Trade-led Growth in Times of Crisis
Asia-Pacific Trade Economists' Conference
2-3 November 2009, Bangkok

Session 12

Revealed Factor Intensity Indices at the Product Level

Olivier Cadot, Miho Shirotori, Bolormaa Tumurchudur

Regional Seminar on

Enhancing Developing Countries' New and Dynamic Sectors of Exports

Bangkok
2-3 November, 2009

Revealed Factor Intensity Indices at the Product Level

Olivier Cadot, University of Lausanne

Miho Shirotori, UNCTAD

Bolormaa Tumurchudur, UNCTAD

Introducing
Revealed Factor Intensity Indices

- What is it?
  - Provides a unique number of “revealed” factor intensity of an exported product, classified at the most disaggregated level, for each year
    - SITC 5- digit (1166 products, years 1962 – 2003)
    - HS 6-digit (over 5000 products, 1988 – 2003)
- What’s the use?
  - Allows us to control for the Heckscher-Ohlin effects in analysing the patterns of trade diversification

Introducing
Revealed Factor Intensity Indices

- Initial motivation

  → To fill gaps in theory & analysis

  - **Theoretical-gap:**
    - Ambiguous linkage between recent approaches (e.g. Hausmann & Klinger, 2007) and the traditional Hecksher-Ohlin approach → Does factor endowment (comparative advantage) matter in explaining export diversification patterns?

  - **Practical-gap:**
    - No sound tool available to measure factor intensities of traded goods at a disaggregated level of product classification

Estimating
Revealed Factor Intensity Indices (RFII)

- Methodology inspired by Hausmann, Hwang & Rodrik (2007)
- RFII for each traded good = a weighted average of the factor abundance of the countries exporting that good.

$$RFII_k(t) = \sum \omega_k^i e^i$$

$$e^i \Rightarrow \{k^i, h^i, l^i\}$$

- Weights are a variant of Balassa's RCA indices

$$\omega_k^i = \frac{X_k^i / X^i}{\sum_i \left(X_k^i / X^i \right)}$$

- "Revealed" → "A product, exported by a country that is richly endowed in human capital, must be human-capital intensive"

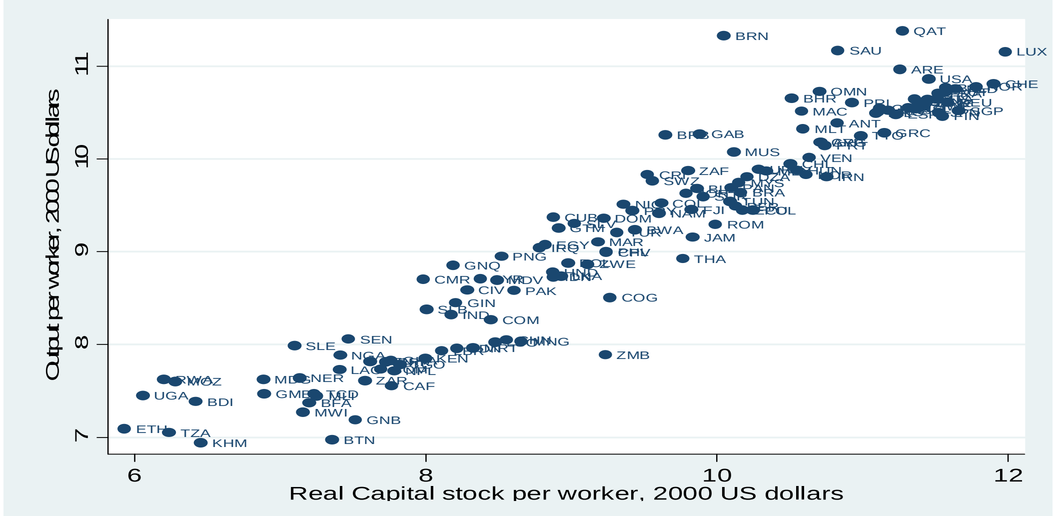
Estimating Revealed Factor Intensity Indices (RFII): National Factor Endowments

