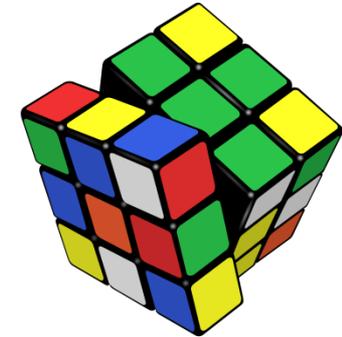




CENTER FOR MACROECONOMIC ANALYSIS AND SHORT-TERM FORECASTING

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Structural Transformation and Quality Ladders: Solving the “Theil's Cube”



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*The First International Workshop
“Market Studies and Spatial Economics”
(Higher School of Economics, Moscow, Russia)*

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Outline

1. Motivation
2. Constructing the index
3. Empirical results
4. How fragile are the results?
5. Concluding comments

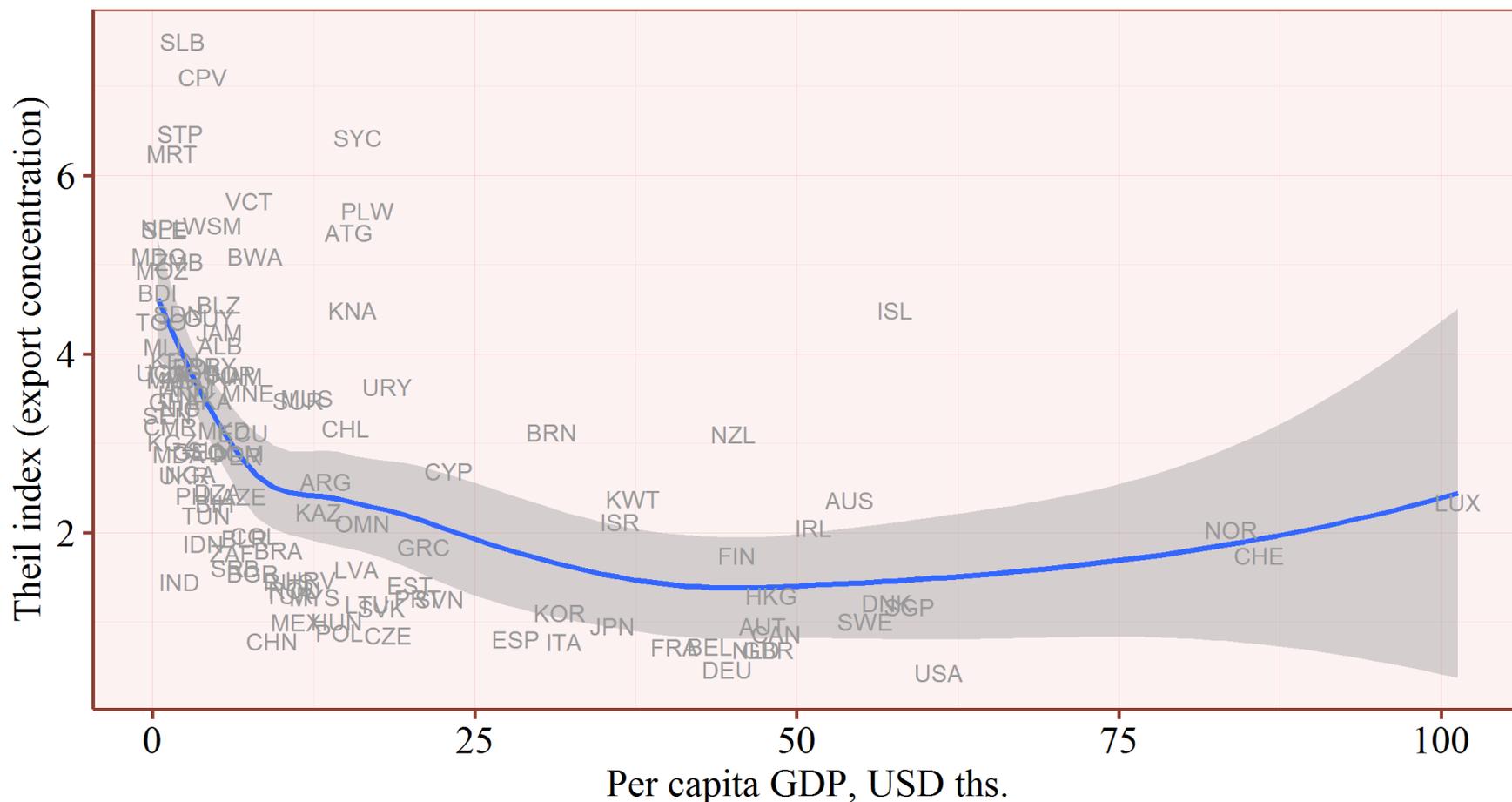
1. Motivation

- **1.1.** Structural transformation (ST), a traditional view ([Kuznets 1973](#); [Duarte & Restuccia 2010](#); [Herrendorf et al. 2014](#))
 - Three sectors: agriculture, manufacturing and services
 - Transition from agriculture to services through manufacturing
- **1.2.** The new wave linking ST to economic diversification
 - Diversification and per capita income: a hump-shaped pattern...
 - *employment and value added diversification* ([Imbs & Wacziarg 2003](#))
 - *export diversification* ([Klinger & Lederman 2006](#); [Cadot et al. 2011](#))
 - ...or no re-specialization? ([Parteka 2010](#); [Mau 2016](#))

1. Motivation

Illustration (2017 data)

Export concentration along the development path



1. Motivation

- **1.3.** Digging deeper into the sources of export diversification
 - Extensive & intensive margins of exp. diversification ([Cadot et al. 2011](#))
 - exporting new products vs leveling export shares of existing products
 - Various econometric explorations ([Parteka & Tamberi 2013](#); [Mau 2016](#); [Lectard & Rougier 2018](#))
 - economic development, market size, economic openness, remoteness, etc.
- **1.4.** Theil index: easily decomposable in many ways, just as...
 -  Rubik's cube
 - We decompose Theil index into the quantity- and quality-driven concentration, thus accounting for structural transformation of exports along both quantity and quality dimensions
 - Why? (*see next slide*)

1. Motivation

- **1.5.** There are two paths to higher export diversification
 - Quality upgrading: *climbing quality ladders*
([Khandelwal 2010](#); [Amiti & Khandelwal 2013](#))
 - *enhancing exports by raising quality and thus unit values*
 - Moving to nearby products : *jumping to new ladders*
([Hausmann & Klinger 2007](#); [Hausmann & Hidalgo 2011](#))
 - *exporting new products close to countries' RCA*
- **The question:**
What is more important for increasing diversification –
mastering exports of new products or
improving the quality of existing ones?

