CENTER FOR MACROECONOMIC ANALYSIS AND SHORT-TERM FORECASTING

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Trade Shares, Structural Transformation and Economic Development: Classifying Country Experience*

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(Higher School of Economics at St. Petersburg, Russia)

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Plan

The aim of the paper

1. Literature review
2. The approach
3. The results

An afterword

The aim of the paper

- Structural change is usually examined as the change in the shares of three aggregated sectors:
  - Agriculture, manufacturing and services
- Such change takes much time and often reflects such well-known and widely-spread process as industrialization
- Minor changes inside each group are usually not in the center of the research interest, though they may help to classify countries by tracks of structural transformation
  - Within industries vs. between industries

The aim of the paper

- The paper classifies countries according to the changes in both export and import structure at the commodity level
- We try to look at the processes that are masked under the common label “industrialization” or “structural change”
- Do countries that have similar patterns of structural change differ in industry- and commodity-level tracks of this change?
- Is there a link between trends in trade diversification and the share of intra-industry trade? For which countries?

1. Literature review

- Structural change: the decline in the share of agriculture in economic activity (employment, production, value added)
- Imbs and Wacziarg (2003) were the first to analyze the structural change in the context of economic diversification
  - The U-shaped track of diversification along the development path
- The U-shaped track of export diversification – Klinger and Lederman (2006), Cadot, Carrere and Strauss-Kahn (2011)
  - Or not? (Parteka and Tamberi, 2013; Mau, 2016)
- Import is usually more stable in structure, but some papers explore both export and import diversification
  - For example, Parteka and Tamberi (2013) use Theil index

1. Literature review

- Dabla-Norris et al. (2013): tracks of structural transformation in terms of aggregated sector shares differ across countries. For ex., compared to countries with similar per capita GDP:
  - China has higher manufacturing value added share
  - India has higher services value added share
- The role of exports for economic development: China's export bundle is much more sophisticated than is expected according to its per capita income (Rodrik, 2006, among others)
  - May be, what you export may drive growth?
  - Interpretation: a country's welfare and its export bundle are both determined by its capabilities (Sutton and Trefler, 2016)

1. Literature review

- Few papers used detailed trade data to classify country experience. For example:
  - Audretsch, Sanders, Zhang (2017): three clusters of countries with different export strategies according to product life cycles
  - Pugliese et al. (2017): an approach to classify countries according to their path along fitness of the country and per capita GDP
- The key advantage of relying on trade data is its disaggregated nature and the availability of data by countries
- Note that the tracks of structural transformation in production or value added may be different
  - However, it is hard to trace them for the worldwide analysis

2. The approach: basics

- First, we look at the level of diversification measured through a relative Theil index (world structure as the reference level) like *Parteka and Tamberi* (2013)
  - It may be stable or not
  - If it is not stable, there is a structural transformation

$$Theil_{c,t} = \sum_{i} s_{c,i,t} ln\left(\frac{s_{c,i,t}}{s_{w,i,t}}\right)$$

- The world trade structure also changes
  - So, by calculating relative Theil index we "account for trends common to all countries" (*Parteka and Tamberi*, 2013, p. 125)

2. The approach: basics

- Second, we calculate the **between** and **within** components of the relative Theil index to show if the major contribution to the structural change is made by trends inside **groups** or not
  - Group, type 1: 18 industries (14 industries in manufacturing)
  - Group, type 2: 4 broad economic categories (CONS, INT, CAP, FUEL)

$$Theil_{c,t}^{B} = \sum_{G} s_{c,G,t} ln\left(\frac{s_{c,G,t}}{s_{w,G,t}}\right)$$

$$Theil_{c,t}^{W} = Theil_{c,t} - Theil_{c,t}^{B}$$

2. The approach: basics

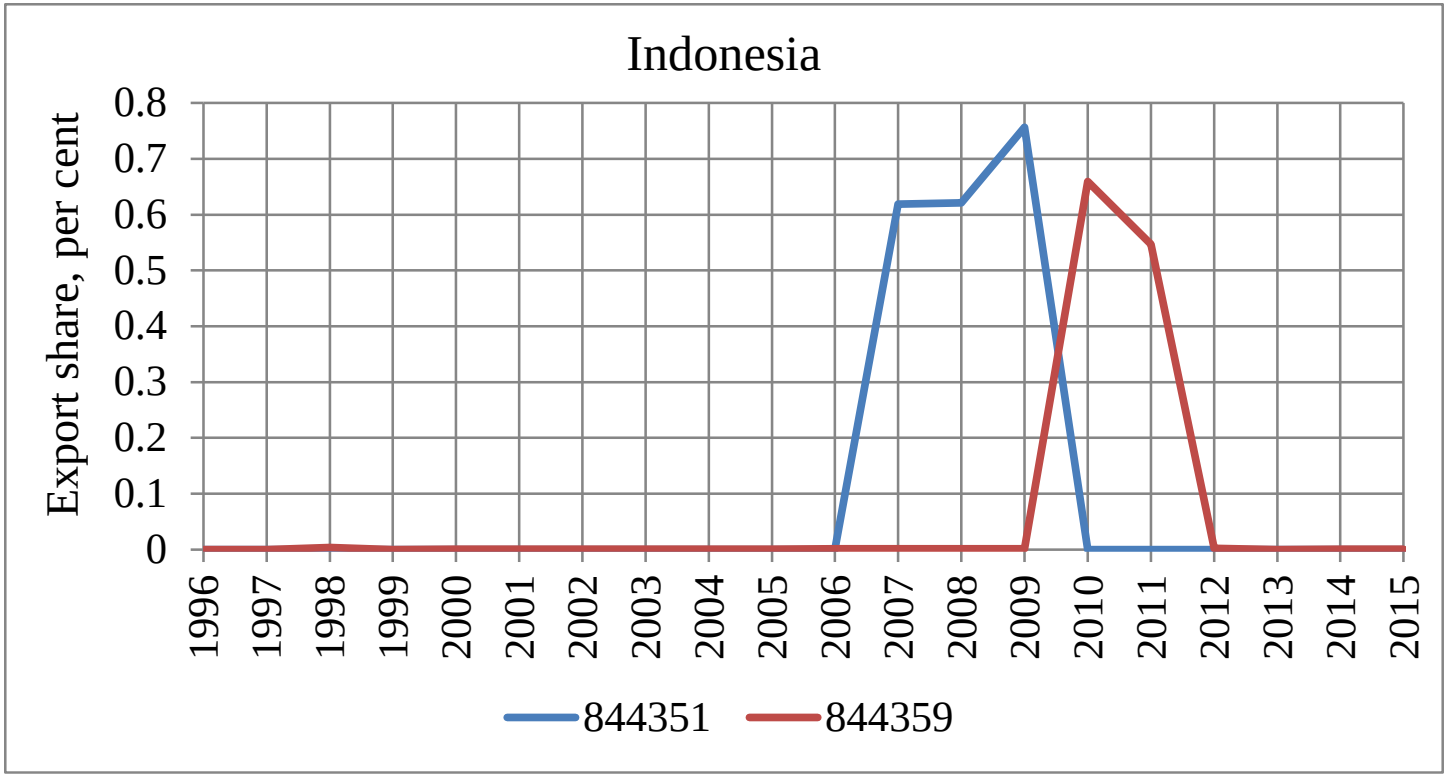
- Third, we look at the differences of the links between Theil indices (export and import) and Grubel-Lloyd (1971) index:
  - Overall
  - CONS and INT commodities