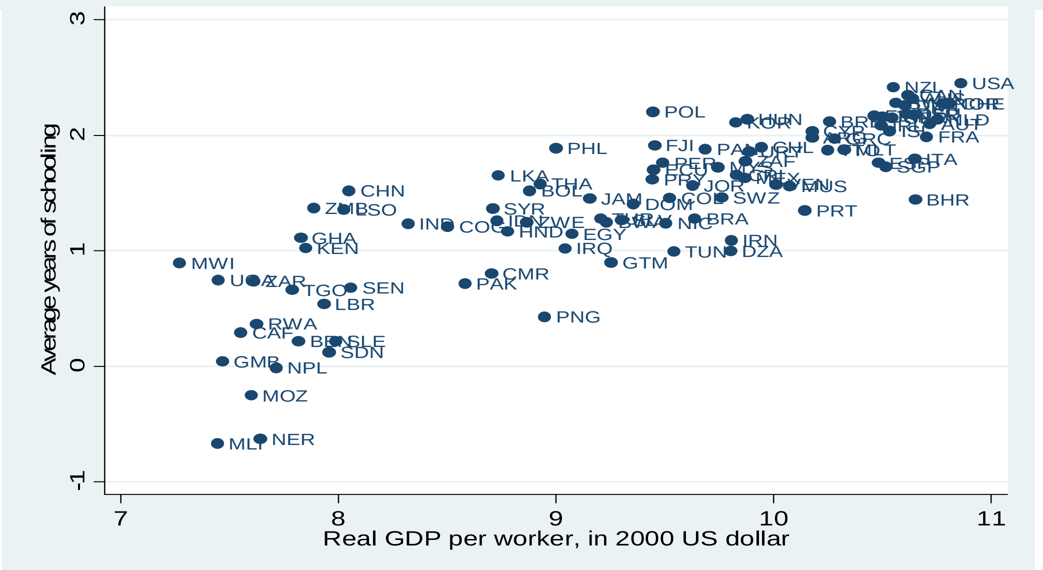
- ***k*** **= Capital Stock** (real, per worker)
  - approach of Easterly & Levine (2001)
  - Version 6.2 of PWT (investment data)
  - for 152 countries, for the period 1951-2003
- ***h*** **= Human Capital Stock**
  - Average years of schooling from Barro & Lee (2001) for each five years
  - Interpolation/extrapolation to get yearly figures for the period 1960-2004 for 105 countries
- ***l*** **= Natural Resource Endowment**
  - Arable land (hector per person), for 203 countries, for the period 1961-2005, from WDI
  - WB database on Natural Capital for over100 countries
    - Non-renewable resources, cropland, pastureland, forested area, and protected areas.
    - Only for 2 years: 1994 and 2000

NOTE: National Factor Endowments

- Reliability check: a plausible degree of correlation

- We also did cluster analysis to check further whether our data is reasonable and realistic





Note: Some caveats

- Limitation of Balassa's RCA index
  - Double counting
  - Should be based on net exports
- Dealing with agricultural distortions
  - WB new database on Agricultural Distortions (2008)
    - Nominal Rate of Assistance (NRA) for 70% of agricultural products for the period of 1955-2005
    - Correction: to keep only undistorted RCAs by weeding out observations characterised by nonzero NRAs

Result – RFII Database

RFI Indices can be downloaded from UNCTAD website: http://r0.unctad.org/ditc/tab/index.shtm

- RFII datasets
  - Formatted both in Excel and Stata
  - Two different sets, depending on product classification (SITC 5-digit or HS 6-digit)
  - Additional datasets - “unbalanced” dataset
- All data on national endowments

Result – RFII Database

RFII Data Coverage

- "Balanced"
  - Good for tracking the evolution of RFII for each good over several years – (balanced panel)
- "Unbalanced"
  - Good for having indices for a greater number of countries

Balanced Data Coverage

	Number of Years	Time period	Number of Countries
Capital Stock	33	1971-2003	136
Human Capital Stock	45	1960-2004	105
Arable Land	45	1961-2005	165
Total coverage	**33**	**1971-2003**	**92**

