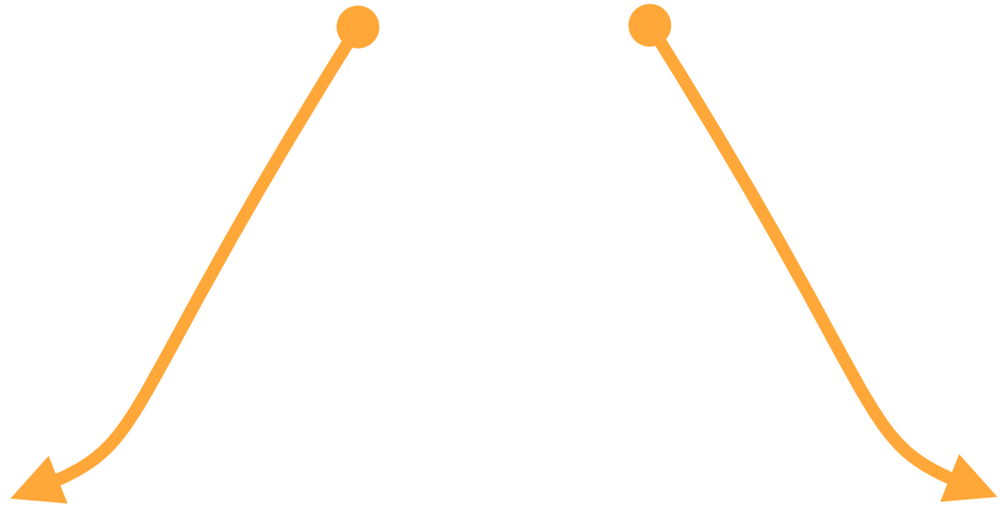
BIO: Adaptation, Ecosystems, Evolvability

Dynamic vs Static



Diversification ↔ **Specialization**

Dynamic vs Static

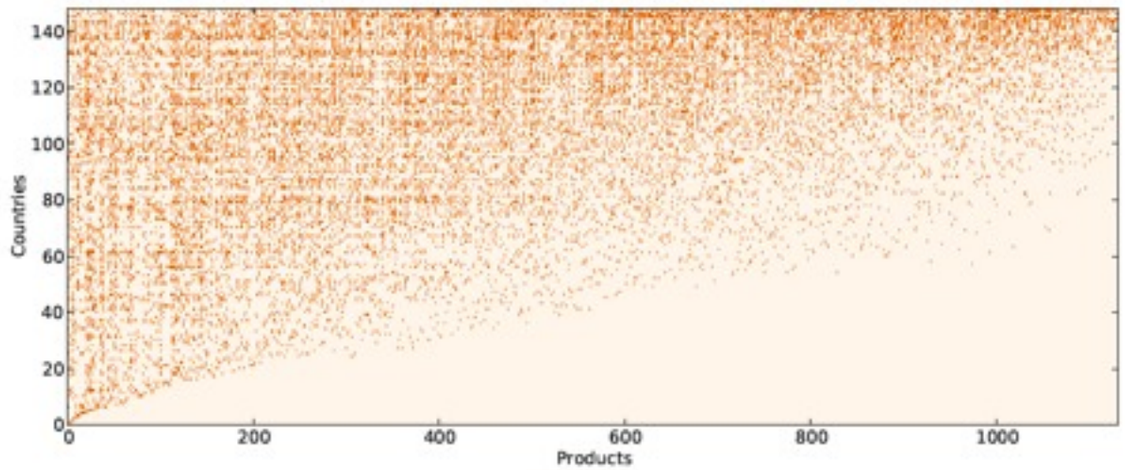


Diversification ↔ **Specialization**

Key challenge

from qualitative to quantitative

NEW **METRICS** FOR THE **COMPETITIVENESS OF COUNTRIES** AND THE **COMPLEXITY OF PRODUCTS**



1. a product is produced by a diversified country
2. a product is produced by a poorly diversified country
3. a country produces a widely diffused product
4. a country produces an exclusive or non-ubiquitous product

1. little insight in the complexity of the product.
2. very informative.
3. little insight in the fitness of the country.
4. very informative on the country fitness.

NON-LINEAR COUPLING BTW **FITNESS OF COUNTRIES** AND **COMPLEXITY OF PRODUCTS**

MEASURING INTANGIBLE PROPERTIES

New metrics for Fitness of countries and Complexity of products

Fitness

$$\tilde{F}_c^{(n)} = \sum_p M_{cp} Q_p^{(n-1)}$$

$$F_c^{(n)} = \frac{\tilde{F}_c^{(n)}}{\langle \tilde{F}_c^{(n)} \rangle_c}$$

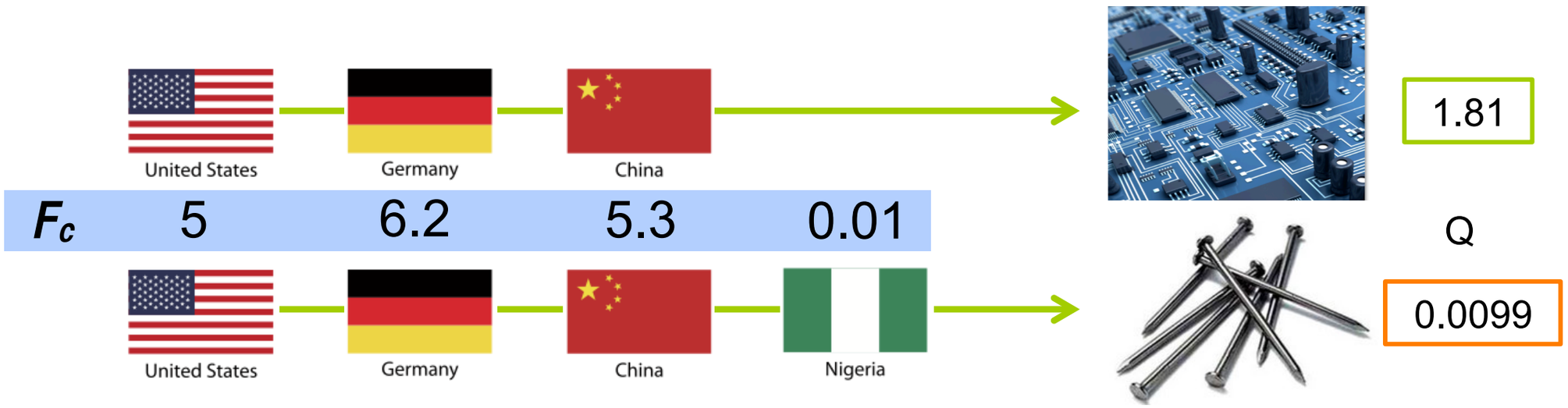
Complexity

$$\tilde{Q}_p^{(n)} = \frac{1}{\sum_c M_{cp} \frac{1}{F_c^{(n-1)}}}$$

$$Q_p^{(n)} = \frac{\tilde{Q}_p^{(n)}}{\langle \tilde{Q}_p^{(n)} \rangle_p}$$

F_c: diversification weighted by complexity

Q_p: Extremal non-linear complexity of products.
A **single low fitness producer** implies low complexity