$$GL_{i,c,t} = 1 - \left| \frac{x_{i,c,t} - m_{i,c,t}}{x_{i,c,t} + m_{i,c,t}} \right|$$

- Finally, we identify countries that experienced structural transformation and split them into several groups
- Why bother about intra-industry trade (Grubel-Lloyd)?
  - Brulhart (2009) analyzes world trends in commodity trade and concludes that economies' sectoral composition is becoming more similar over time due to the surge in intra-industry trade

2. The approach: minor technical details

- Sharp changes should be treated carefully
  - In most cases, they reflect unexplainable surges and drops in trade shares of some commodities, such as Indonesian printing machinery

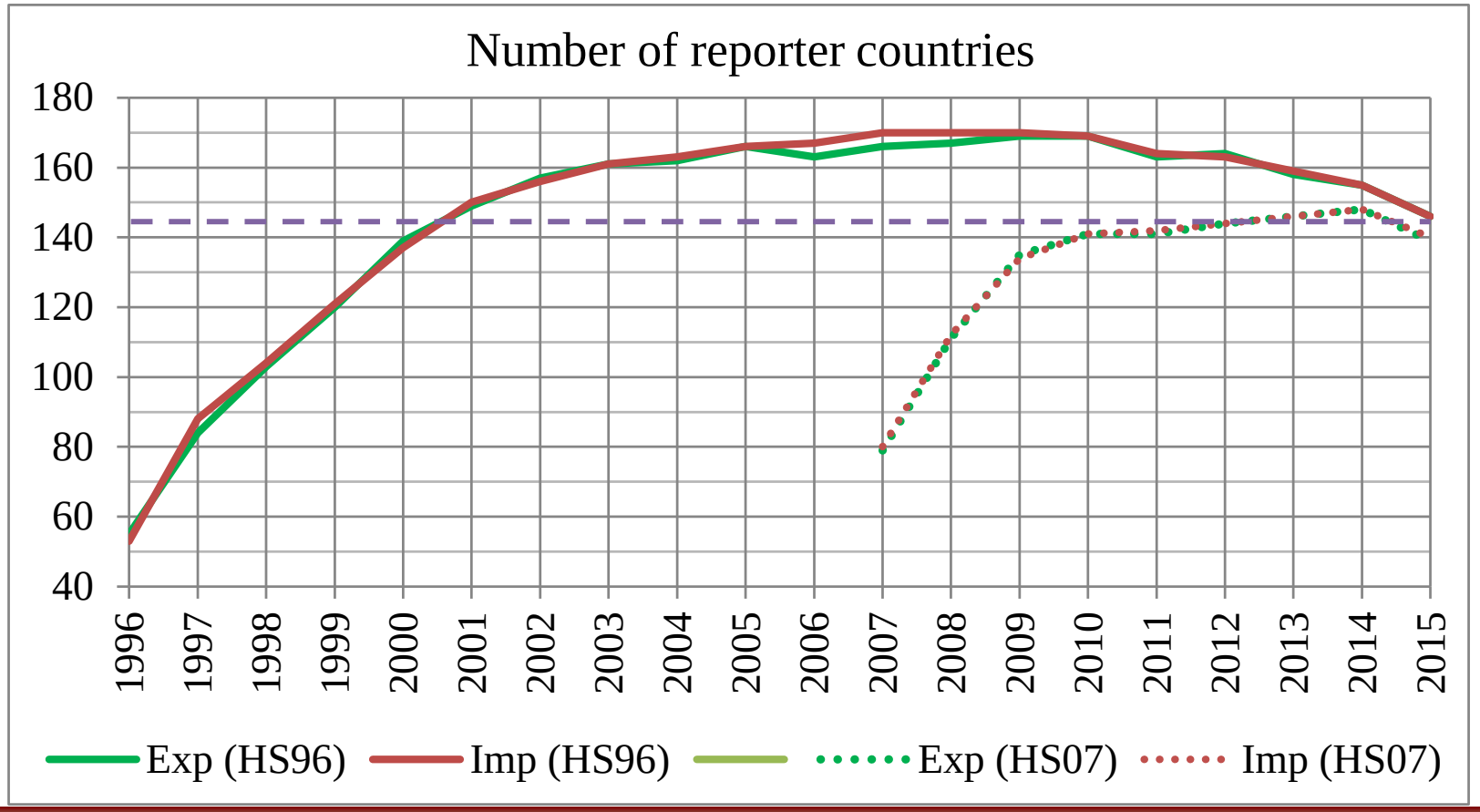


2. The approach: minor technical details

- At this stage of the research, we do not eliminate these surges and drops but simply remember about them
  - In pooled and panel regressions, we do not care about these changes as they do not impact much on the overall results
  - At the country level, we switch off the years with a sharp change of Theil index (as they become important for individual countries)
  - Potentially, it is better to look at the industry level (what industries contributed to such changes?), and then deep into commodity data

3. The results: a preliminary look

- Classification: HS 1996; Period: 2001-2015 [77 countries]
  - Lower quartile by per capita income is excluded

