Structural Transformations in the Product Space

Key Concepts

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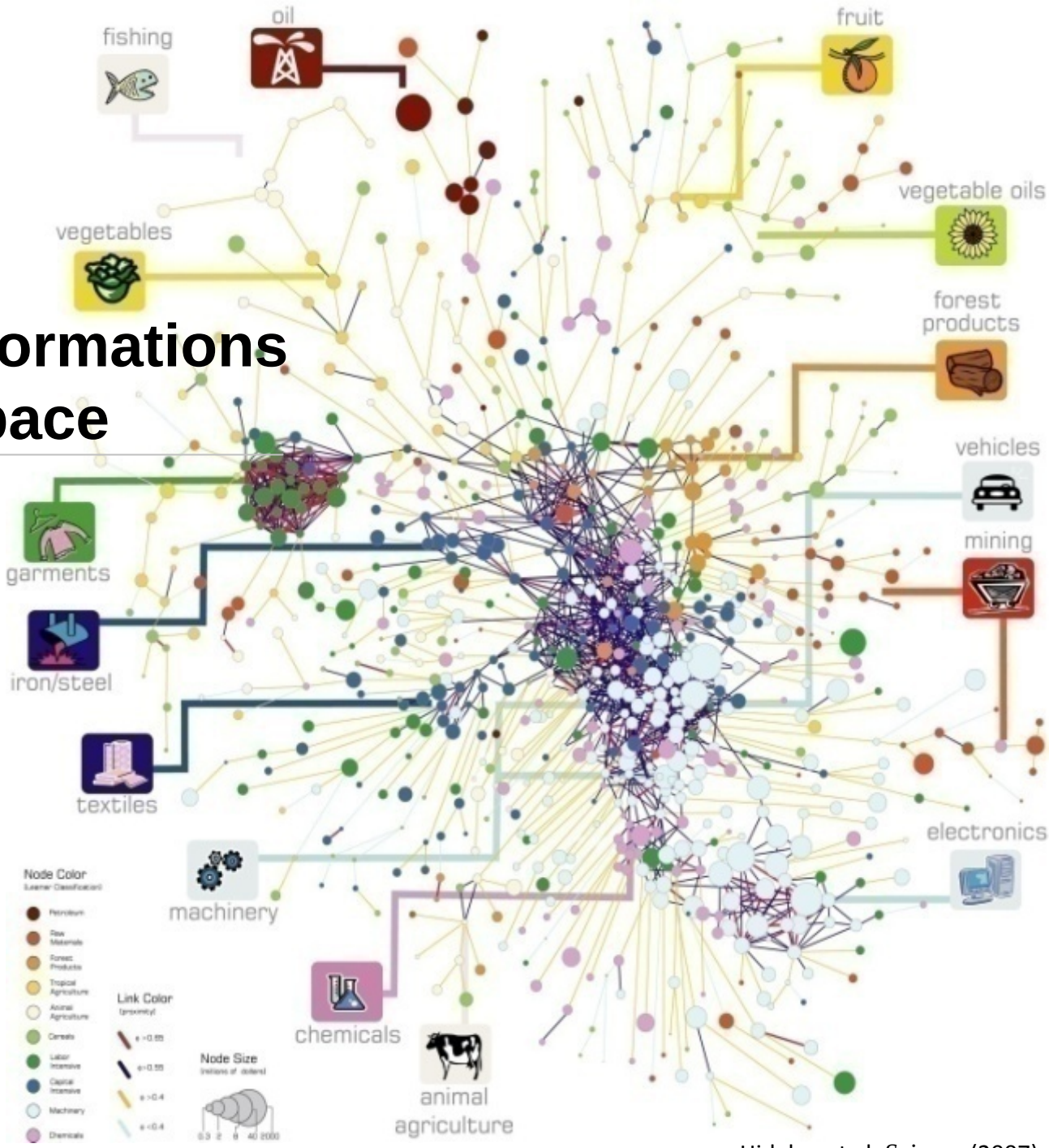


Hidalgo et al. *Science* (2007)

Structure of the Presentation

- Revealed comparative advantage index
- Export Sophistication: PRODY and EXPY
- Proximity and density
- Open forest
- Strategic value

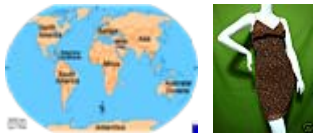
What do we mean when we say that a commodity is “exported with comparative advantage”?