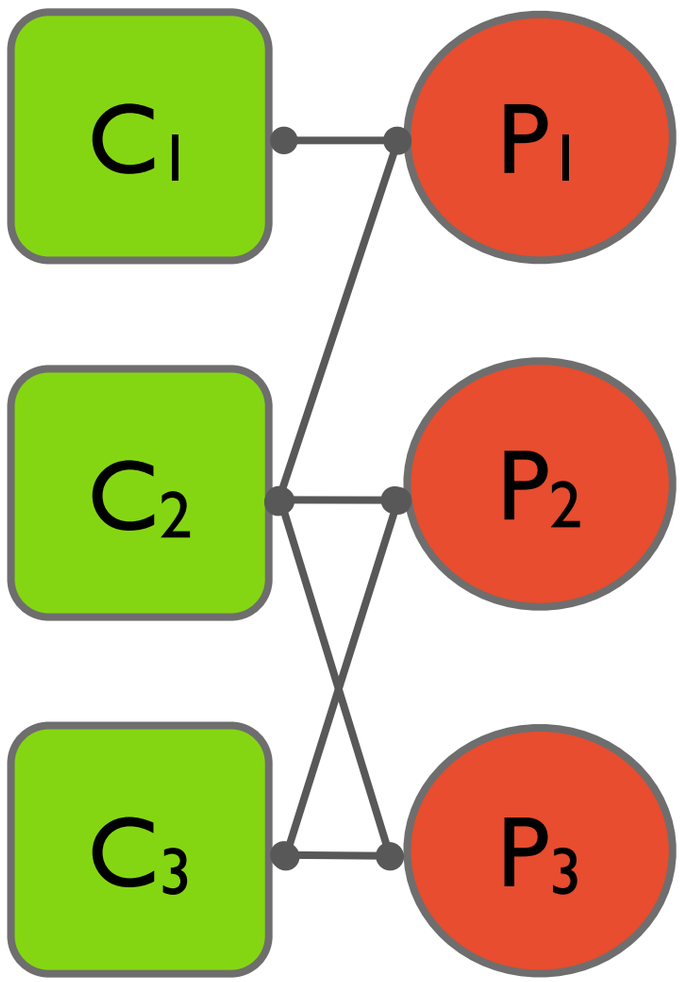


The building blocks of economic complexity

César A. Hidalgo[1] and Ricardo Hausmann

Center for International Development and Harvard Kennedy School, Harvard University, Cambridge, MA 02138

Countries Products



Available Data

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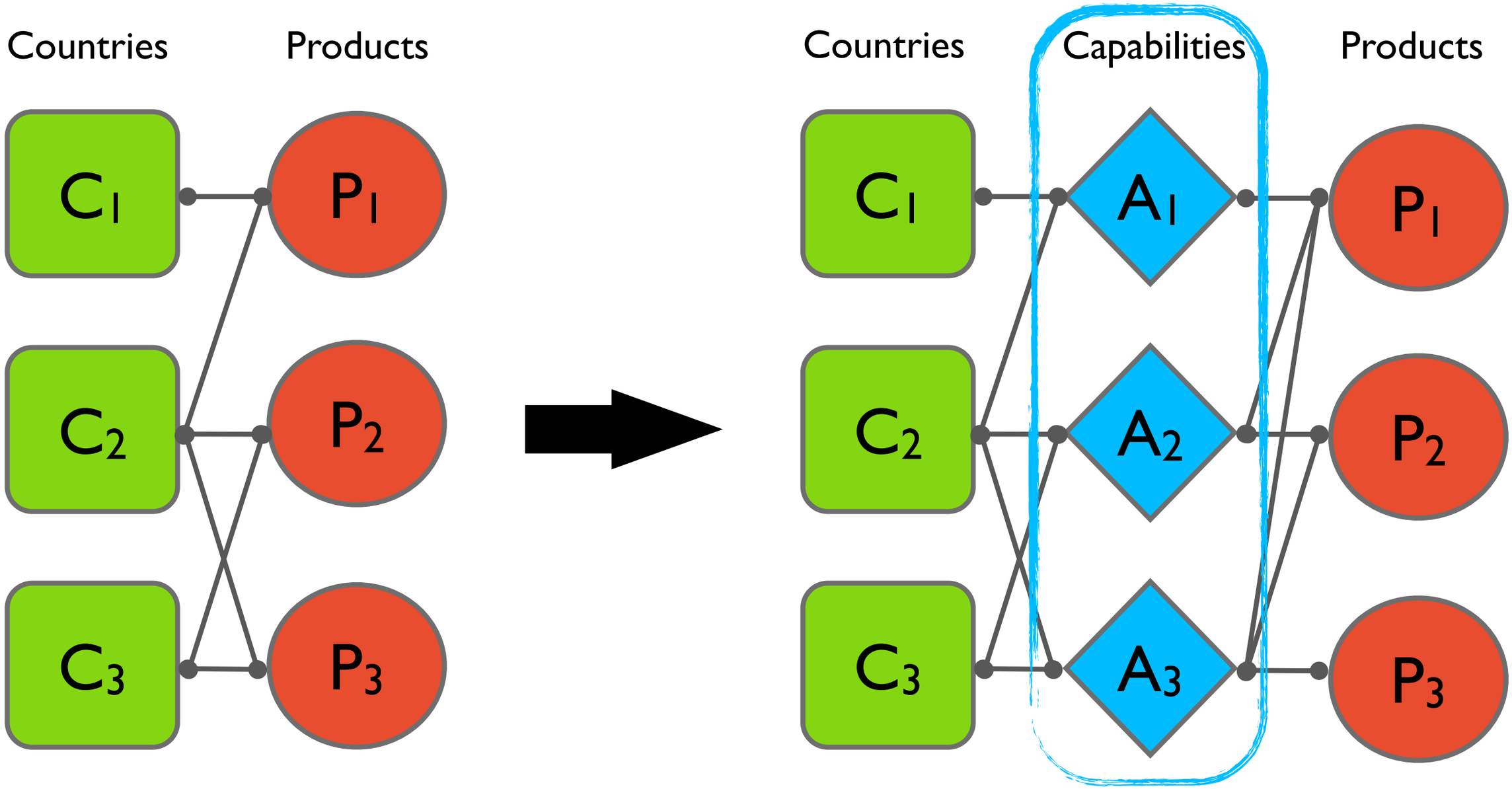