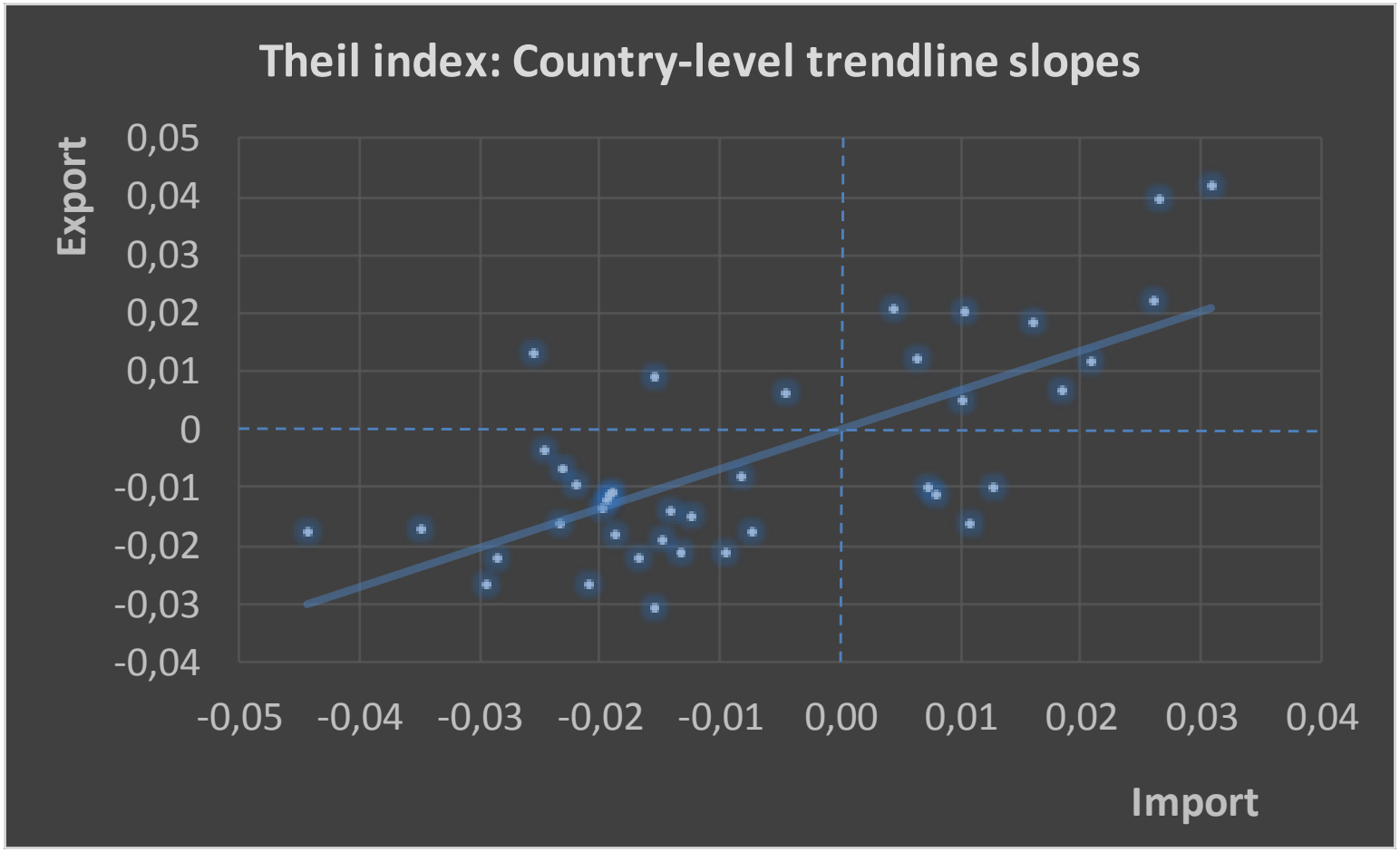


3. The results: a preliminary look

- Is there a trend in overall export and import diversification?
  - 4 countries: weird data (Panama, Philippines, Tanzania, Zambia)
  - 2 countries: no trends, 5-% significance (Ecuador, Hungary)
  - 14 countries: trends in M only (9 – Theil's decline; 5 – Theil's growth)
  - 17 countries: trends in X only (9 – Theil's decline; 8 – Theil's growth)
  - 40 countries: trends in both M and X
    - 23 – Theil's decline for both M and X
    - 10 – Theil's growth for both M and X
    - 7 – mixed trends
      (US, Portugal, Netherlands, Bulgaria – growth of M concentration;
      Brazil, Mexico, Jordan – growth of X concentration)