Unbalanced Data Coverage

	Time Period	Number of Countries
Capital Stock	1951-2003	51-141
Human Capital Stock	1960-2004	103-105
Arable Land	1960-2004	165-203
Total coverage	**1961-2003**	**76-99**

Result – RFII Database

Examples of the RFII at the product level

a. HS 6 digit (2000)

Year	HS-6 digit	HS6 Description	HS Section	Section Description	HS Chapter	Export	Import	RHCI	RCI	RNRI_land	RNRI_nc	RNRI_sa	RNRI_pc
2000	010120	Live asses mules and hinnies	1	Live animals	1	869'009	1'383'990	6.77	45'985	0.74	17'994	5'154	8'957
2000	010210	Live pure-bred breeding bovine animals	1	Live animals	1	320'355'389	282'322'642	7.72	51'182	1.01	18'506	2'720	13'207
2000	010290	Live bovine animals, other than pure-bred breed	1	Live animals	1	679'923'473	1'414'390'438	6.17	35'705	1.54	16'327	3'555	9'583
2000	010310	Live pure-bred breeding swine	1	Live animals	1	41'803'433	39'072'786	9.02	93'136	0.70	24'944	8'598	10'952
2000	010391	Live swine weighing <50kg (excl. pure-bred bree	1	Live animals	1	32'109'689	104'885'738	1.16	5'744	0.88	4'428	47	3'504
2000	010392	Live swine weighing >=50kg (excl. pure-bred bre	1	Live animals	1	278'756'751	243'334'912	7.10	74'585	0.21	6'014	828	4'656
2000	010410	Live sheep	1	Live animals	1	317'030'035	104'489'345	6.66	17'987	0.83	19'565	12'367	6'693
2000	010420	Live goats	1	Live animals	1	37'171'611	15'276'933	5.54	39'155	0.86	29'154	17'025	9'208
2000	010511	Live fowls of species Gallus domesticus, weighi	1	Live animals	1	39'116'577	114'191'443	6.37	18'203	0.36	5'955	2'130	2'770
2000	010519	Live ducks, geese, turkeys and guinea fowls, we	1	Live animals	1	4'388'634	14'998'743	6.55	22'618	0.37	4'505	916	2'402

RFII – Summary Statistics

Summary statistics of Revealed Factor Intensity Indices (SITC, year 2000)

Variable	Obs	Mean	Std. Dev.	Min	Max
rhci	1166	7.07	1.62	1.52	11.21
rci	1166	60'257	30'726	2'608	149'916
rnri_land	1166	0.61	0.35	0.07	4.18
rnri_nc	1166	14'768	8'998	2'028	73'993
rnri_sa	1166	4'826	5'428	31	61'315
rnri_pc	1166	6'909	4'011	1'087	43'272

rhci	Revealed human capital intensity
rci	Revealed (physical) capital intensity
rnri_land	Revealed natural resource intensity- land
rnri_nc	Revealed natural resource intensity-natural capital
rnri_sa	Revealed natural resource intensity-sub-oil assets
rnri_pc	Revealed natural resource intensity-pastured and crop land