Available Data

Model

Key challenge 2

how to forecast economic growth

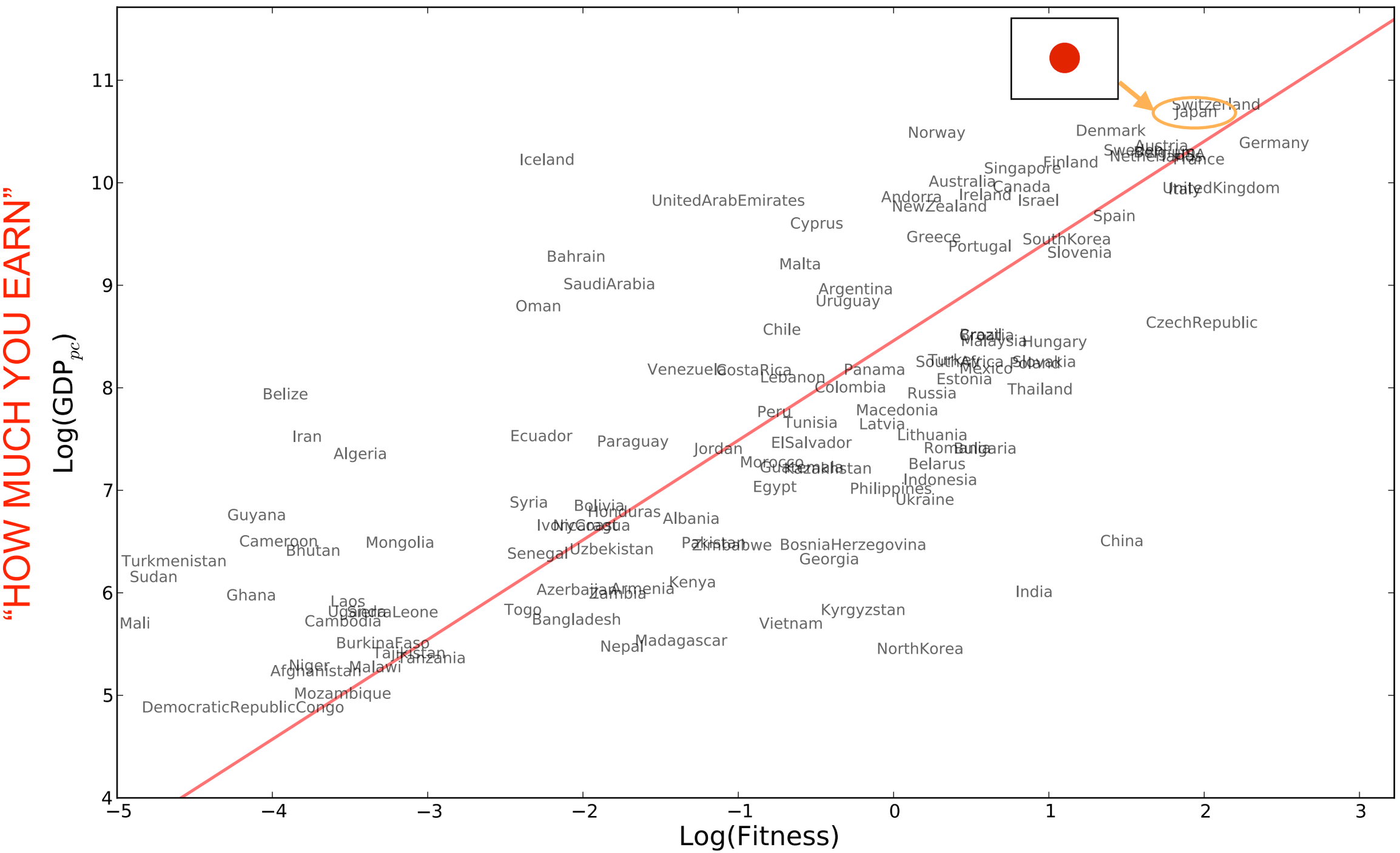
SCIENTIFIC GROUNDING OF ECONOMIC PREDICTION

(beyond std tools and Reinhart and Rogoff excel-gate)

M. Cristelli, A. Tacchella, L. Pietronero, *The Heteregenous Dynamics of Economic Complexity,* (Working paper)

FITNESS vs GDP$_{pc}$

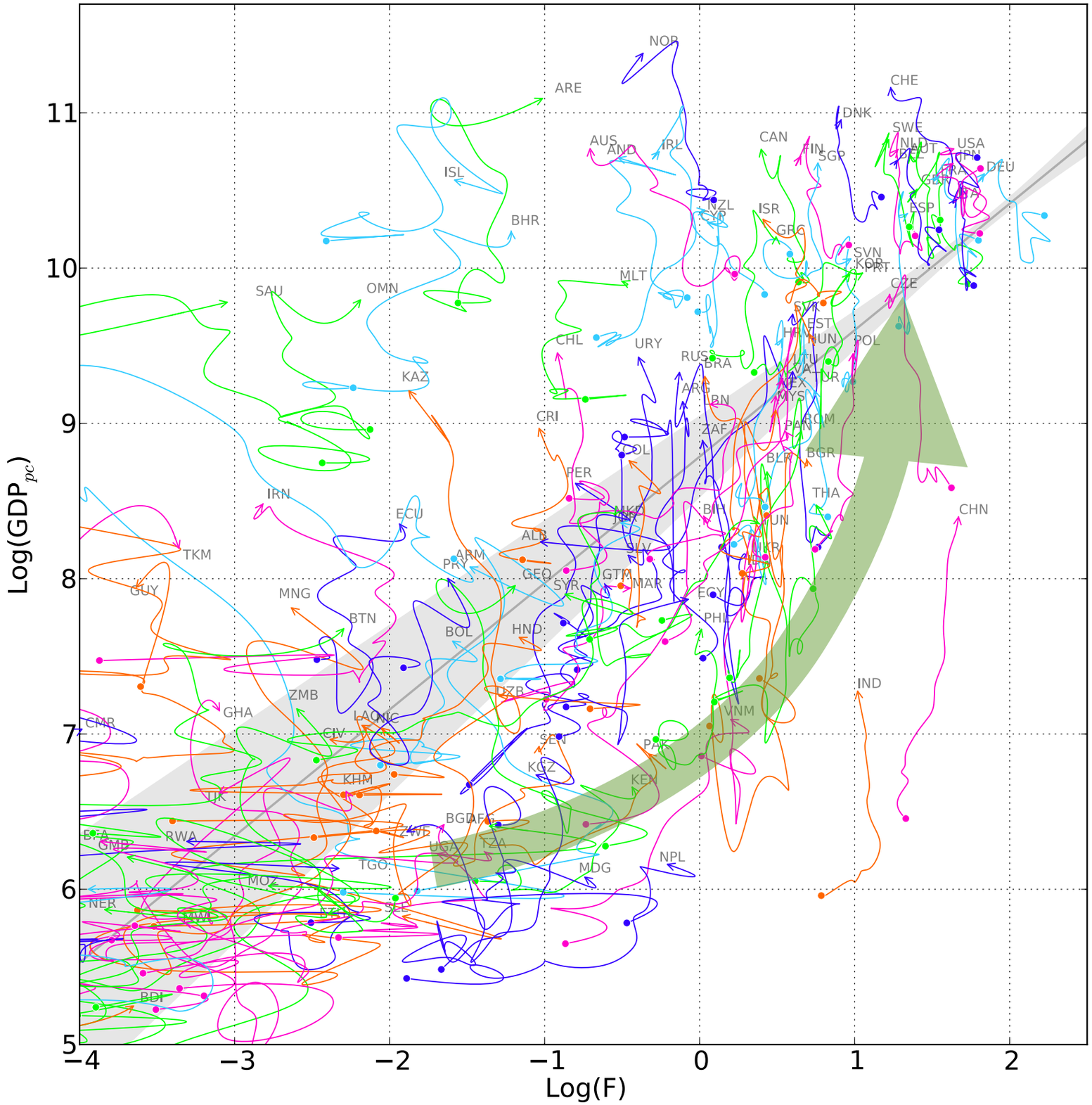
Red Line: average trend, NOT a regression