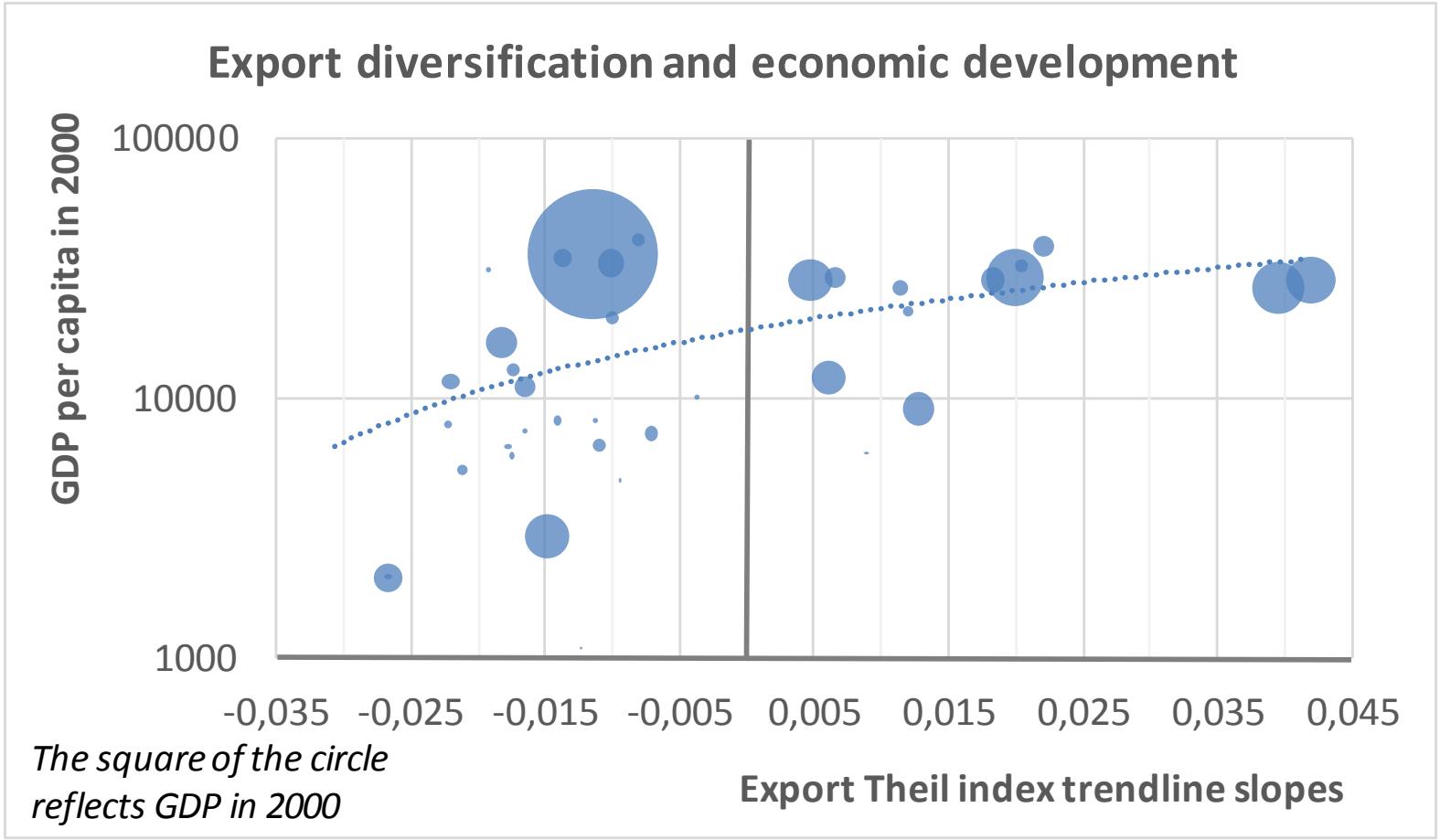
3. The results: a preliminary look

- Generally, trends in export and import diversification are close



3. The results: a preliminary look

- It is harder to diversify for countries with low per capita GDP



3. The results: pooled

```
Call:
lm(formula = theilX ~ grubel, data = hPanel)

Residuals:
    Min      1Q  Median      3Q     Max
-1.6856 -0.5302 -0.1200  0.4195  3.8104

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  3.44365    0.04261   80.81   <2e-16 ***
grubel      -4.48369    0.11511  -38.95   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.7641 on 1153 degrees of freedom
Multiple R-squared:  0.5682,    Adjusted R-squared:  0.5678
F-statistic:  1517 on 1 and 1153 DF,  p-value: < 2.2e-16
```

3. The results: pooled

```
Call:
lm(formula = theilX ~ theilM + grubel, data = hPanel)

Residuals:
    Min      1Q  Median      3Q     Max
-3.4172 -0.3851  0.0270  0.3116  3.4043

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  1.89799    0.06977   27.20   <2e-16 ***
theilM       1.10623    0.04355   25.40   <2e-16 ***
grubel      -2.66564    0.11673  -22.84   <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.6121 on 1152 degrees of freedom
Multiple R-squared:  0.7232,    Adjusted R-squared:  0.7227
F-statistic:  1505 on 2 and 1152 DF,  p-value: < 2.2e-16
```

3. The results: panel

```
Oneway (individual) effect Between Model

Call:
plm(formula = theilX ~ theilM + grubel, data = hPanel, model = "between",
    index = c("country", "year"))

Balanced Panel: n=77, T=15, N=1155
Observations used in estimation: 77

Residuals :
     Min.   1st Qu.    Median   3rd Qu.      Max.
-1.549926 -0.378618  0.028389  0.271953  1.929127

Coefficients :
            Estimate Std. Error t-value  Pr(>|t|)
(Intercept)  1.71851    0.28938  5.9385 8.665e-08 ***
theilM       1.22243    0.17996  6.7929 2.385e-09 ***
grubel      -2.42023    0.47649 -5.0793 2.744e-06 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    99.373
Residual Sum of Squares: 25.645
R-Squared:      0.74194
Adj. R-Squared: 0.73496
F-statistic: 106.375 on 2 and 74 DF, p-value: < 2.22e-16
```

3. The results: panel

```
Oneway (individual) effect Between Model

Call:
plm(formula = theilXcons ~ theilMcons + grubelCONS, data = hPanel,
    model = "between", index = c("country", "year"))

Balanced Panel: n=77, T=15, N=1155
Observations used in estimation: 77

Residuals :
     Min.   1st Qu.    Median   3rd Qu.      Max.
-1.845442 -0.371270  0.019077  0.440095  2.088618

Coefficients :
            Estimate Std. Error t-value  Pr(>|t|)
(Intercept)  2.68818    0.34198  7.8606 2.375e-11 ***
theilMcons   0.52984    0.24139  2.1950    0.0313 *
grubelCONS  -3.72082    0.58647 -6.3444 1.596e-08 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    99.43
Residual Sum of Squares: 37.629
R-Squared:      0.62155
Adj. R-Squared: 0.61132
F-statistic: 60.7677 on 2 and 74 DF, p-value: 2.4335e-16
```

3. The results: panel

```
Oneway (individual) effect Between Model

Call:
plm(formula = theilXint ~ theilMint + grubelINT, data = hPanel,
    model = "between", index = c("country", "year"))

Balanced Panel: n=77, T=15, N=1155
Observations used in estimation: 77

Residuals :
     Min.   1st Qu.    Median   3rd Qu.      Max.
-0.883706 -0.182375 -0.042448  0.247700  1.517235

Coefficients :
            Estimate Std. Error t-value  Pr(>|t|)
(Intercept)  1.99439    0.19587  10.182 1.010e-15 ***
theilMint    1.16102    0.10323  11.246 < 2.2e-16 ***
grubelINT   -3.09414    0.31260  -9.898 3.416e-15 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    126.4
Residual Sum of Squares: 12.725
R-Squared:      0.89932
Adj. R-Squared: 0.8966
F-statistic: 330.505 on 2 and 74 DF, p-value: < 2.22e-16
```

3. The results: country groups

1. 40 countries out of 77 have experienced structural transformation **both in exports and imports** (Theil index)
   - Large higher-income countries: trade concentration
   - Lower-income countries: trade diversification
   - Small higher income countries: mixed trends

2. The previously found negative correlation between Theil index (trade concentration) and Grubel-Lloyd index (the share of intra-industry trade) holds for **most but not all** countries