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2. Constructing the index

- 2.1. Export concentration (Theil) index

- Unweighted Theil

index ([Cadot et al. 2011](#)):

$$Theil^{(c)} = \sum_i \frac{X_i^{(c)}}{\sum_i X_i^{(c)}} \ln \left(\frac{X_i^{(c)}}{\sum_i X_i^{(c)}} / \frac{1}{n^{(c)}} \right)$$

-
- Weighted Theil

index ([Parteka & Tamberi 2013](#)): $Theil^{(c)} = \sum_i s_i^{(c)} \ln \left(s_i^{(c)} / s_i^{(W)} \right)$, or

$$Theil^{(c)} = \sum_i s_i^{(c)} \ln \left(s_i^{(c)} \right) - \sum_i s_i^{(c)} \ln \left(s_i^{(W)} \right),$$

where s^c and s^W are the shares:

$$s_i^{(c)} = \frac{p_i^{(c)} q_i^{(c)}}{\sum_i p_i^{(c)} q_i^{(c)}}, \quad s_i^{(W)} = \frac{p_i^{(W)} q_i^{(W)}}{\sum_i p_i^{(W)} q_i^{(W)}}$$

2. Constructing the index

- 2.2. Why weighting the index?
 - Unweighted measure isolates country-specific trade patterns from those typical for world trade structure ([Parteka & Tamberi 2013](#), p. 124)
 - The lack of homogeneity in classification units ([Lessmann 2014](#), p. 37): thus, unequal distribution of export value by products is natural
 - For example, *motor cars* (HS 8703, world trade is above 700 USD bln in 2017) vs *photographic paper* (HS 3703, world trade is lower than 1 USD bln in 2017)
 - Weighted index measures the deviation of a country's product-level export structure from patterns of world demand (a country should aim at exporting products according to these patterns to avoid over- or underproduction)
 - We aim at checking if the product-level export structure is shifted from "standard" structure represented by the world demand for imports

2. Constructing the index

- 2.3. Decomposing the index (concept)

- There are examples of Theil index decomposition in the literature on income inequality: *i.e.*, [Duro & Esteban \(1998\)](#) decompose it into 4 parts:
 - productivity per worker
 - unemployment rate
 - activity rate over potentially active population
 - working-age population rate
- In trade economics, Theil index was decomposed only into the extensive and the intensive margins of exports ([Cadot et al. 2011](#))
- We develop a **novel decomposition** of Theil index into 2 components:
 - concentration resulted from the differences in the structure of quantities (export volumes in physical terms) between a country and the world
 - concentration resulted from the differences in the structure of unit values (reflect both prices – but eliminate the changes in world prices – and quality)

2. Constructing the index

- **2.4. Decomposing the index (maths)**

- We start from

- the weighted index:

$$Theil^{(c)} = \sum_i s_i^{(c)} \ln(s_i^{(c)}) - \sum_i s_i^{(c)} \ln(s_i^{(W)})$$

- Then add

- and subtract

- the same term: $Theil^{(c)} = \left[\gamma - \sum_i s_i^{(c)} \ln(s_i^{(W)}) \right] + \left[\sum_i s_i^{(c)} \ln(s_i^{(c)}) - \gamma \right],$

where

$$\gamma = \sum_i s_i^{(c)} \ln(s_i^{(c_w)}), \text{ and } s_i^{(c_w)} = \frac{p_i^{(W)} q_i^{(c)}}{\sum_i p_i^{(W)} q_i^{(c)}} \text{ is the "neutral" share of product } i$$

- **The resulting decomposition is the following:**

$$Theil^{(c)} = \left[\sum_i s_i^{(c)} \ln(s_i^{(c_w)} / s_i^{(W)}) \right] + \left[\sum_i s_i^{(c)} \ln(s_i^{(c)} / s_i^{(c_w)}) \right]$$

Theil_q

Theil_{uv}

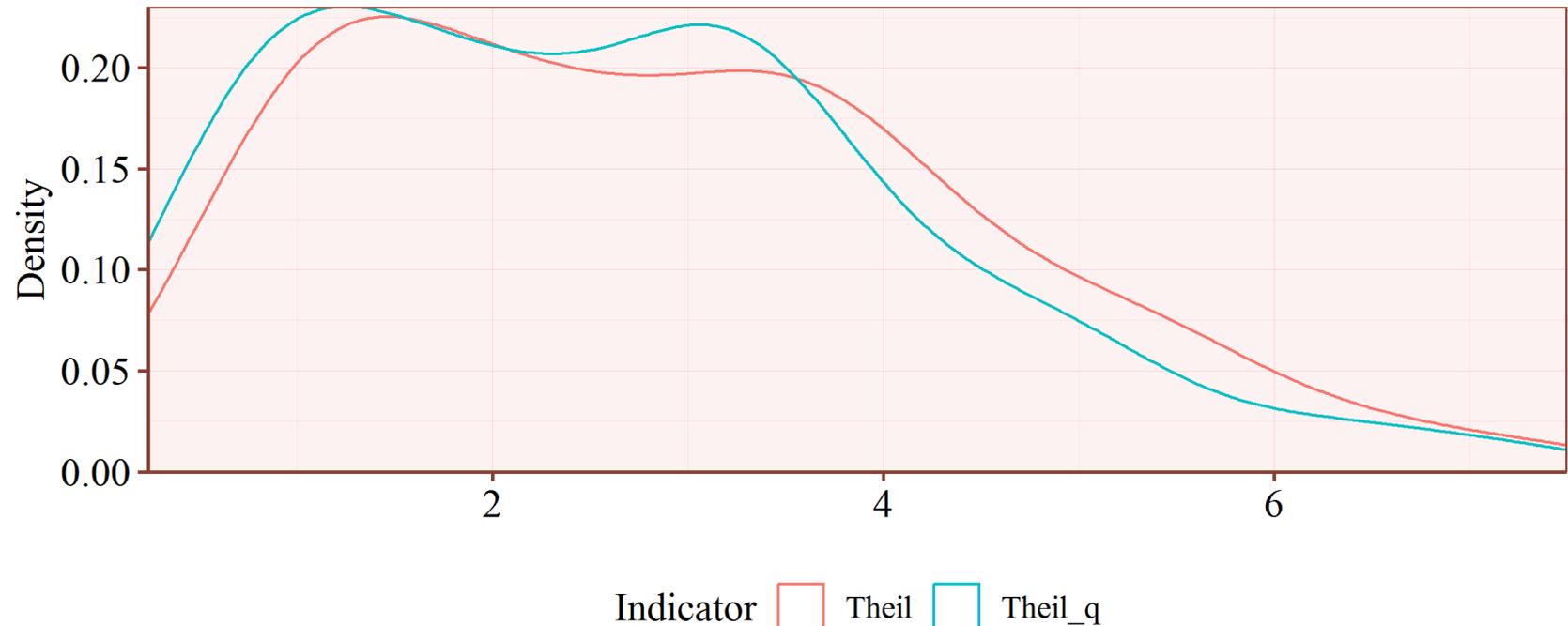
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3. Empirical results