RCA Index = $\dfrac{\text{Share of commodity in a country's total export}}{\text{Share of commodity in total world export}}$

$$= \frac{xval_{c,i,t} \Big/ \sum_{i} xval_{c,i,t}}{\sum_{c} xval_{c,i,t} \Big/ \sum_{i}\sum_{c} xval_{c,i,t}}$$

where $\boldsymbol{xval_{c,i,t}}$ is country $\boldsymbol{c}$'s export of commodity $\boldsymbol{i}$ at time $\boldsymbol{t}$

Share of dresses in Italy's export = **0.09**



Share of dresses in world export = **0.05**

RCA=1.8 > 1

Italy exports dresses with comparative advantage

Balassa , *The Manchester School* (1965)

How do we measure product sophistication (PRODY)?

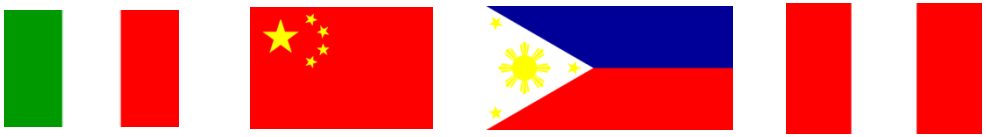
PRODY reflects the per capita income associated with the commodity.

$$PRODY_{i,t} = \sum_c \left[\frac{\left(xval_{c,i,t} \Big/ \sum_i xval_{c,i,t} \right)}{\sum_c \left(xval_{c,i,t} \Big/ \sum_i xval_{c,i,t} \right)} \right] \times GDPPerCapita_{c,t}$$