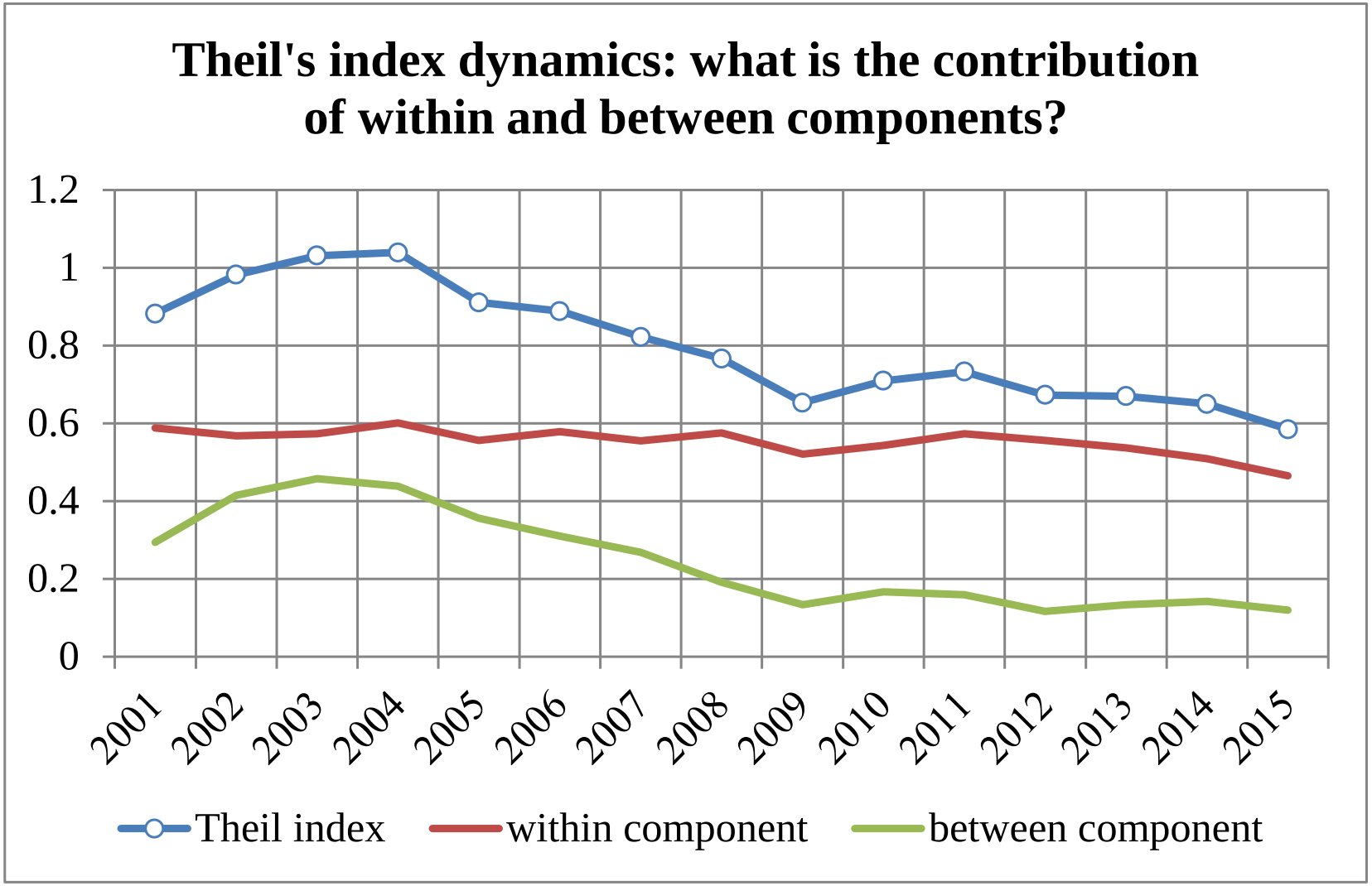
3. The results: country groups

Country group	*I*	*II*	*III*	*IV*	
No. Countries	(9)	(7)	(6)	(18)	
Theil (decline)	-	3	4	16	
Theil (growth)	7	3	-	-	
Theil (mixed)	2	1	2	2	
GL-	**3**	**1**	**2**	**10**	
GL+	1	1	-	-	
GLm	1	-	-	-	
GL0	4	5	4	8	
	Australia	Hong Kong	Brazil	Algeria	Paraguay
	France	Ireland	China	**Bulgaria**	**Peru**
	Germany	Oman	**Korea**	Cambodia	**Poland**
	Italy	**New Zealand**	Mexico	Colombia	**Romania**
	Netherlands	Portugal	Russia	**Dominican Rep.**	**Vietnam**
	Sweden	Saudi Arabia	**India**	**Ethiopia**	**Thailand**
	Switzerland	Singapore		Kazakhstan	Tunisia
	UK			Jordan	**Uganda**
	USA			**Malaysia**	Uruguay