- **3.1.** The distribution for the **quantity**-driven component of Theil index approx. equals the distribution for the whole index

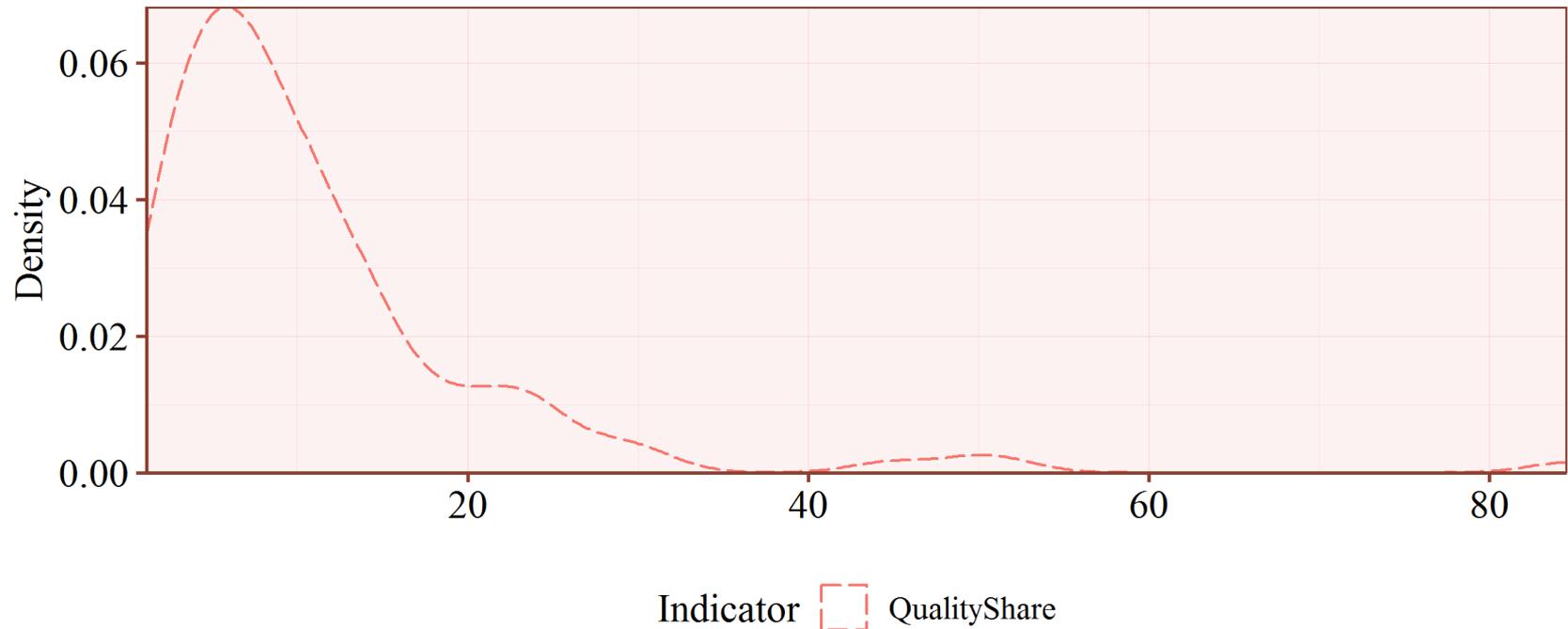
Theil index and its quantity-driven component,
kernel density distribution by countries (2017)



3. Empirical results

- => The share of the **quality**-driven component of Theil index for most countries is fairly small (less than a quarter)

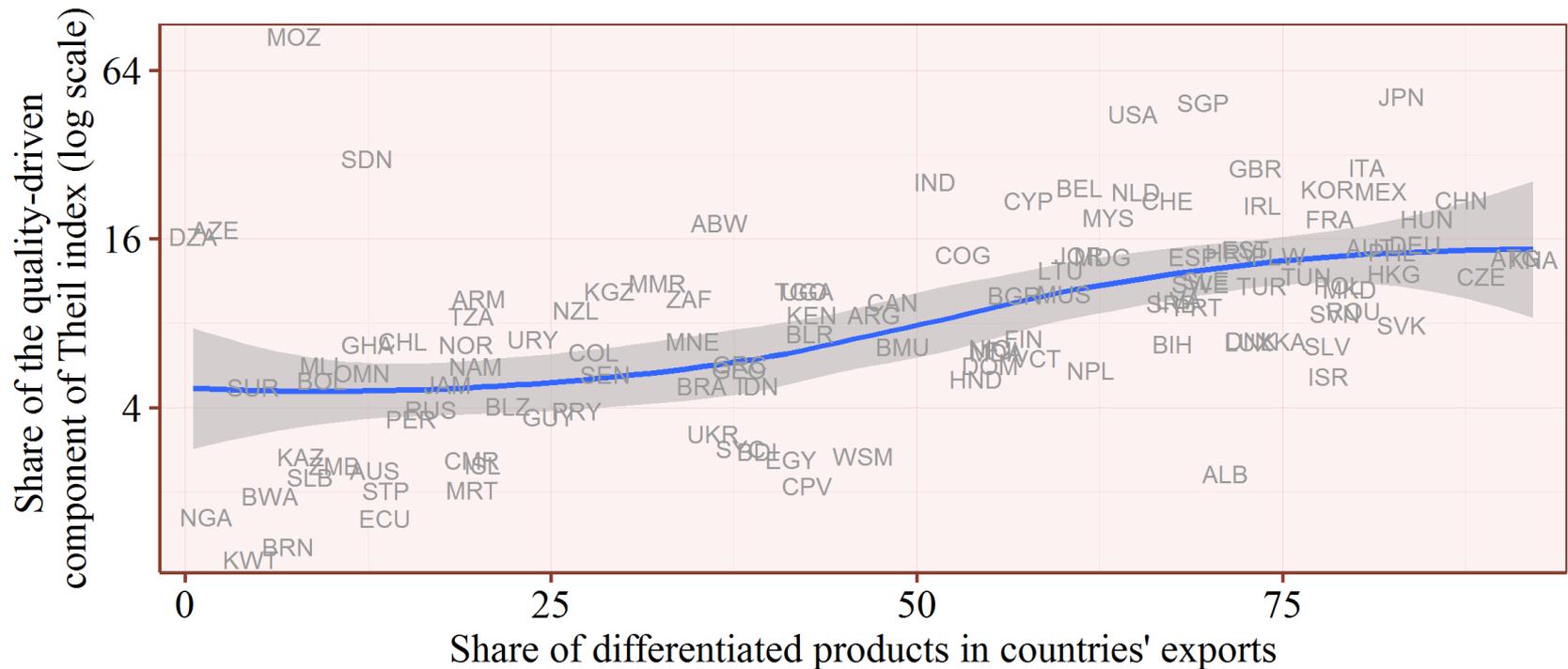
Share of the quality-driven component,
kernel density distribution by countries (2017)