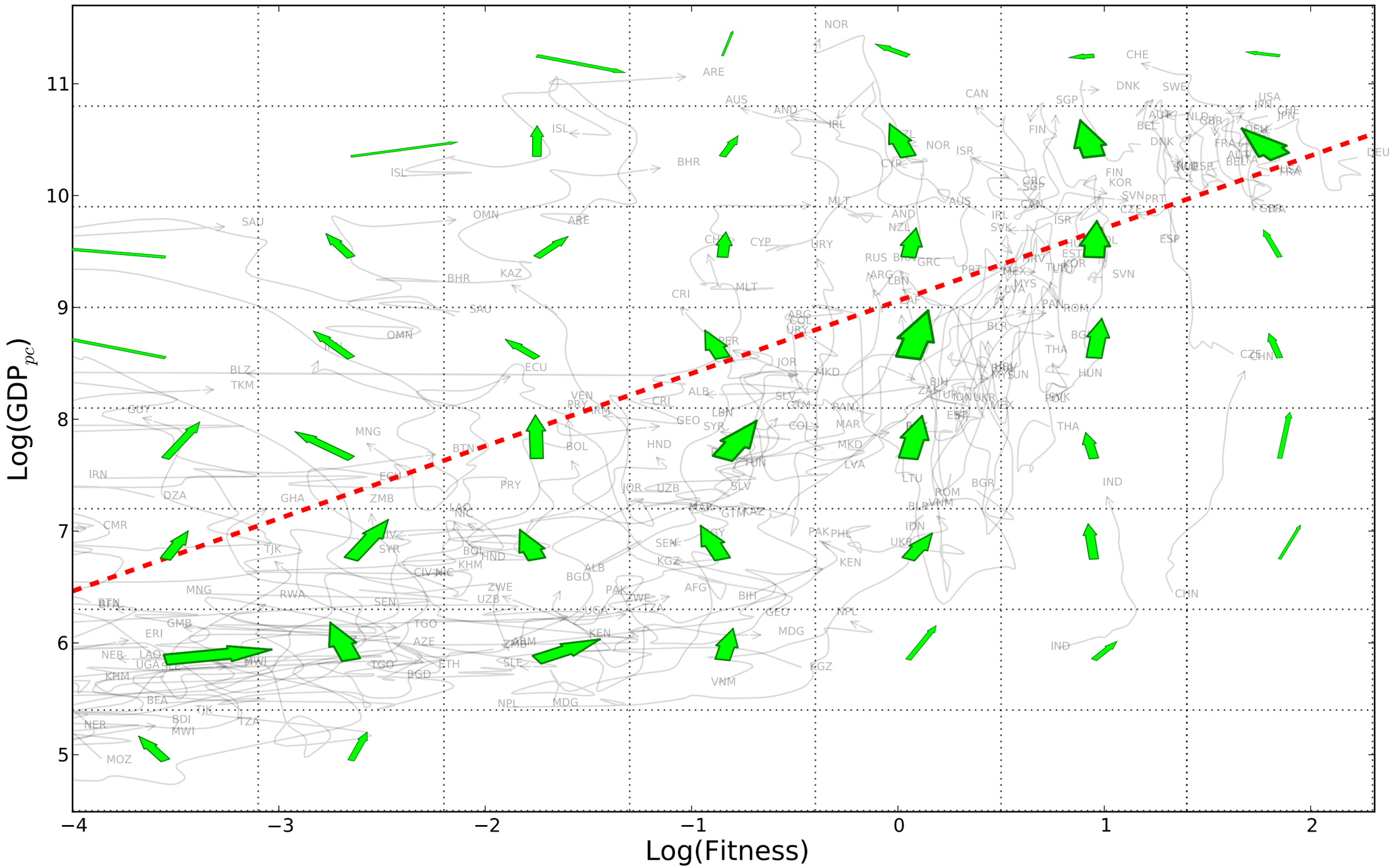
“HOW MUCH YOU EARN”

“HOW GOOD YOU ARE”