GDP per capita

GDP	**High**	**Low**
High	I	II
Low	III	IV

3. The results: country groups



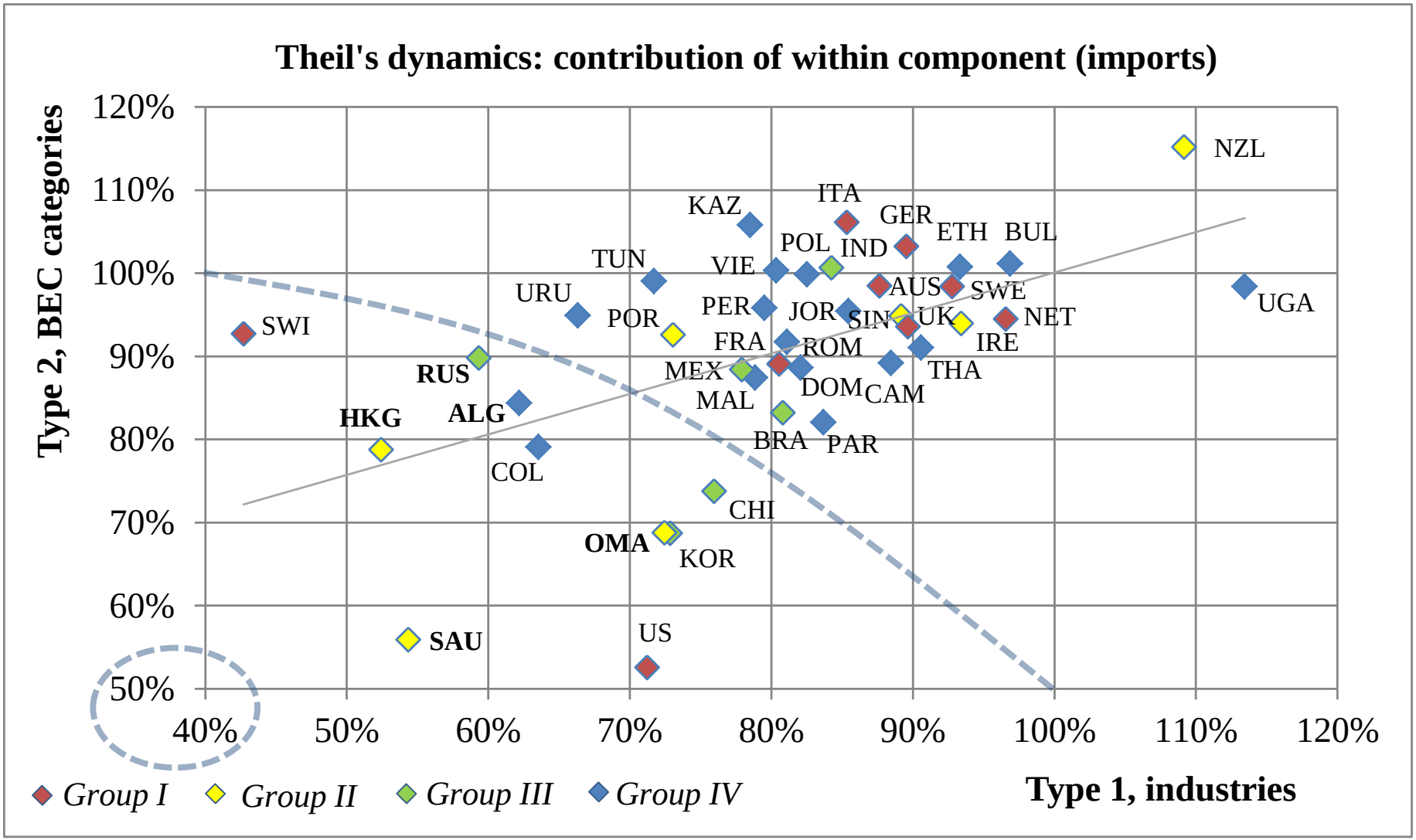
3. The results: country groups

- The dynamics of export and especially import diversification is dominated by structural change **within** industries

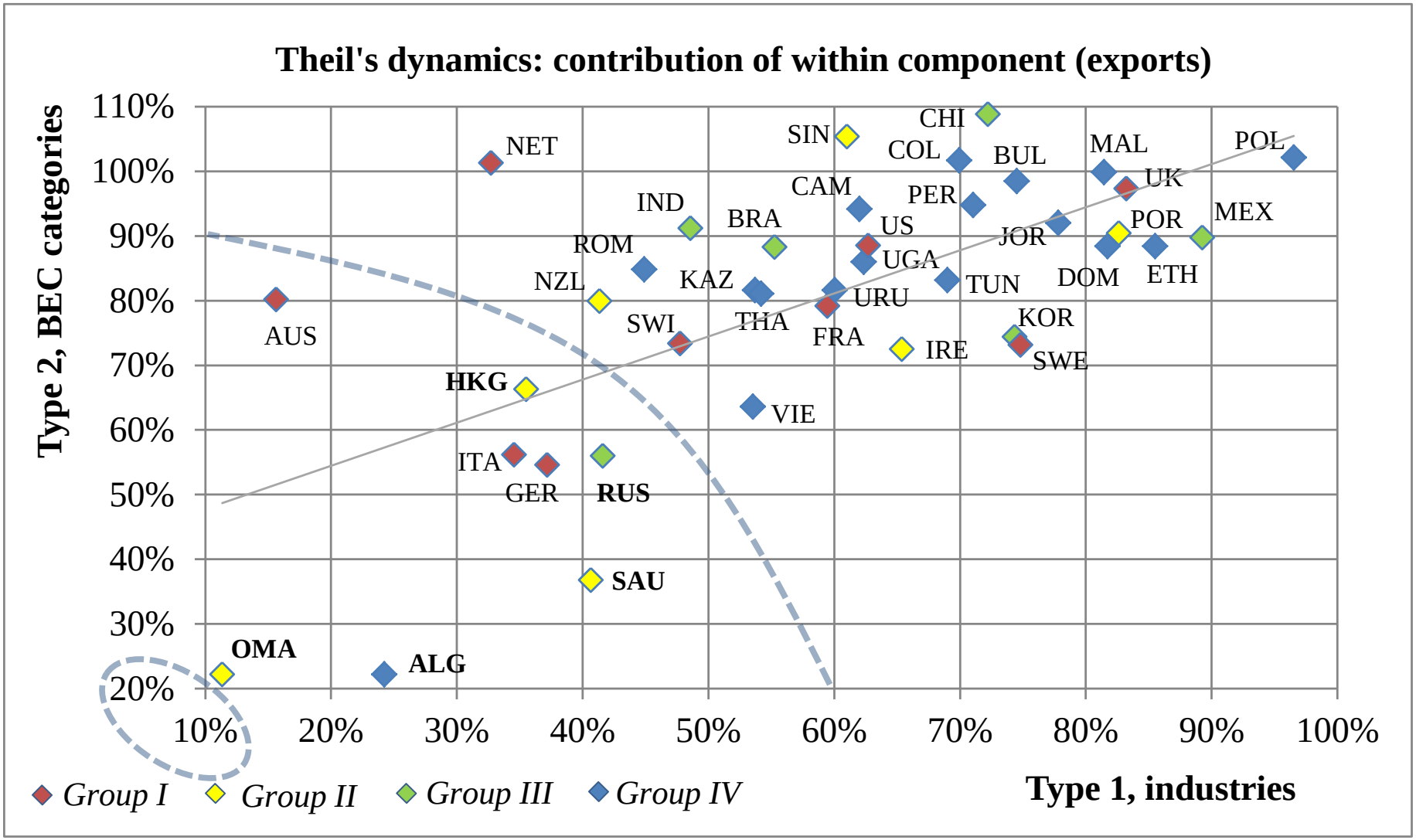
3

  - The contribution of the within component *doesn't depend much* on basic countries' characteristics such as GDP and per capita income
  - The between component is important for *small fraction of countries*: Hong Kong, oil exporters and some developed countries (Switzerland and the US for imports; Australia, Italy and Germany for exports)
  - The between component *matters more for exports* than for imports