3. Empirical results

- 3.2. But ¹⁾ only 65% of world trade consists of goods that are relatively heterogeneous in quality (and thus prices), and...

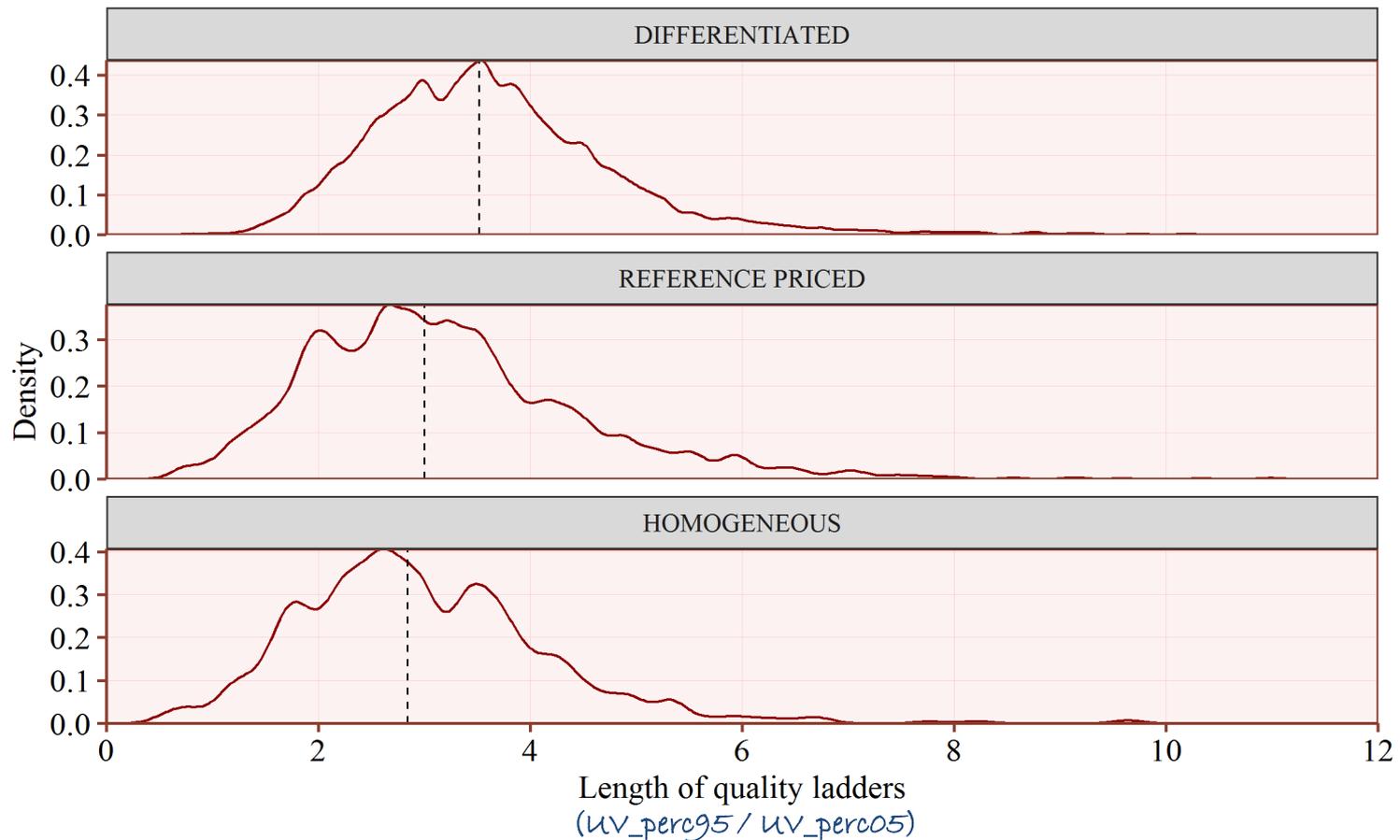
Share of the quality-driven component & share of differentiated products defined in [Rauch \(1999\)](#), by countries (2017)