PRODY = $ 34k

$ 44k $ 30k $ 32k $ 31k $ 32k

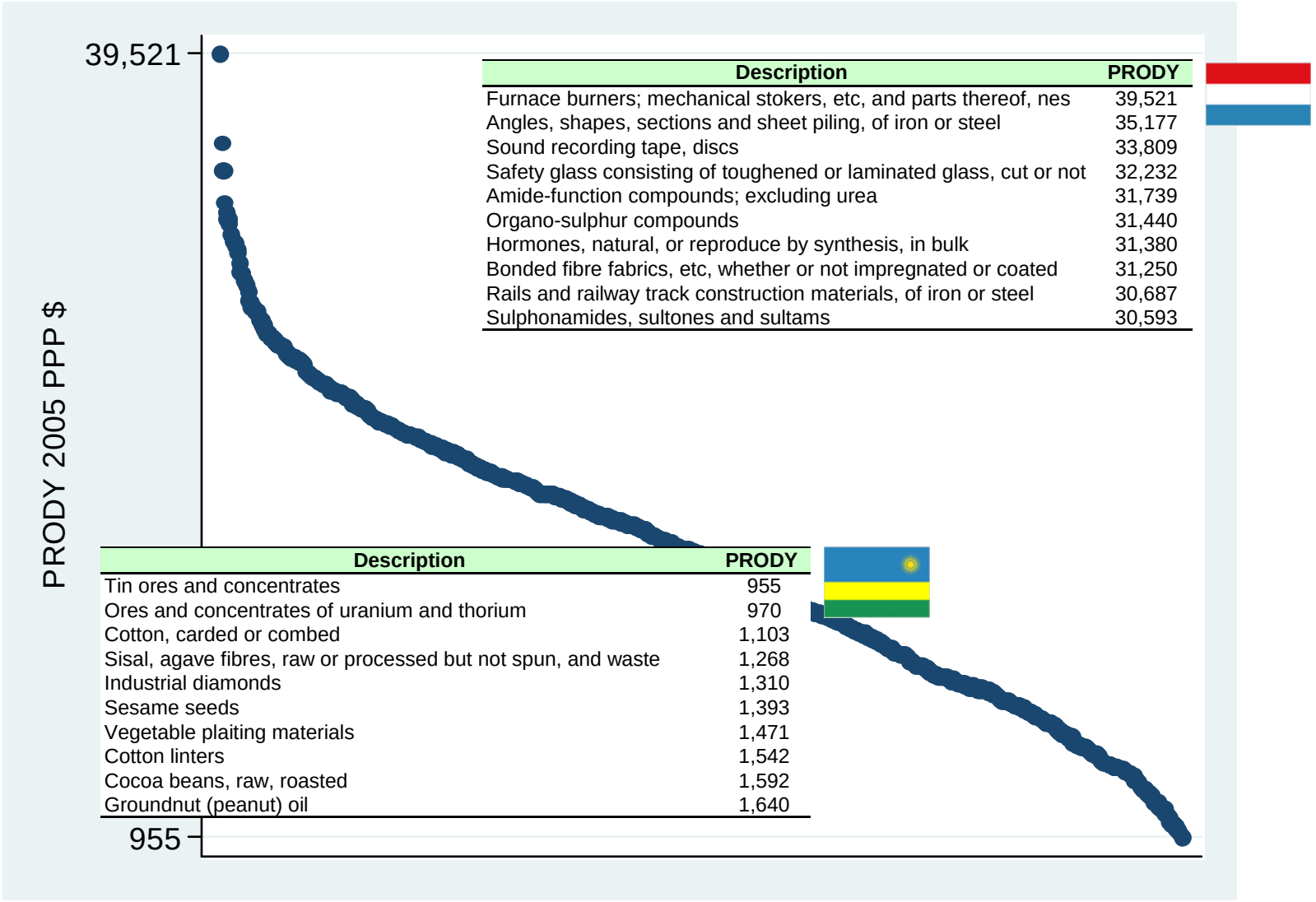
PRODY = $ 12k



$ 30k $ 8k $ 5k $ 7k

Hausmann, Hwang and Rodrik , *Journal of Economic Growth* (2007)

Most and least sophisticated commodities



Description	PRODY
Furnace burners; mechanical stokers, etc, and parts thereof, nes	39,521
Angles, shapes, sections and sheet piling, of iron or steel	35,177
Sound recording tape, discs	33,809
Safety glass consisting of toughened or laminated glass, cut or not	32,232
Amide-function compounds; excluding urea	31,739
Organo-sulphur compounds	31,440
Hormones, natural, or reproduce by synthesis, in bulk	31,380
Bonded fibre fabrics, etc, whether or not impregnated or coated	31,250
Rails and railway track construction materials, of iron or steel	30,687
Sulphonamides, sultones and sultams	30,593

Description	PRODY
Tin ores and concentrates	955
Ores and concentrates of uranium and thorium	970
Cotton, carded or combed	1,103
Sisal, agave fibres, raw or processed but not spun, and waste	1,268
Industrial diamonds	1,310
Sesame seeds	1,393
Vegetable plaiting materials	1,471
Cotton linters	1,542
Cocoa beans, raw, roasted	1,592
Groundnut (peanut) oil	1,640

How do we measure the sophistication of a country's export basket (EXPY)?