RFII – Summary Statistics

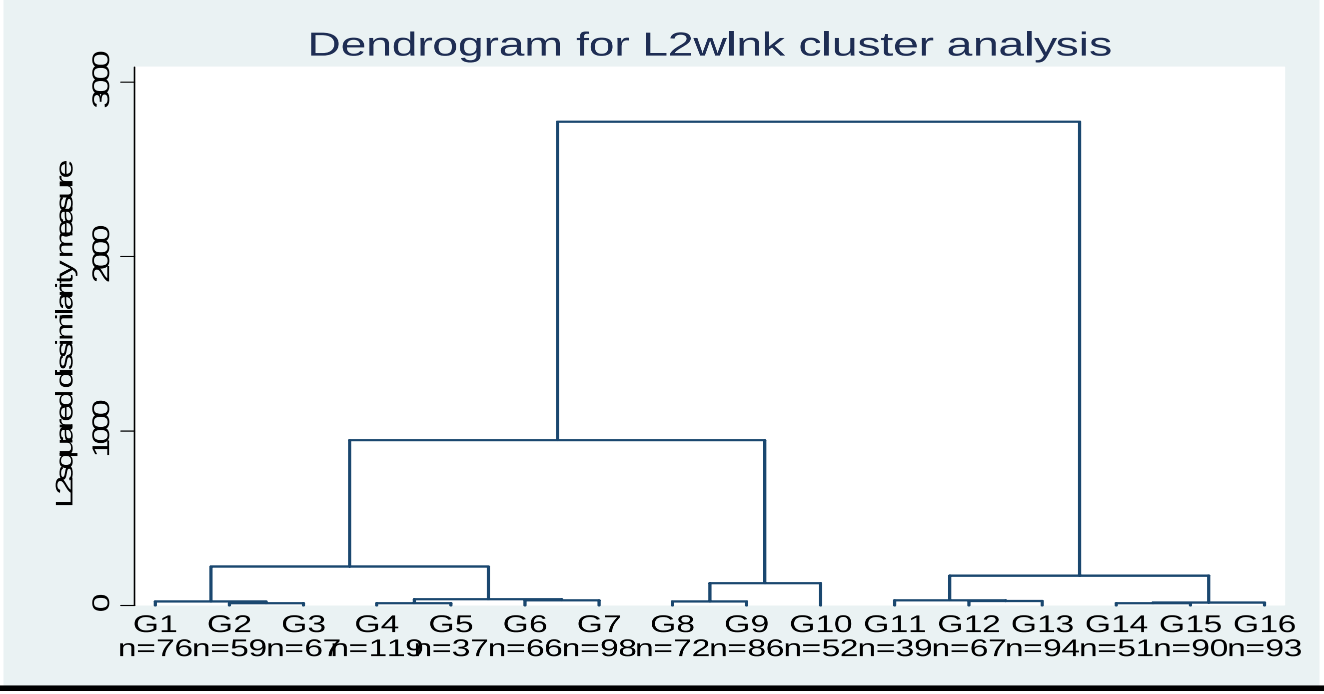
Simple averages of Factor Intensity Indices by industry (SITC 1-digit)

sitc1	SITC 1 digit description	RHCI	RCI	RNRI_land	RNRI_nc	RNRI_sa	RNRI_pc
0	Food and live animals	6.27	39'067	0.79	15'428	4'422	8'314
1	Beverages and tobacco	6.95	52'538	0.61	15'070	4'614	7'704
2	Crude materials, inedible, except f	6.37	42'159	0.74	16'382	5'256	7'640
3	Mineral fuels, lubricants and relat	6.94	47'869	0.69	20'925	12'070	6'187
4	Animal and vegetable oils and fats	5.67	34'756	0.74	12'748	3'795	6'709
5	Chemicals	7.66	72'169	0.59	16'641	6'119	7'354
6	Manufact goods classified chiefly b	7.06	62'059	0.55	13'667	4'342	6'380
7	Machinery and transport equipment	8.23	87'231	0.56	15'474	4'705	6'998
8	Miscellaneous manufactured articles	7.04	60'941	0.46	11'818	3'607	5'814
9	Commod. & transacts. not class. acc	7.60	75'250	0.79	18'288	7'253	6'115

Mashinery and Chemicals
have the highest RF capital
human capital indices

RFII - Cluster Analysis

Dendrogram of Ward's Cluster Analysis



	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Revealed Capital Intensity Index	10'783	23'386	39'601	58'076	81'636	102'341
Revealed Human Capital Intensity Index	3.29	5.20	6.37	7.38	8.16	9.05
Number of Goods	72	167	224	273	237	193

RFII - Cluster Analysis

Percentages of SITC 1 digit industries, by clusters

SITC sectors at 1 digit	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
0 Food and live animals	26%	17%	18%	10%	3%	4%
1 Beverages and tobacco	1%	1%	0%	2%	1%	0%
2 Crude materials, inedible, except f	31%	26%	17%	12%	5%	7%
3 Mineral fuels, lubricants and relat	0%	1%	5%	3%	0%	1%
4 Animal and vegetable oils and fats	8%	4%	3%	1%	1%	0%
5 Chemicals	4%	11%	8%	13%	25%	18%
6 Manufact goods classified chiefly b	17%	25%	31%	36%	29%	26%
7 Machinery and transport equipment	0%	1%	4%	7%	22%	28%
8 Miscellaneous manufactured articles	10%	15%	14%	18%	13%	14%
9 Commod. & transacts. not class. acc	3%	0%	0%	0%	1%	2%
	100%	100%	100%	100%	100%	100%