3. Empirical results

- ... ²⁾ quality ladders' length for differentiated products is higher

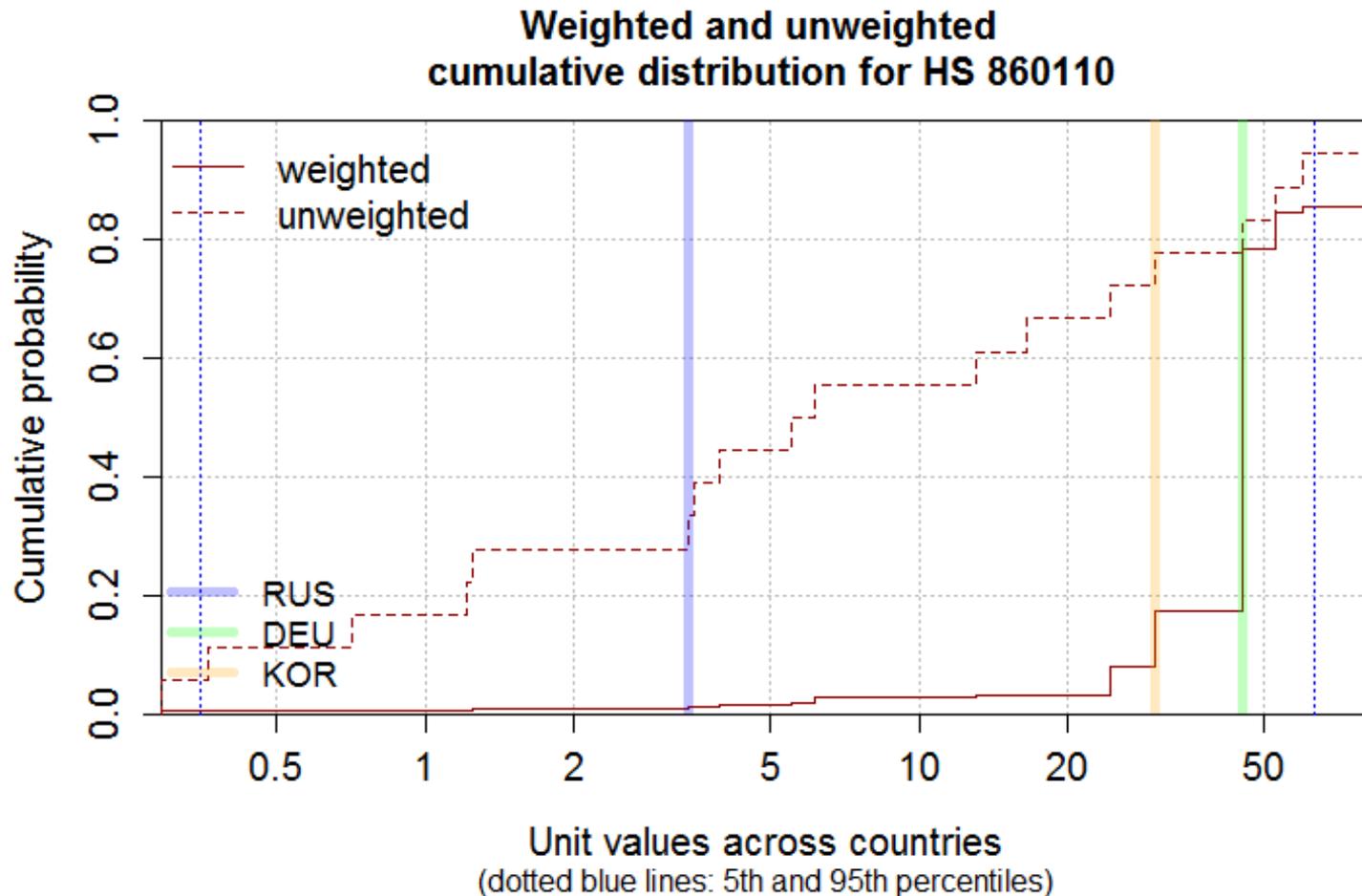
Length of quality ladders by product groups defined in [Rauch \(1999\)](#), kernel density distribution by countries (2017)



3. Empirical results

What are quality ladders?

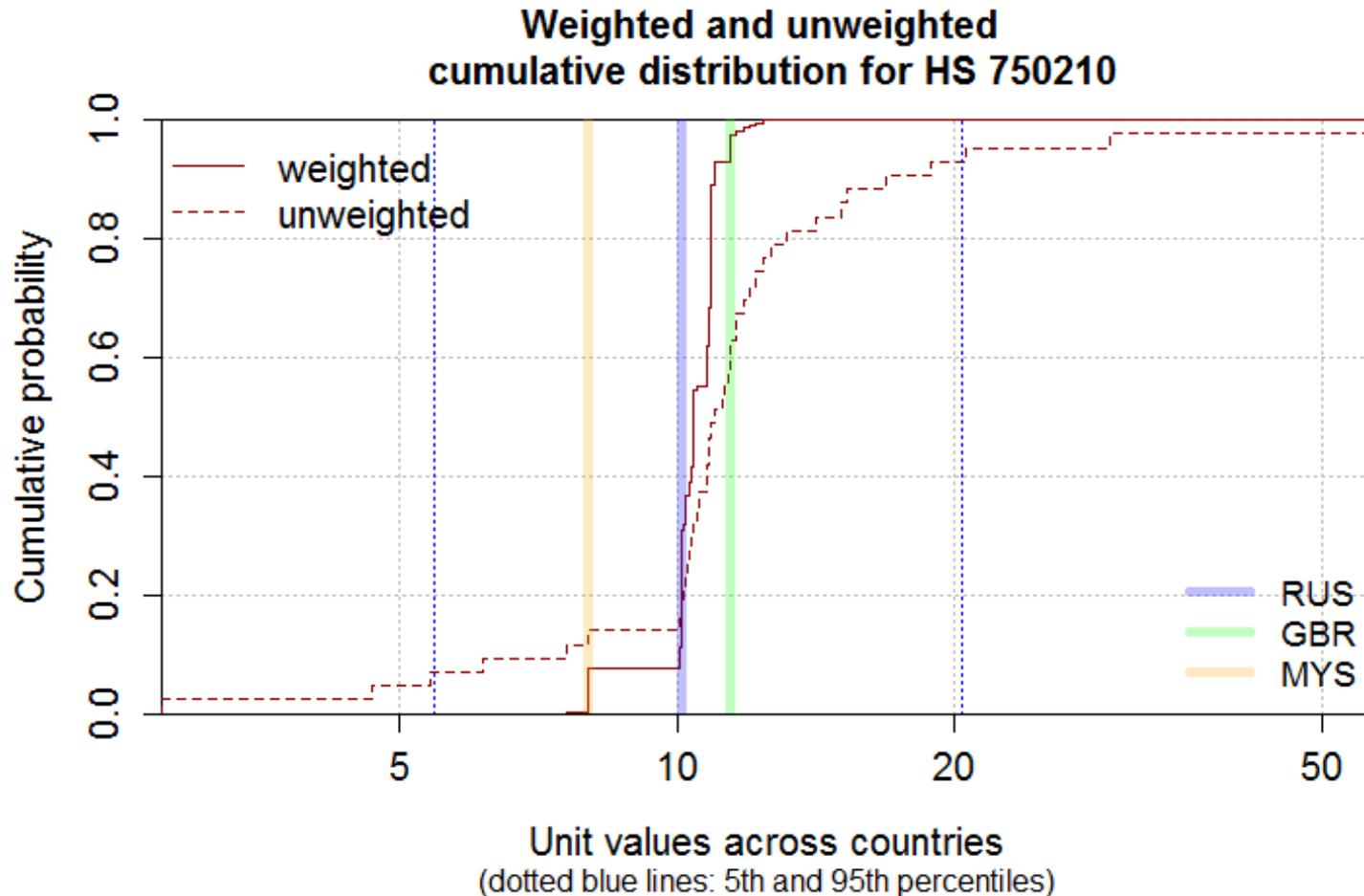
- Quality ladders are longer for some products, e.g. *locomotives*, ...