EXPY represents the income level associated with a country's export basket

$$EXPY_{c,t} = \sum_i \left(\frac{xval_{c,i,t}}{\sum_i xval_{c,i,t}} \times PRODY_{i,t} \right)$$

$12,000
50%

$10,000
20%

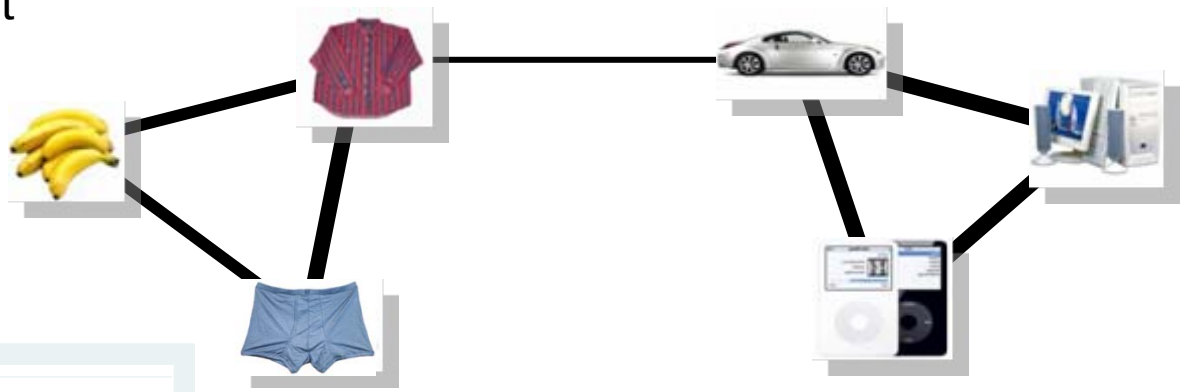
$34,000
30%

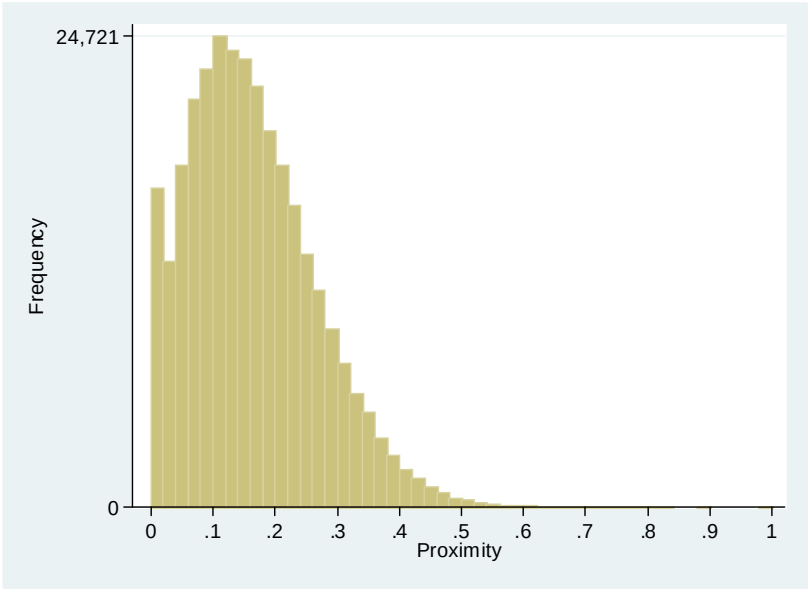
EXPY=$18,200

Hausmann, Hwang and Rodrik , *Journal of Economic Growth* (2007)

How are commodities linked in the product space?

Proximity is based on the idea that the ability of a country to produce a product depends on its ability to produce other products





$$\phi_{ij} = \min\left\{ \begin{matrix} P(i \text{ is exported} \mid j \text{ is exported}), \\ P(j \text{ is exported} \mid i \text{ is exported}) \end{matrix} \right\}$$

“RCA Matrix”

	x1	x2	x3	x4
A	1 RCA>=1	1	1	0
B	1	1	1	1
C	1	0	1	1
D	0 RCA<1	1	1	1
E	1	0	1	1

Conditional Probability Matrix

	x1	x2	x3	x4
x1		2/3	**4/5**	**3/4**
x2	**2/4**		**3/5**	**2/4**
x3	4/4	3/3		4/4
x4	3/4	2/3	**4/5**	

Proximity:

P(x2|x3)=3/5

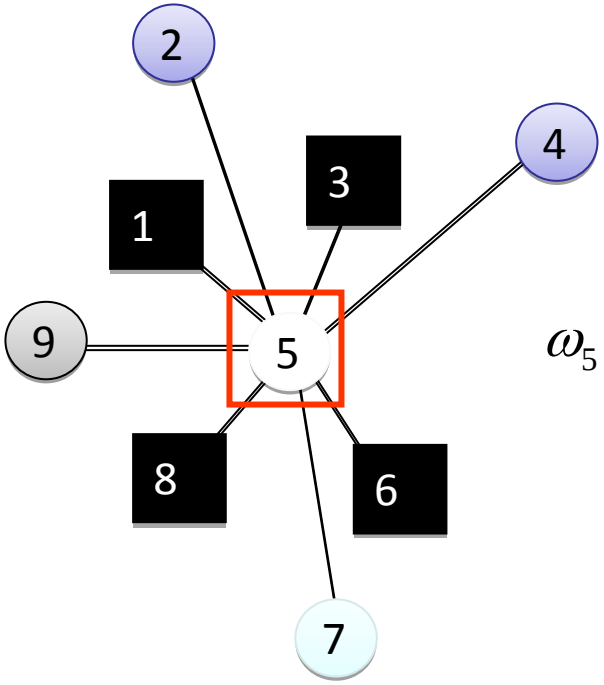
P(x3|x2)=3/3

How do we measure a country's ability to adopt a new commodity?

Density measures how close (far) a commodity, not exported with comparative advantage, is to the country's export basket

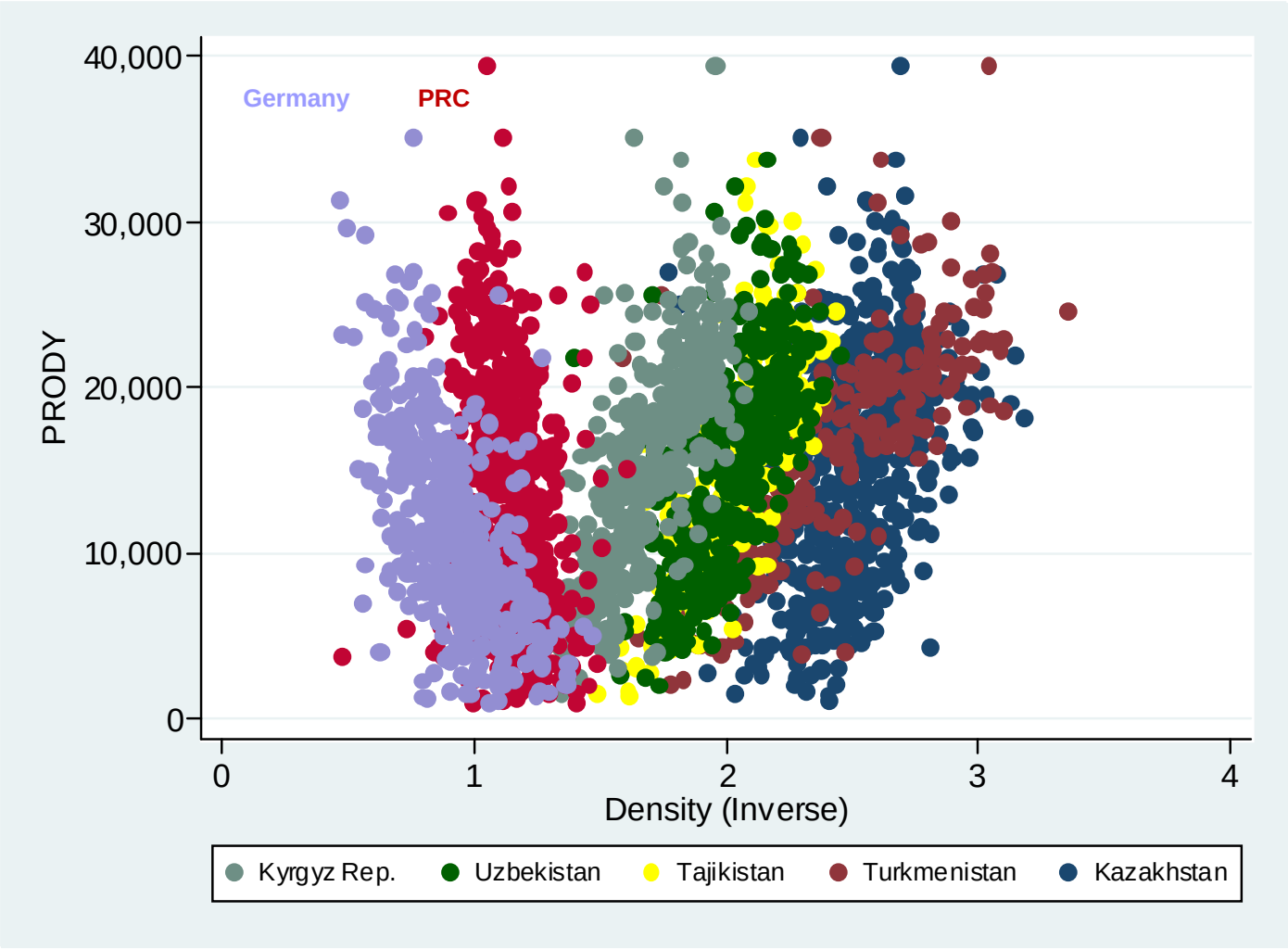
$$\omega_j = \frac{\sum_i \phi_{ij} x_i}{\sum_i \phi_{ij}}, \quad x_i = \begin{cases} 1 \text{ if } \text{RCA}_i \geq 1 \\ 0 \text{ if } \text{RCA}_i < 1 \end{cases}$$