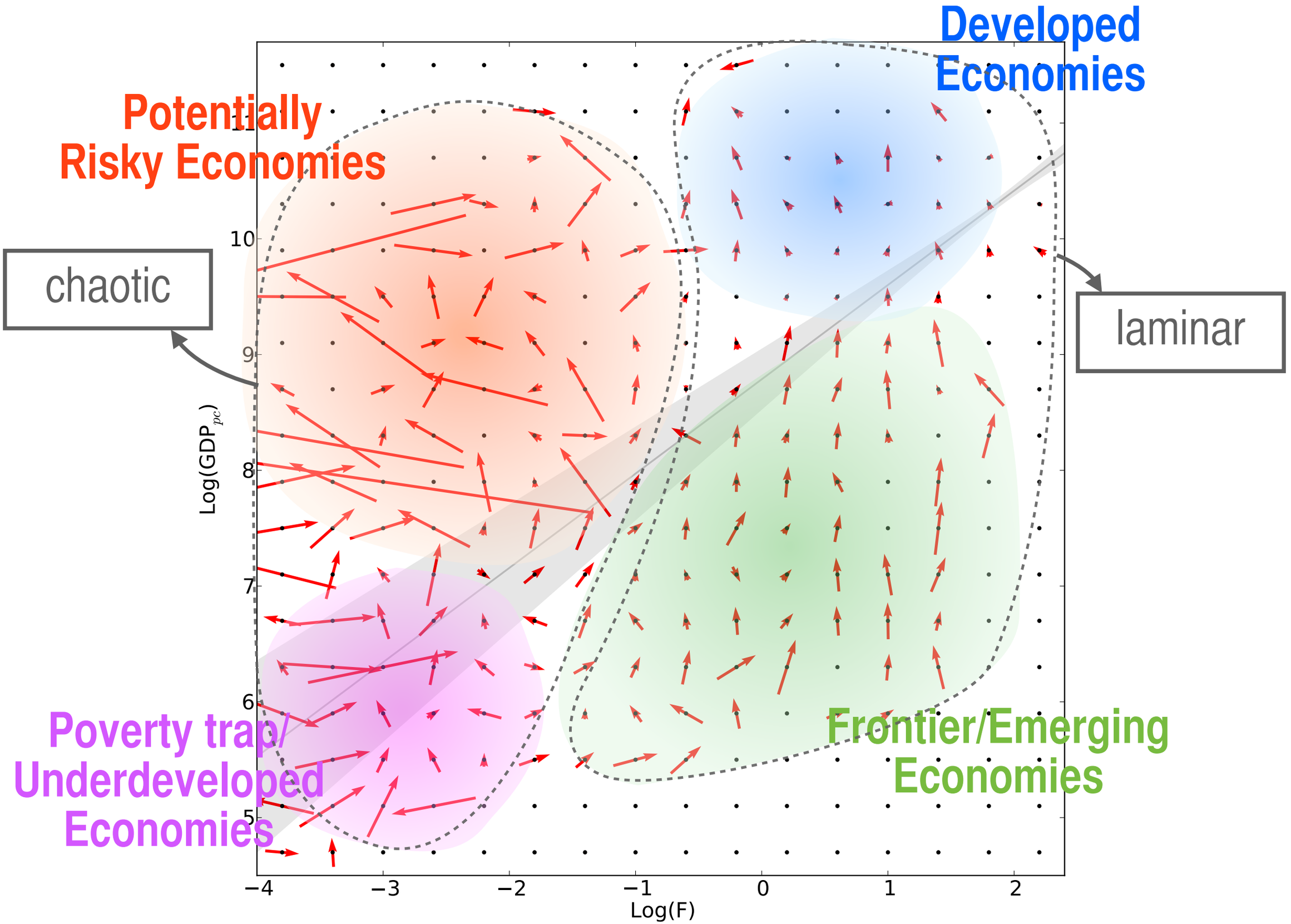
Collective dynamics ... a mess but not everywhere



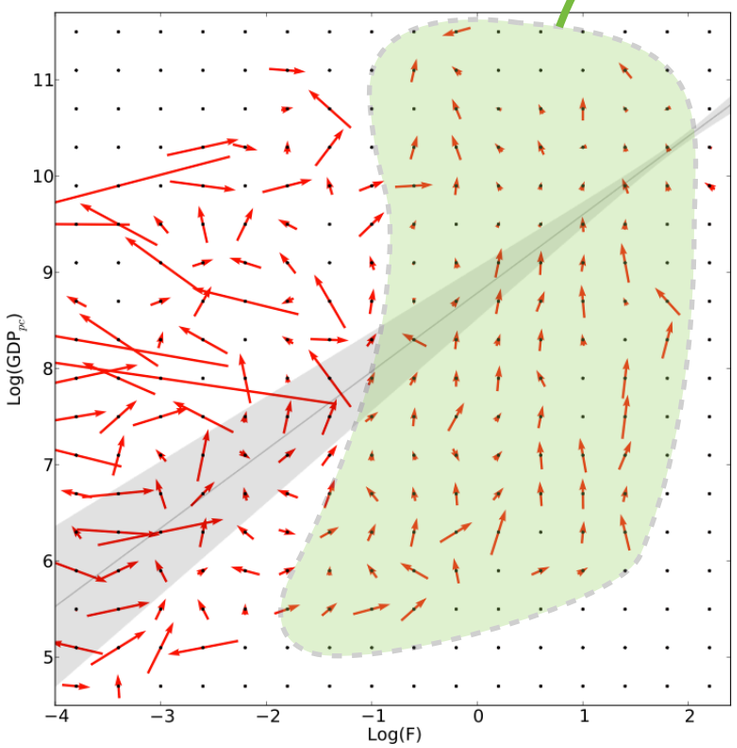
Weather-like forecast



Weather-like forecast: Heterogeneous dynamics



Borrowing concepts from dynamical systems

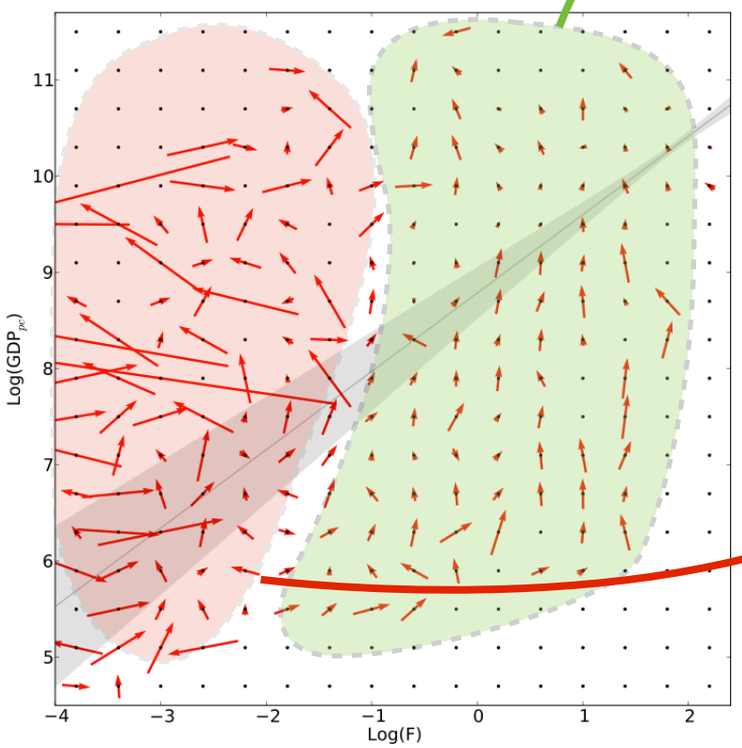


Laminar regime

Low effective dimension ($d_e \approx 2$)

Fitness is the relevant and driving variable for the economic dynamics in this regime