3. Empirical results

What are quality ladders?

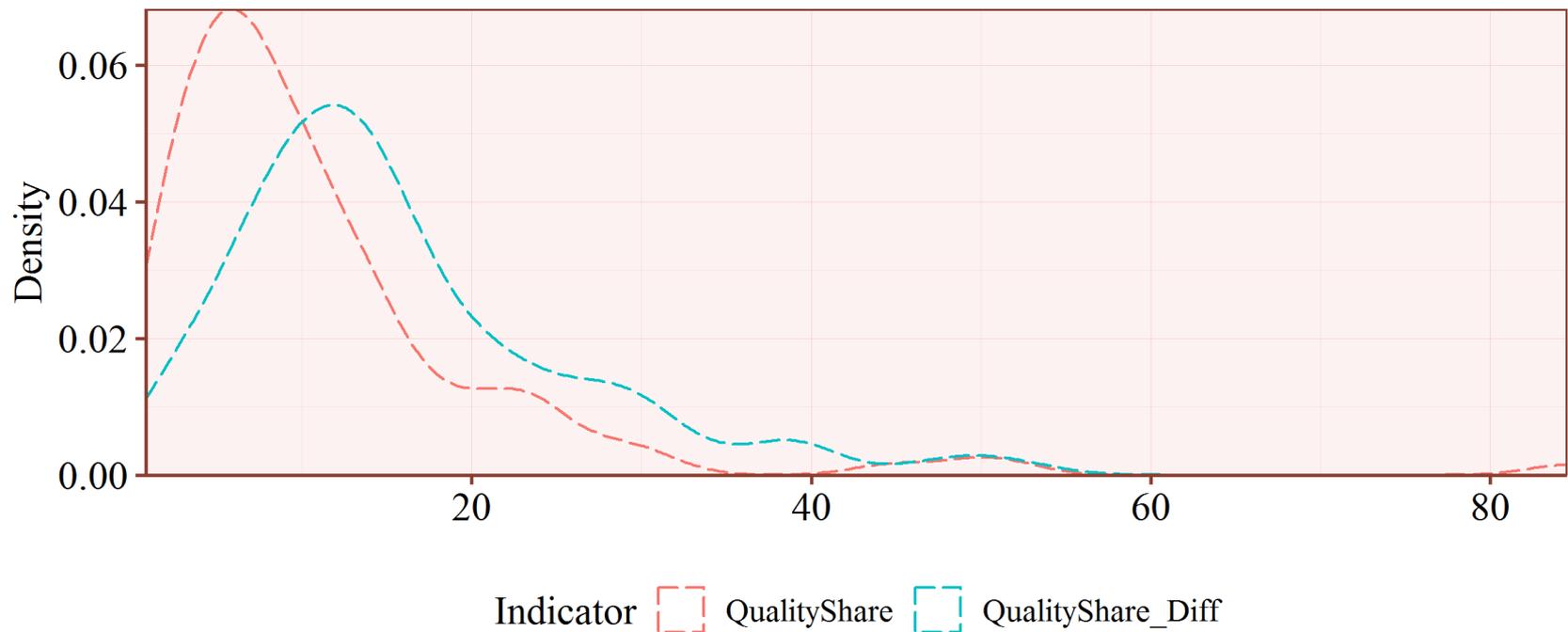
- ... and shorter for others, e.g. *unwrought nickel*



3. Empirical results

- **3.3** Even for differentiated products only, countries are more likely to experience export concentration patterns different from the world average due to the *different mix of products*

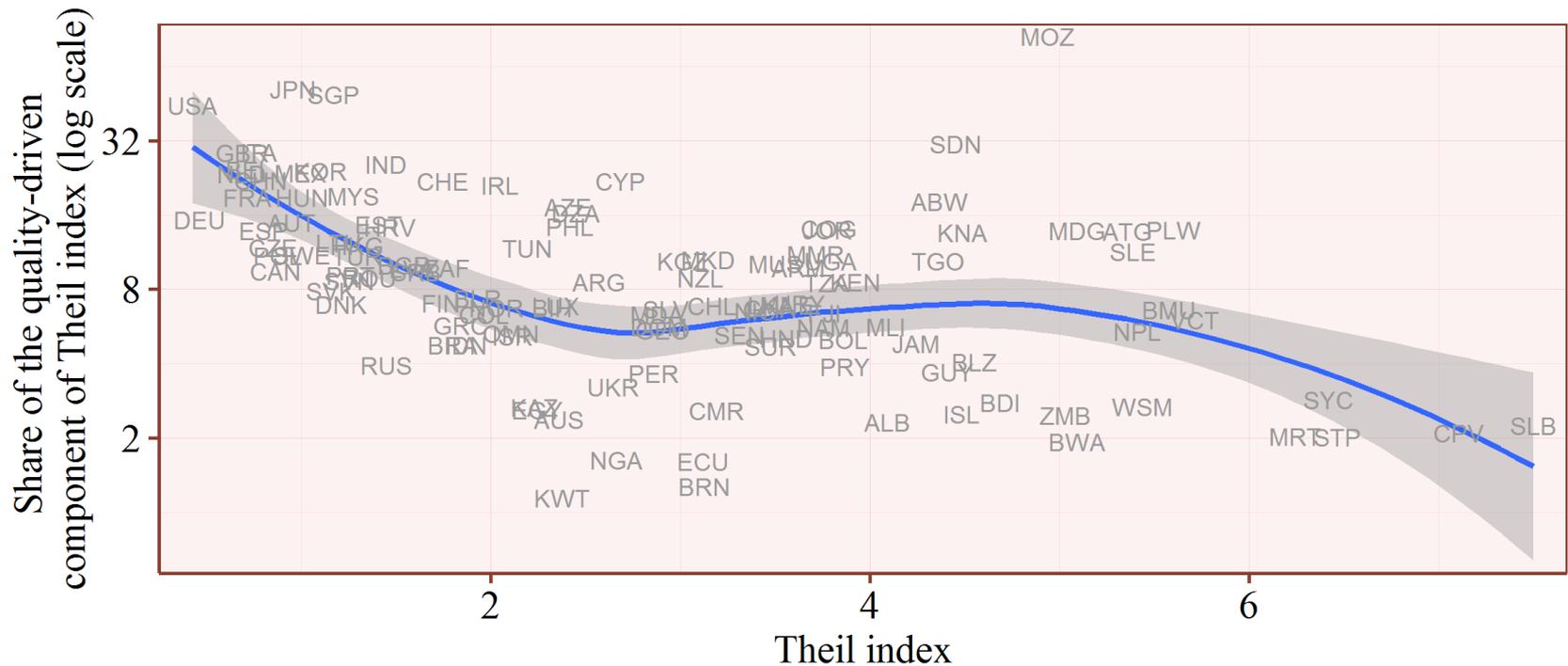
Share of the quality-driven component for all products & differentiated products, kernel density distribution by countries (2017)