$path_j$



$$\omega_5 = \frac{\phi_{15} + \phi_{35} + \phi_{65} + \phi_{85}}{\phi_{15} + \phi_{25} + \phi_{35} + \phi_{45} + \phi_{65} + \phi_{75} + \phi_{85} + \phi_{95}}$$

PRODY and Density

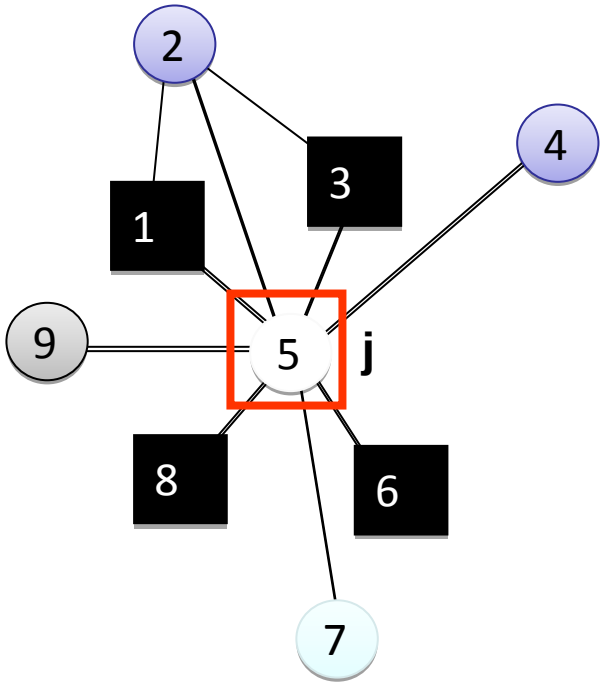


How do we measure the value of a country's unexploited export opportunities?