Borrowing concepts from dynamical systems



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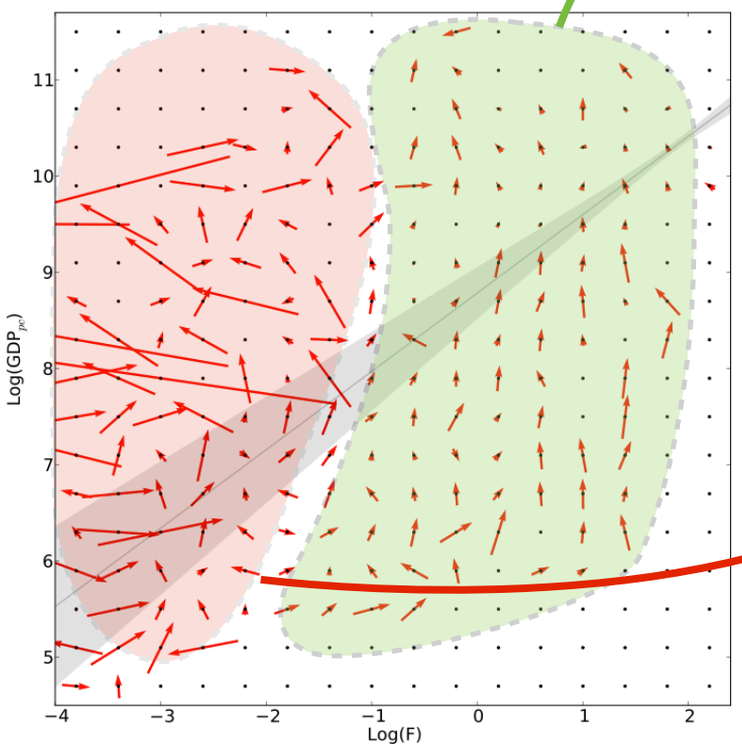
Chaotic regime

Chaotic dynamics OR $d_e \gg 2$

Dynamics is ruled by several other exogenous factors competing with Fitness

Borrowing concepts from dynamical systems



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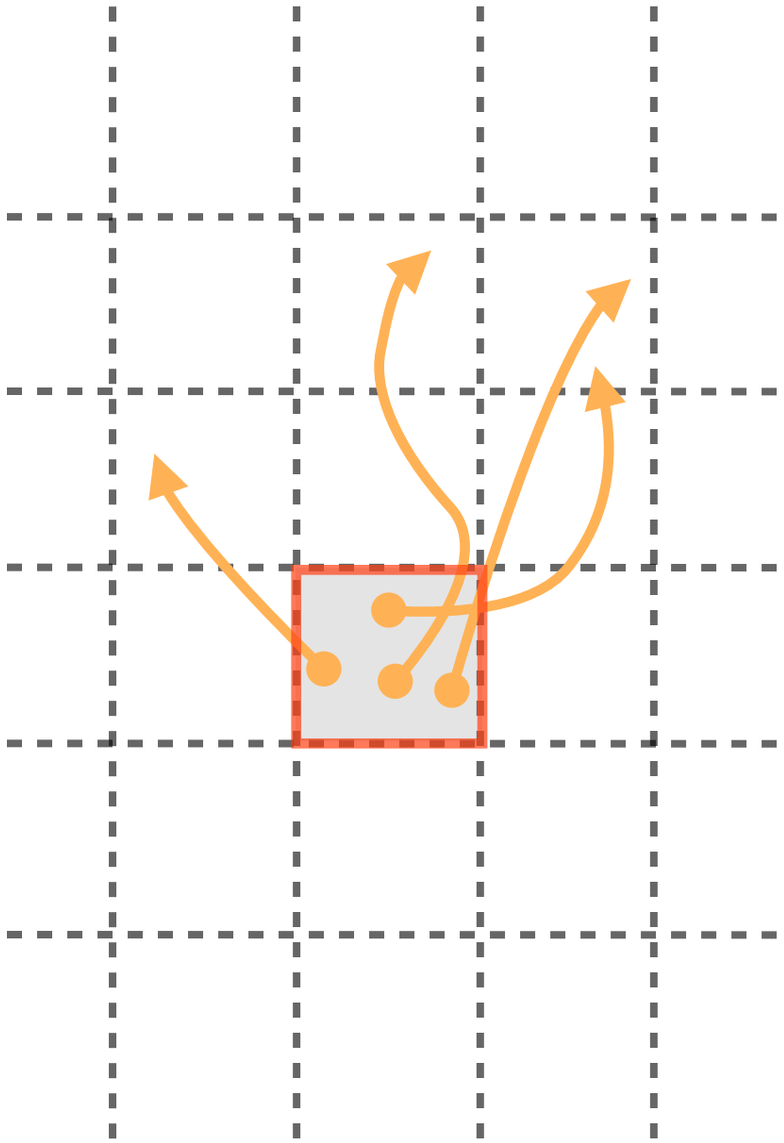
SELECTIVE PREDICTABILITY