3. Empirical results

- 3.4. High shares of the **quality**-driven component are more typical for countries with low export concentration

Theil index & the share of the quality-driven component, by countries (2017)



3. Empirical results

- Findings:

- Our results **do not support** the idea that climbing the quality ladders (quality upgrading *within the existing products*) is the best way to proceed with structural transformation
- Rather, they favor the network approach by *Hausmann et al.* that **product mix** is crucial for economic development
 - That is, countries should move to more complex products first
- We agree with [Wacker and Trenczek \(2017\)](#) that *quality upgrading is unlikely to be a successful strategy on its own, esp. for developing countries that export goods with less potential to increase unit values*

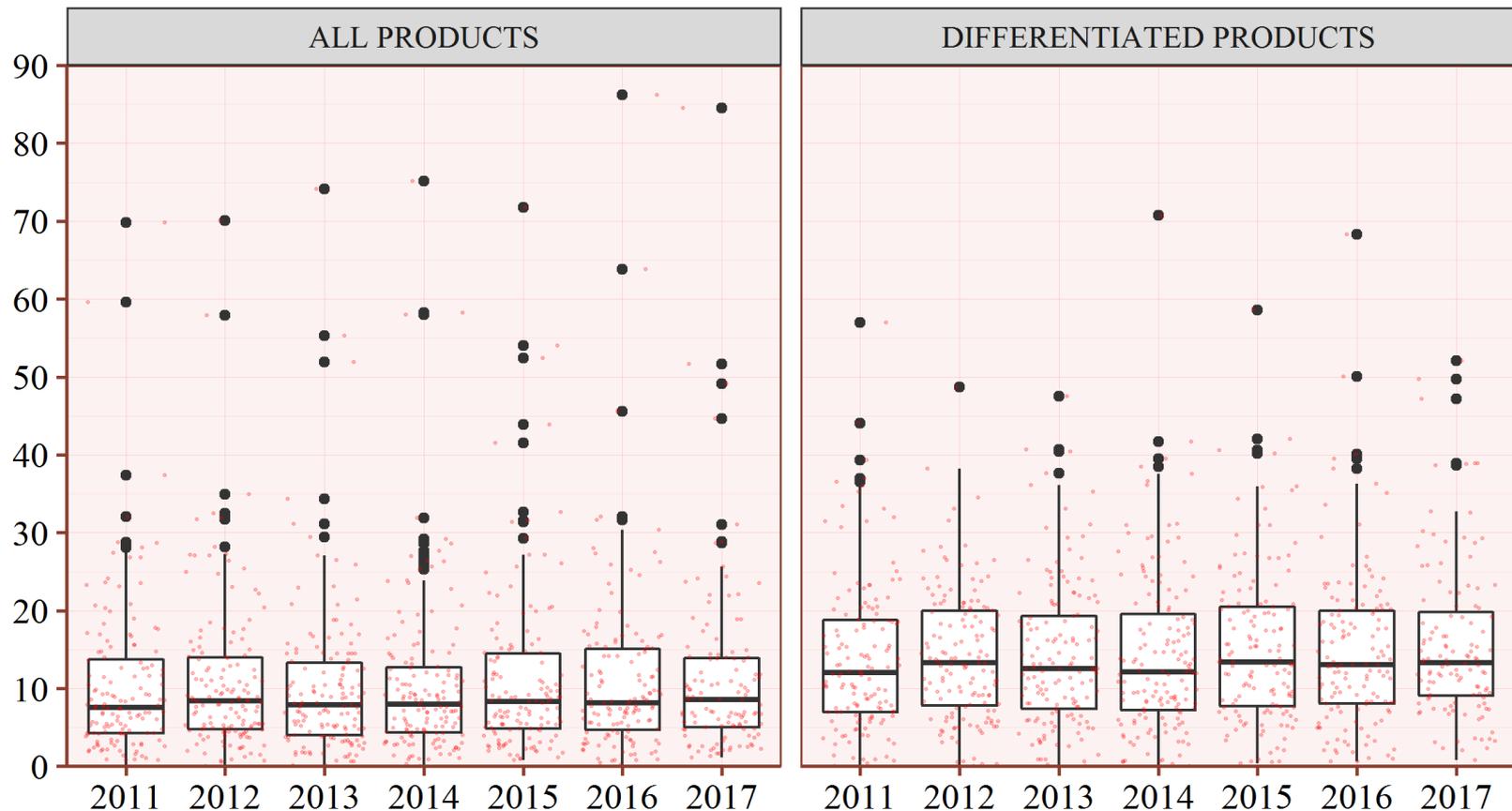
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4. How fragile are the results?