Open forest measures how close (far) all unexploited export opportunities are from the current export basket

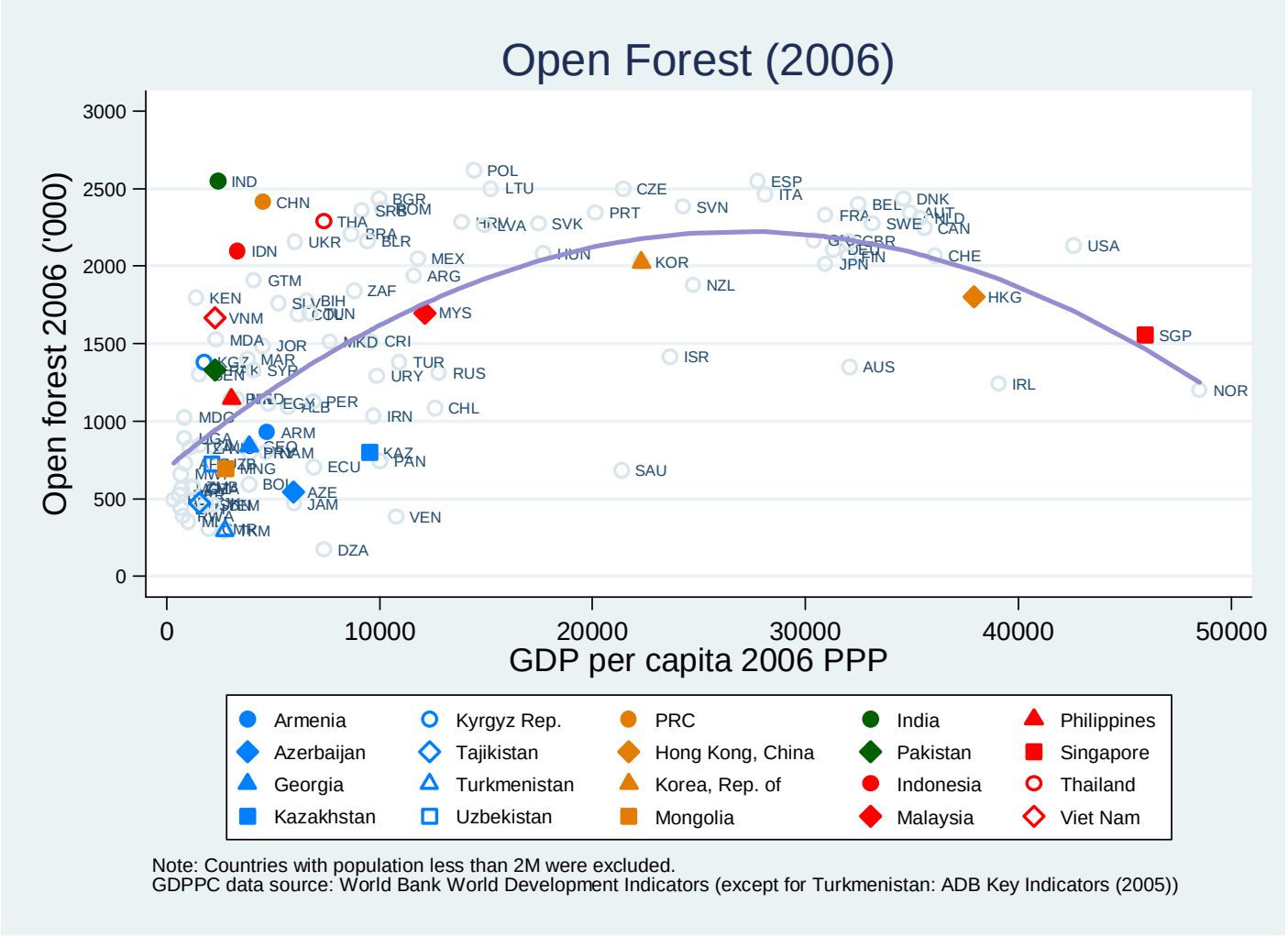
$$OpenForest_c = \sum_j \sum_i \left[\frac{\phi_{ij} x_{ci}}{\sum_i \phi_{ij}} (1 - x_{cj}) \text{PRODY}_j \right],$$

$$\text{where } x_{ci,cj} = \begin{cases} 1 \text{ if RCA}_i \geq 1 \text{ for country c} \\ 0 \text{ if RCA}_i < 1 \text{ for country c} \end{cases}$$



$$OpenForest = \omega_2 \text{PRODY}_2 + \omega_4 \text{PRODY}_4 + \omega_7 \text{PRODY}_7 + \omega_9 \text{PRODY}_9$$