Method of Analogs: forecasting the future by the knowledge of the past



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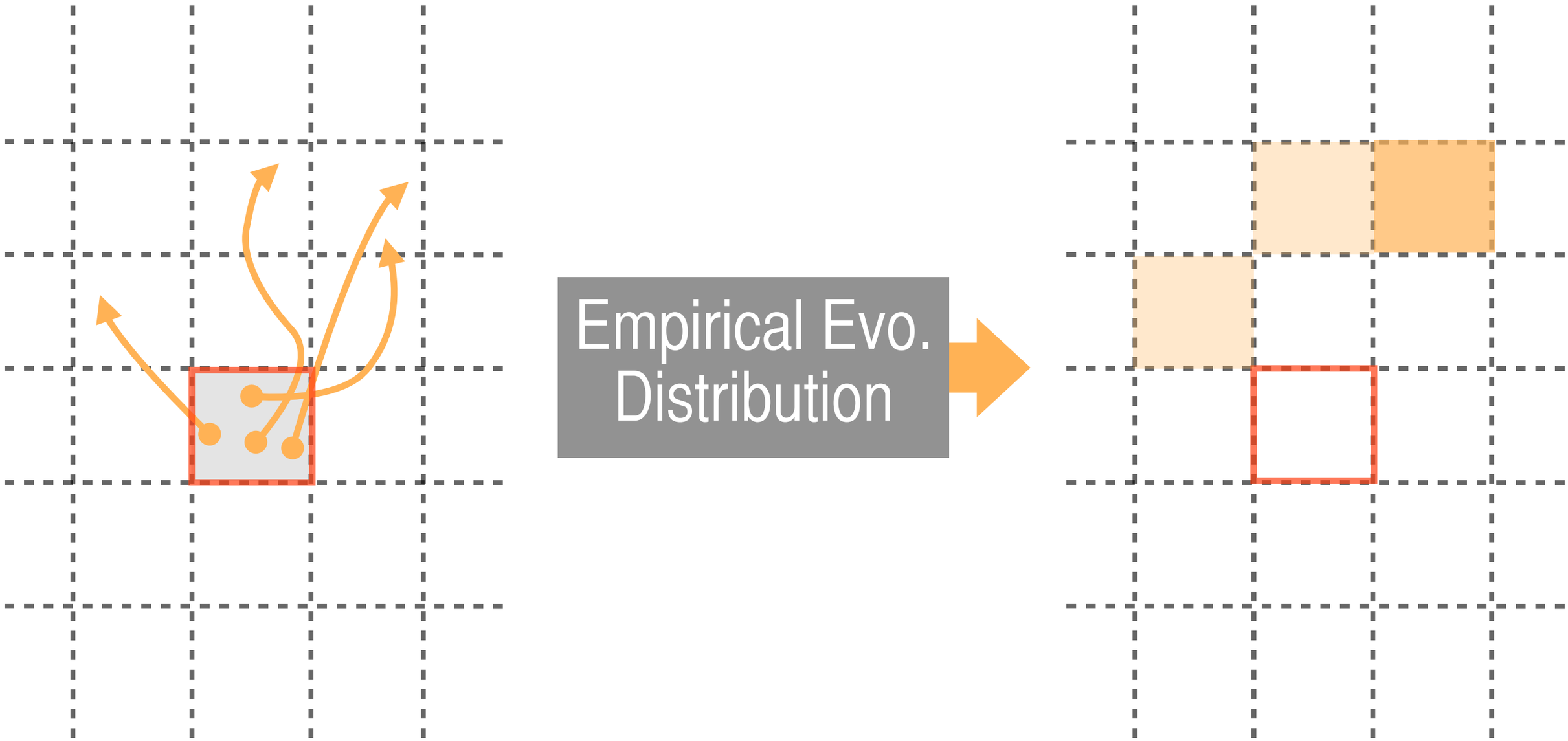
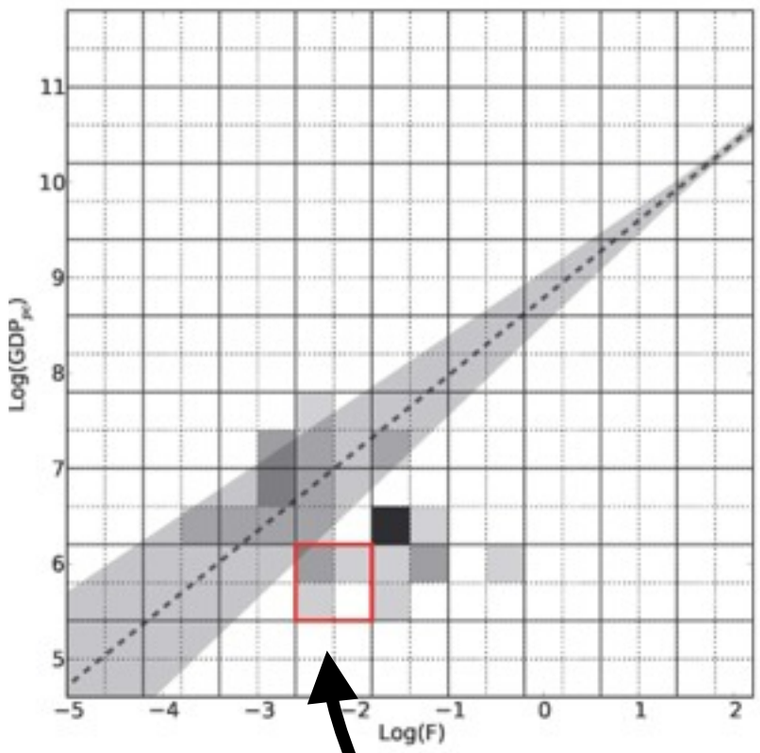
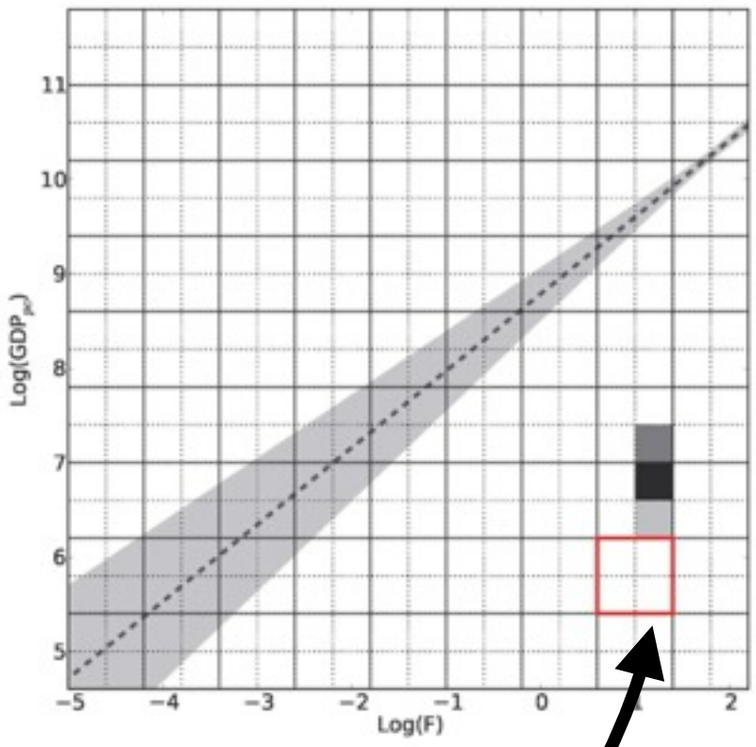
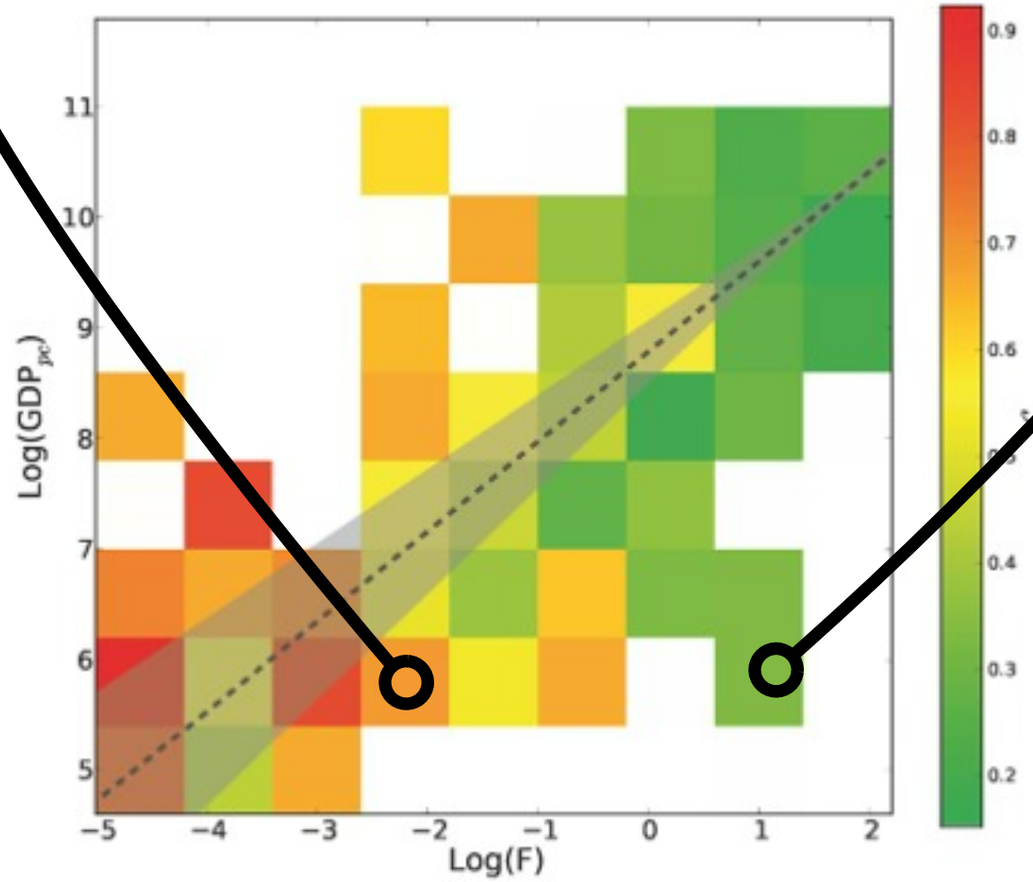