3. The results: country groups



3. The results: country groups



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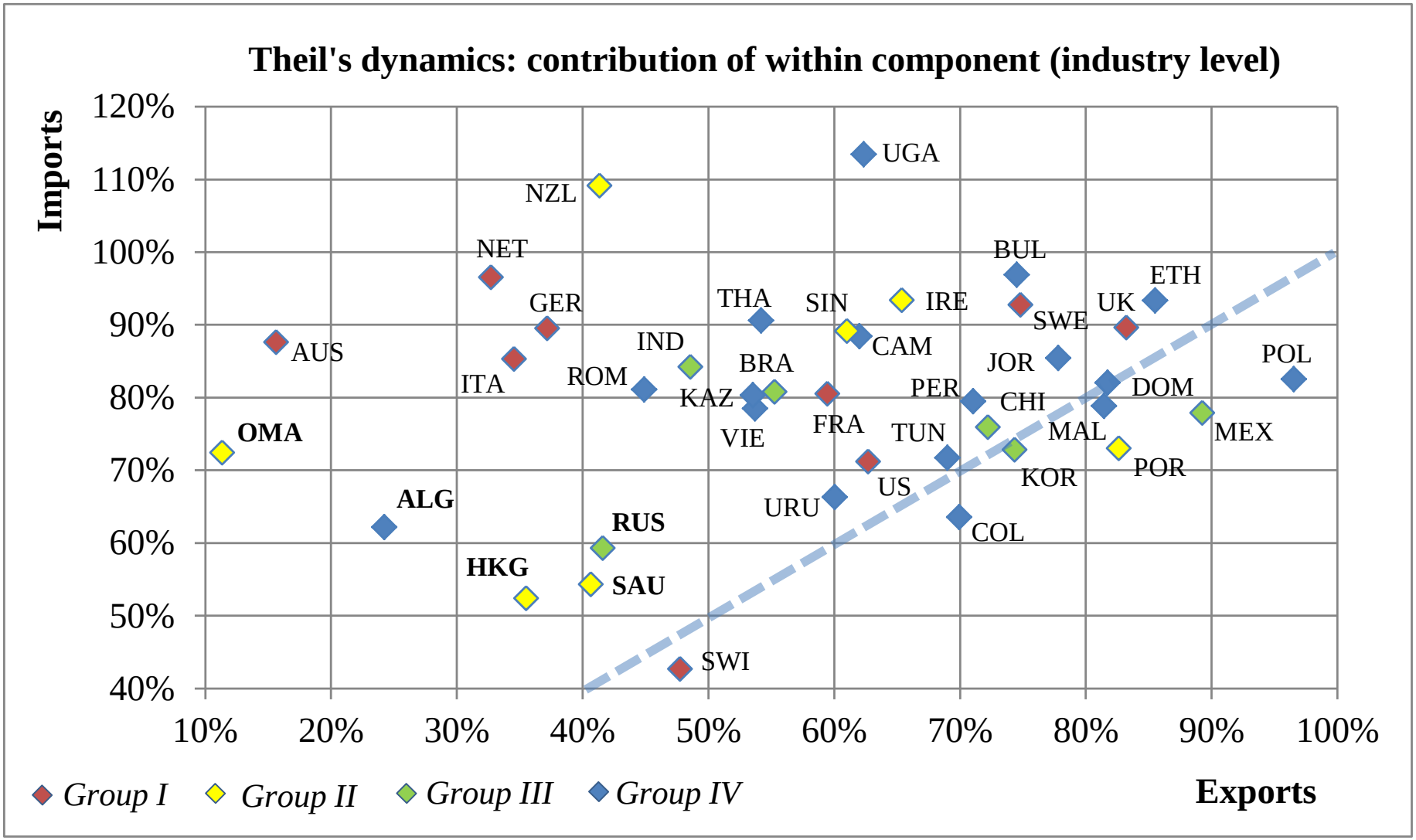