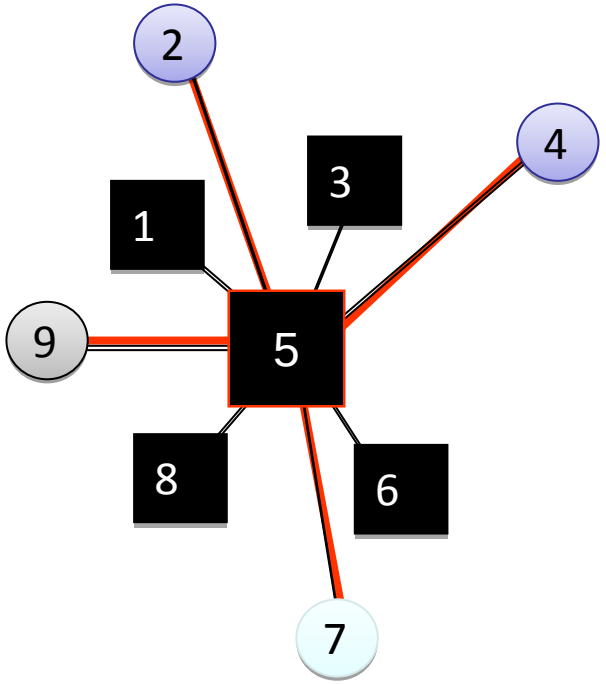
Open Forest and per capita GDP



Note: Countries with population less than 2M were excluded.
GDPPC data source: World Bank World Development Indicators (except for Turkmenistan: ADB Key Indicators (2005))

How do we measure the strategic value of a commodity?

Strategic value provides a measure of the potential contribution of a commodity, not exported with comparative advantage, to the open forest



$$SV_5 = \left(OF_{new(\text{with } 5)} - OF_{old(\text{without } 5)}\right) + \omega_5 PRODY_5$$

$$= \sum_{i=2,4,7,9} \frac{\phi_{i5}}{path_i} PRODY_i$$

‘Nearby’ commodities with the highest strategic values

	PRODY	Strategic Value
Kazakhstan		
Fine animal hair, not carded or combed	2,819	8,797
Wool greasy or fleece-washed of sheep or lambs	21,806	6,714
Nickel and nickel alloys, unwrought	25,093	8,009
Anthracite, not agglomerated	4,761	10,163
Oats, unmilled	27,066	7,031
Kyrgyz Rep.		
Cotton linters	1,542	7,265
Bones, ivory, horns, coral, shells and similar products	6,970	9,163
Nuts edible, fresh or dried	4,411	7,783
Cotton waste, not carded or combed	6,218	8,935
Ores and concentrates of other non-ferrous base metals	4,914	6,252
Tajikistan		
Sesame seeds	1,393	7,573
Tea	1,654	7,207
Goat and kid skins, raw, whether or not split	2,989	7,583
Sheep and lamb skin without the wool, raw, whether or not split	4,356	6,527
Cotton linters	1,542	7,235
Turkmenistan		
Under garments of textile fabrics, not knitted or crocheted; mens and boys	6,636	10,715
Coffee green, roasted; coffee substitutes containing coffee	2,081	6,098
Petroleum gases and other gaseous hydrocarbons, nes, liquefied	25,582	4,487
Ores and concentrates of other non-ferrous base metals	4,914	7,015
Wool greasy or fleece-washed of sheep or lambs	21,806	5,980
Uzbekistan		
Horsehair and other coarse animal hair, not carded or combed	5,317	8,993
Waxes of animal or vegetable origin	2,701	6,918
Cotton seeds	4,344	6,439
Ores and concentrates of other non-ferrous base metals	4,914	6,772
Wool greasy or fleece-washed of sheep or lambs	21,806	5,746

Thank You.