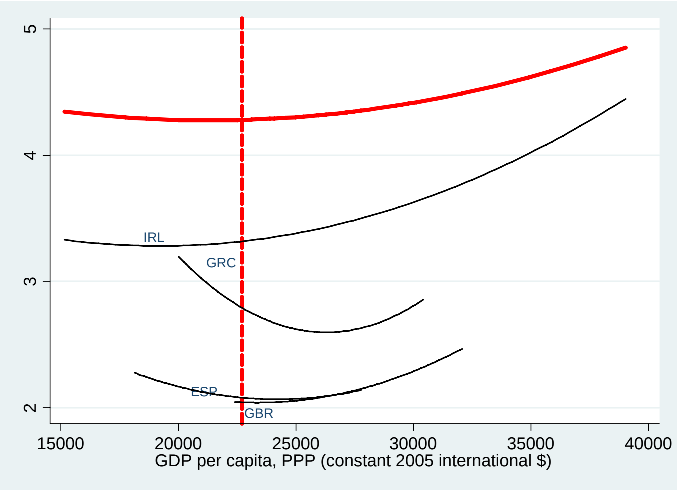
Percentages of clusters, by SITC 1 digit industries

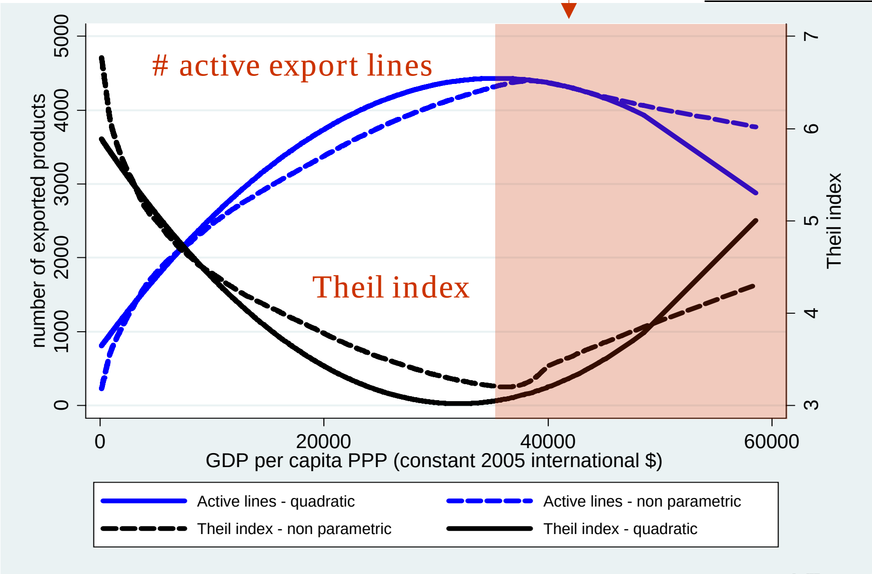
SITC sectors at 1 digit	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	
0 Food and live animals	15%	22%	31%	20%	6%	6%	100%
1 Beverages and tobacco	8%	8%	8%	50%	25%	0%	100%
2 Crude materials, inedible, except f	14%	27%	23%	20%	7%	9%	100%
3 Mineral fuels, lubricants and relat	0%	5%	55%	32%	0%	9%	100%
4 Animal and vegetable oils and fats	25%	29%	25%	13%	8%	0%	100%
5 Chemicals	2%	11%	10%	21%	35%	21%	100%
6 Manufact goods classified chiefly b	4%	12%	21%	28%	20%	15%	100%
7 Machinery and transport equipment	0%	1%	7%	14%	39%	39%	100%
8 Miscellaneous manufactured articles	4%	15%	18%	29%	18%	16%	100%
9 Commod. & transacts. not class. acc	25%	0%	0%	0%	38%	38%	100%