- The median share of the **quality**-driven component across all countries is rather stable in dynamics

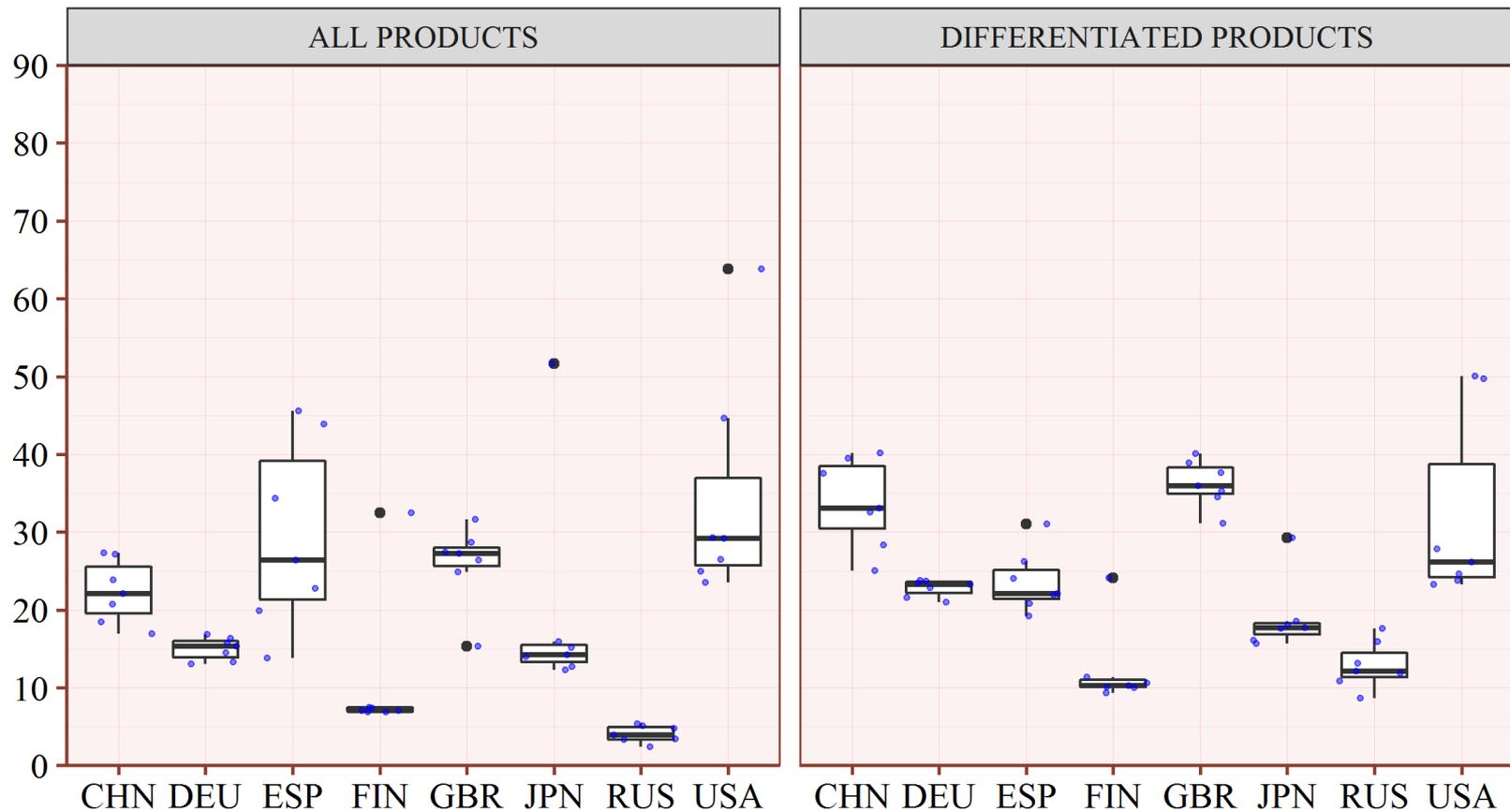
Share of the quality-driven component of Theil index



4. How fragile are the results?

- However, individual countries sometimes experience outliers due to sharp changes in unit values for major commodities

Share of the quality-driven component of Theil index



4. How fragile are the results?



United Nations Commodity Trade Stat

Selected classification: HS2007
 Selected commodities: 710610 (Silver (incl. silver plated with gold/platinum), in powder form)
 Selected reporters: Japan
 Selected years: 2011, 2012, 2013, 2014, 2015, 2016, 2017
 Selected partners: World
 Selected trade flows: Export

Sort Order Refresh

[Direct Download](#) [SDMX Download](#) [Printable Format](#)

[Modify Selection](#) [View Graph & Map](#) [View Explanatory Notes](#) [View Not-Available-Data](#)
[Switch to any HS classifications](#)

Period	Trade Flow	Reporter	Partner	Code	Trade Value	NetWeight (kg)	Quantity Unit	Trade Quantity	Flag
2011	Export	Japan	World	<u>710610</u>	\$964,146,294	2,656,287	<u>8</u>	2,656,287	0
2012	Export	Japan	World	<u>710610</u>	\$1,031,166,018	3,147,428	<u>8</u>	3,147,428	0
2013	Export	Japan	World	<u>710610</u>	\$1,024,680,095	3,493,222	<u>8</u>	3,493,222	0
2014	Export	Japan	World	<u>710610</u>	\$935,066,738	3,706,452	<u>8</u>	3,706,452	0
2015	Export	Japan	World	<u>710610</u>	\$795,877,585	3,984,651	<u>8</u>	3,984,651	0
2016	Export	Japan	World	<u>710610</u>	\$1,167,110,527	4,483,540	<u>8</u>	4,483,540	0
2017	Export	Japan	World	<u>710610</u>	\$1,137,814,035	4,658,703,426	<u>8</u>	4,658,703,426	0

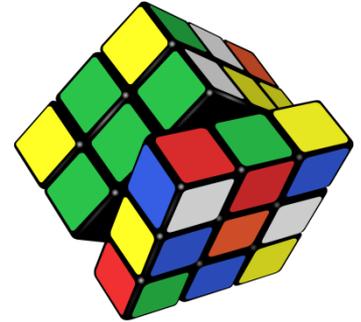
Estimated quantity/netweight shown in italics
 Flag refers to quantity/netweight estimation:
 0 = no estimation, 2 = quantity, 4 = netweight, 6 = both quantity and netweight

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5. Concluding comments

- Theil index allows one to calculate export concentration due to the differences in the product mix & product quality
 - Bulk of the differences are associated with product mix
*=> this speaks in favor of changing the product mix first:
jump to longer ladders and then climb up!*
- The results are stable as a whole, but...
- ... **much caution** should be taken while analyzing Theil index decomposition **at the individual country level**
 - Outliers in physical volumes data may affect the decomposition severely (for some country-year pairs)



**MANY THANKS
for your attention!**