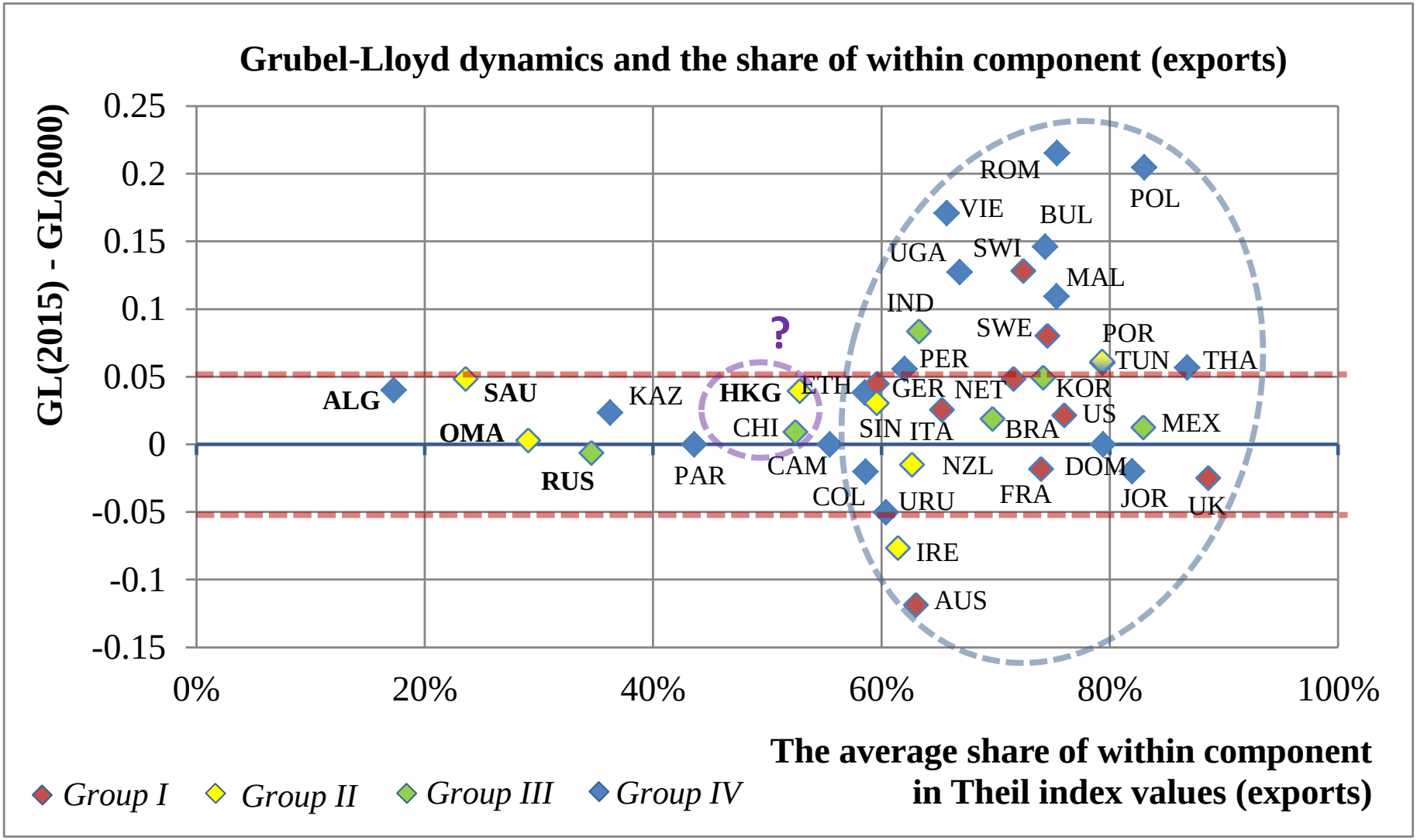
3. The results: country groups

- The link between Theil index and GL index is quite complex

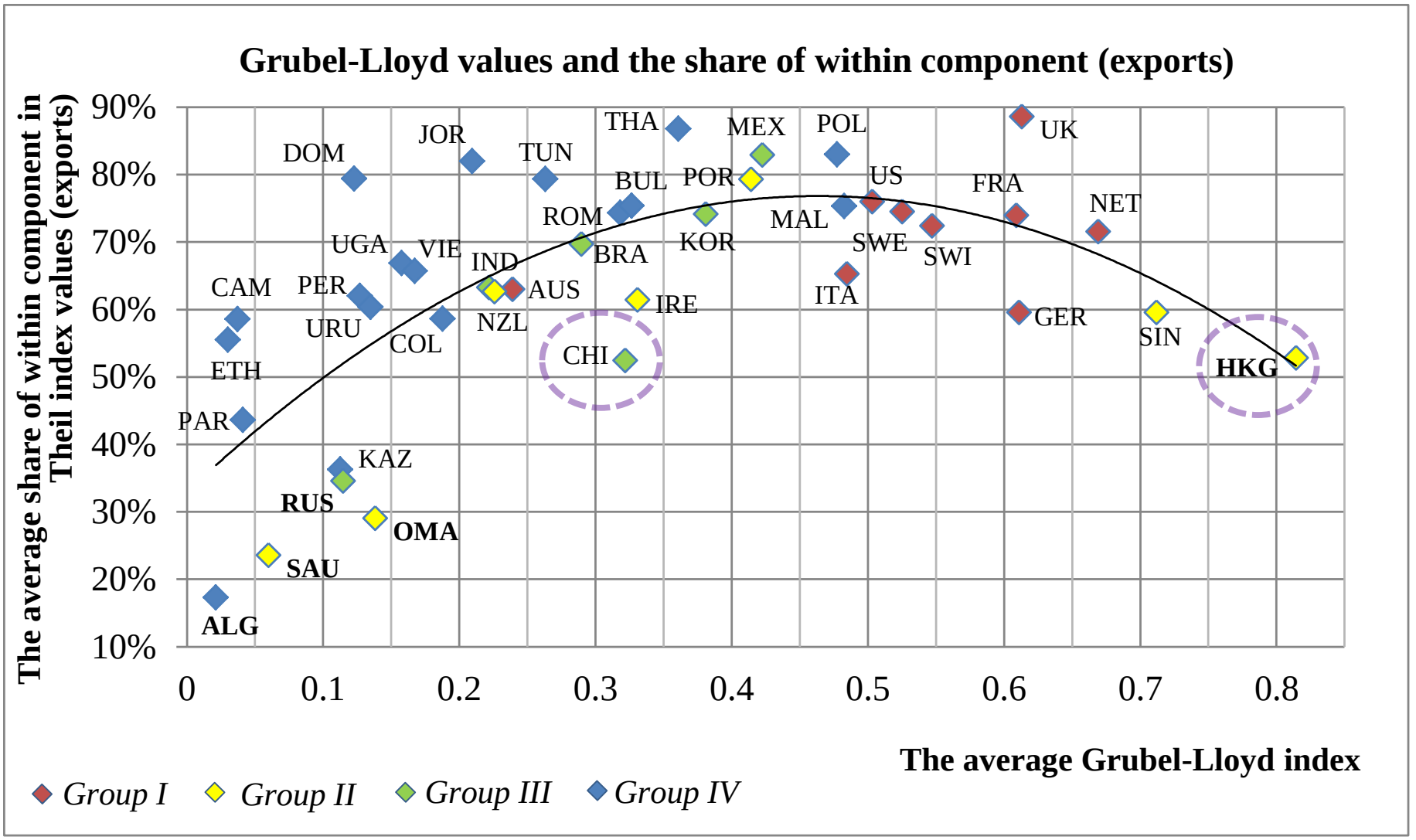
4

  - Large changes in Grubel-Lloyd index were experienced only by countries with the average share of the **within component** above 60%
  - Note that countries with the average share of the within component below 60% have **either very low or very high** average GL index values (in both cases, the dynamics of GL index is limited)

3. The results: country groups



3. The results: country groups



An afterword

- Like *Parteka and Tamberi* (2013), we show that, on average, export and import diversification trends are close
  - However, we also demonstrate that these trends do not coincide for a significant portion of countries
- We find that the dynamics of X and esp. M diversification is dominated by structural change within industries
- We explore the link between trade concentration and intra-industry trade and find that the nature of this link is complex
  - The overall correlation is negative, but the share of within component in Theil index values also plays a role

An afterword

- Classifying country experience according to all the facts explored here is not a simple task
  - Basic countries' characteristics such as GDP and per capita income were shown to be of a weak importance for many of them
  - Many of the hidden facts are waiting to be explored carefully

=> No sound country classification at the moment

  - However, we hope that the results of our preliminary research would be a good starting point for further research in this fruitful area

Thanks for your attention!