Economic development and export diversification: Stylized facts (Cadot, Carrère & Strauss-Kahn, March 2009)

Along the path of income growth, countries
• First diversify (up to $25'000 PPP per capita GDP)
• Then re-concentrate

and this is true even for individual country trajectories :





Australia
Austria
Belgium
Canada
Denmark
Finland
France
Greece
Germany
Hong Kong
Ireland

Japan
Netherlands

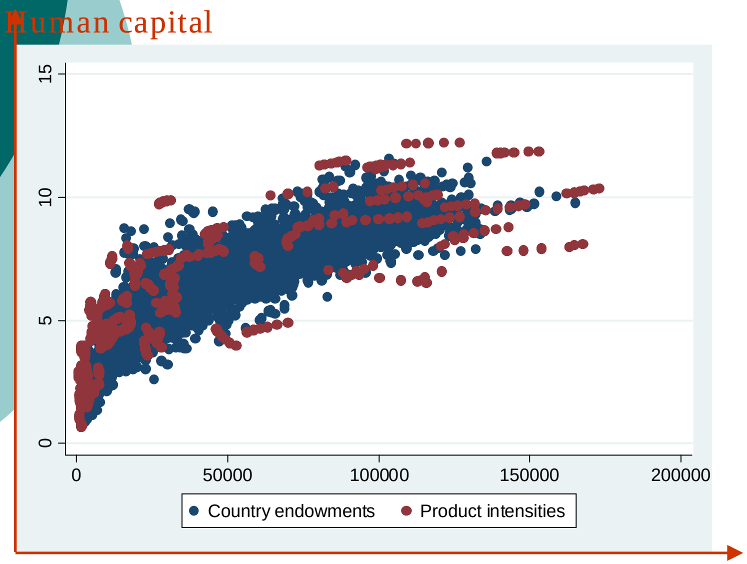
Norway
Singapore

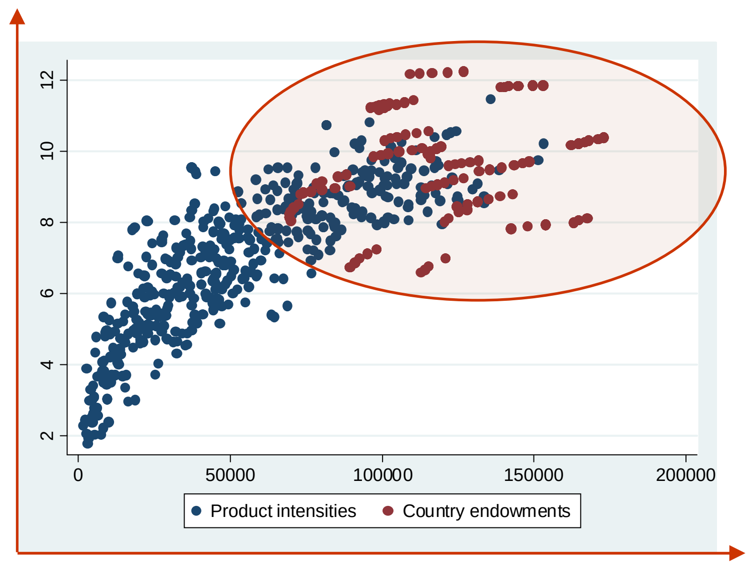
Sweden
Switzerland
United King.
United States

How and why do rich countries re-concentrate their exports? (Cadot, Carrère & Strauss-Kahn, March 2009)

Countries close many export lines as part of normal churning...

... but past the $25'000 turning point they close export lines that are **out of tune with their endowments**.





Capital

... that is, part of the diversification observed at middle income levels may be inefficient

Reference: Cadot, Carrère, Strauss-Kahn. "Export diversification: What's behind the hump?"

Conclusion

- RFI indices
  - Generate a more economically meaningful categorization of products according to their factor intensities, at the most disaggregated level of product classification
  - Can be useful for trade policy analysis, particularly concerning structural transformation and export diversification

→ **Try the RFII Database & Give us your feed back!**