the *Selective Predictability* Scheme



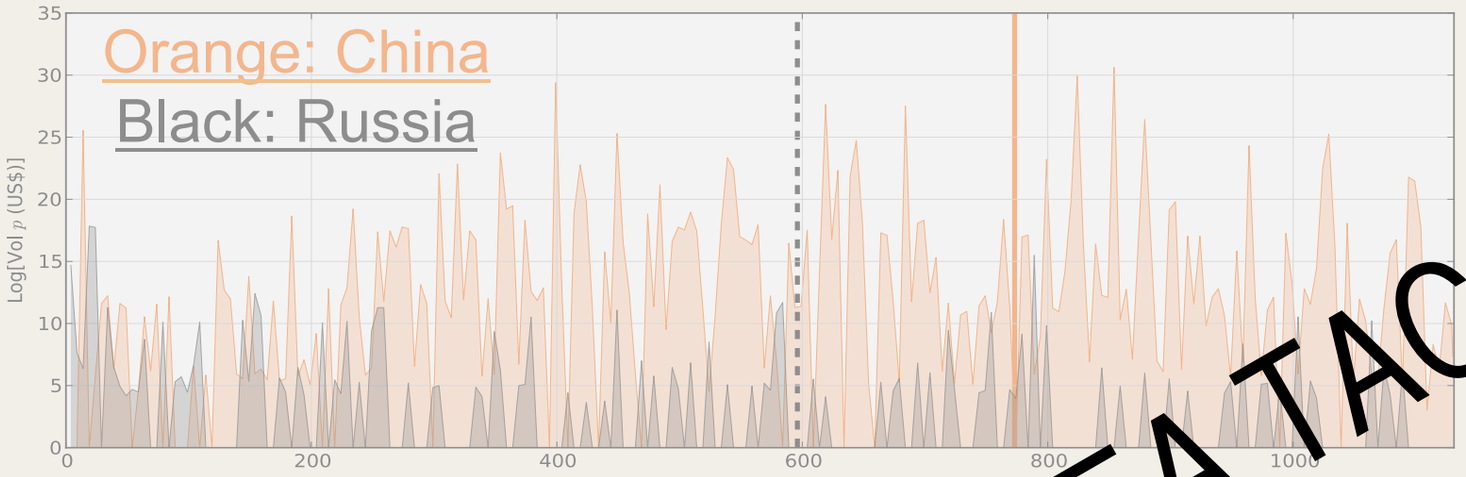




$$\mathcal{C} = \frac{n_{\text{boxes}}^{(i)}}{N^{(i)}} - \frac{1}{N^{(i)}}$$

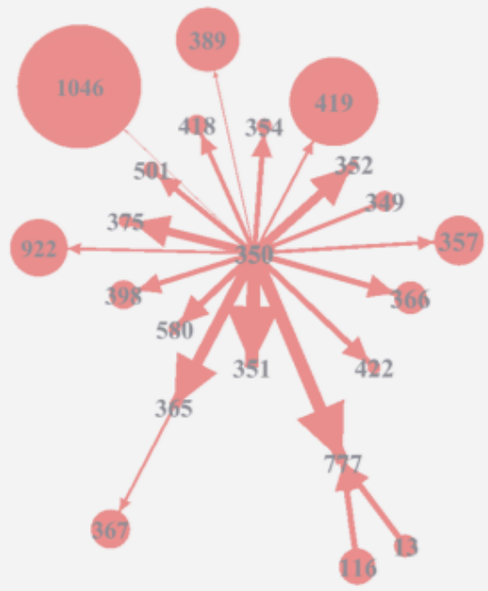
NB: $N^{(i)} \geq 10$

Complexity of Products & Networks of Products



With a consistent ordering of the products is possible to define a spectrum

Interesting to compare it with the network of products and its communities to understand and forecast development



SCIENTIFIC REPORTS

A New Metrics for Countries' Fitness and Products' Complexity

Andrea Tacchella[1,2], Matthieu Cristelli[2,1], Guido Caldarelli[3,2,4], Andrea Gabrielli[2,3] & Luciano Pietronero[1,2,4]

(accepted for publication in PLOSONE)

Measuring the Intangibles: a Metrics for the Economic Complexity of Countries and Products

M. Cristelli, A. Tacchella, A. Gabrielli, G. Caldarelli, L. Pietronero

PLOS | ONE

A Network Analysis of Countries' Export Flows: Firm Grounds for the Building Blocks of the Economy

Guido Caldarelli[1,2,3], Matthieu Cristelli[2,4]*, Andrea Gabrielli[2,3], Luciano Pietronero[2,4,3], Antonio Scala[2,3], Andrea Tacchella[4,2]

JEDC

Economic complexity: Conceptual grounding of a new metrics for global competitiveness

A. Tacchella[a], M. Cristelli[b], G. Caldarelli[b, d, e], A. Gabrielli[c, d], L. Pietronero[a, c, d]

further information

http://pilhd.phys.uniroma1.it/PILgroup_Economic_Complexity/Home.html

http://sites.google.com/site/matthieucristelli/