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Vertical and Horizontal Dynamics in Export Unit Values

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The presentation is based on a paper co-authored with Jan Trenczek (JGU Mainz).

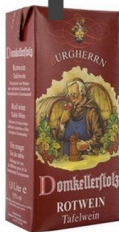
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Dimensions of export dynamics/'upgrading'



?



Motivation and background

Diverging views about the relevance of vertical vs. horizontal upgrading in development process:

- **'horizontal view'**: e.g. Hausmann, Hwang, and Rodrik (2007 JEG), Lin (2011)
 - emphasizes externalities of products, network effects and opportunities in product space, diversification aspects
 - relates to Singer (1949, 1950), Prebisch (1950), Sarkar and Singer (1991 WD)
- **'vertical view'**: e.g. Lederman and Maloney (2012), literature on vertical upgrading (Schott, 2004 QJE)
 - relevant specialization pattern is not across but within sectors ('vertical specialization')
 - capital-intensive 'advanced' economies produce vertically differentiated goods at higher unit values (within the same product category) than less capital-intensive countries

Contributions of our paper

Our paper contributes to this debate by:

- showing that despite strong patterns of vertical convergence in unit values...
 - ...vertical specialization is unlikely to be a successful development strategy on its own.
- ⇒ Scope for upgrading differs across products/sectors!
- conceptual contribution by decomposing overall unit value changes

Related literature on export unit values

seminal papers using unit values (\$ per ton of exports) *within* products as broad quality/vertical specialization measures:

- Schott (2004 QJE) on vertical specialization (10-digit)
- Hardig and Javorcik (2012 REStat) for the effect of FDI on export upgrading (4-digit)
- Hummels and Klenow (2005 AER) on the quality margin (6-digit, 10-digit), disentangle price from quality effects
- Hallak and Schott (2011 QJE) disentangle demand price effects using the trade balance (only broad industries even for 43 countries covered)
- Khandelwal (2010 REStud) uses export market shares (principally down to 10-digit)

Related literature on export unit values

Why we use raw unit values (at this stage):

Feenstra and Romalis (2014 QJE):

- disentangle demand *and supply* side price effects (4-digit)
- this might exaggerate differences between unit values and prices
 - intuition: as demand rises, less efficient exporters enter, which produce at lower quality
- “much of the variation in unit values is explained by quality”
- furthermore: results not very robust
 - “the key lesson we take from these comparisons is that estimates for quality are very sensitive to proxies chosen for important model variables.”

Unit value data: BACI database (CEPII)

- down to 6-digit HS92
- transformation of UN COMTRADE data
 - uses import side of trade
 - subtracts CIF
 - checks consistency/credibility
 - all quantities transformed into tons
- We focus on developments between 1995-97 and 2005-07.
- multidimensional data:
 - > 10 years
 - > 4,800 HS-6 products
 - 154 exporters
 - 154 importers
- ⇒ ~ 10 million observations per year
 - computation
 - complexity of data set dimensions

Example of product classification (SITC 2)

1 Beverages and tobacco

11 Beverages

112 Alcoholic beverages

1121 Wine of fresh grapes

11213 Vermouths & other wines of fresh grapes flavoured

7 Machinery and transport equipment

77 Electrical machinery, apparatus & appliances n.e.s.

775 Household type, elect. & non-electrical equipment

7757 Elec.-mech., domestic appliances and parts

77571 Vacuum cleaners & floor polishers

We focus mostly on manufacturing (SITC 5-8):

5 Chemicals

6 Manufactured goods

7 Machinery and transport equipment

8 Miscellaneous manufacturing

Data manipulation

Given the extremely right-skewed nature of unit values, we delete outliers as follows:

- unit values (on the 6-digit level) that are $\geq 100\times$ or $\leq 0.01\times$ the median UV of that product
- unit values on the country and 6-digit level that are $\geq 10\times$ or $\leq 0.1\times$ the median UV of that country in that product
- Concerning unit value *changes* at the country level, we ignore countries with UV changes $2\times$ the IQR above or below the median.

Other data sources

- country perspective
 - macro and aggregate trade data (exports/GDP etc.) from wbopendata
 - PWT
- product perspective
 - PRODY 1997 from CEPII
 - Rauch (1996 JIE) conservative classification of products (4-digit)
 - 1 differentiated
 - 2 traded on organized exchange
 - 3 reference priced

Do we see unit value convergence?

- If vertical specialization is important: do we see convergence in unit values (across countries)?
- Moreover: is convergence faster in some products? Or otherwise 'more promising'?

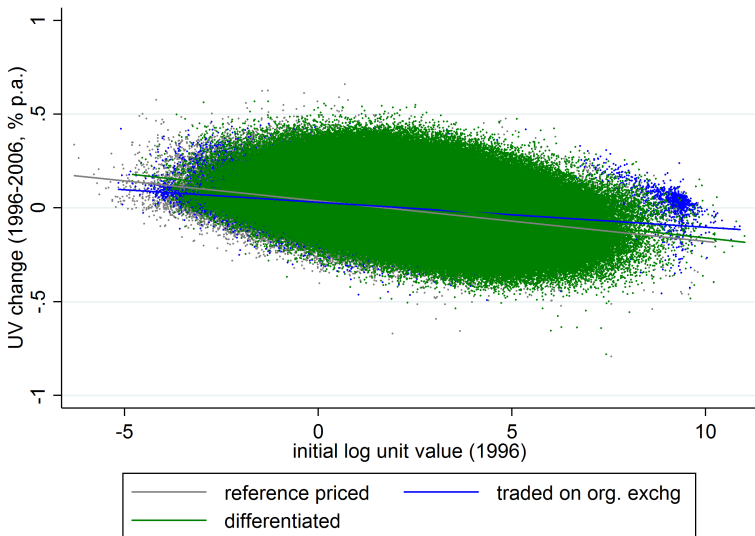
Baseline convergence specification

$$\Delta \ln(UV_{ig,t}) = a + \rho_{ig} \ln(UV_{ig,t-1}) + \alpha_g + \gamma_i + \varepsilon_{ig,t} \quad (1)$$

- convergence parameter ρ may or may not be country or product (group) specific
- conditional interpretation:
 - inclusion of product-specific effect α_g .
→ ρ captures convergence in UVs *within* products
 - exclusion of α_g . → ρ *additionally* captures convergence in UVs *between* products

Note: also possible to estimate the above on a bilateral level

Convergence (within and between)



Convergence in UVs: key results

VARIABLES	(1) $\Delta \ln(UV)$	(2) $\Delta \ln(UV)$	(3) $\Delta \ln(UV)$	(4) $\Delta \ln(UV)$
$\ln(UV_{t-1})$	-0.0126*** (9.84e-05)	-0.0656*** (0.000240)	-0.0692*** (0.000263)	
differentiated				-0.0682*** (0.000271)
organised exchange				-0.0568*** (0.00101)
reference priced				-0.0596*** (0.000472)
HS 6 product FE	No	Yes	Yes	Yes
SITC	0-9	0-9	5-8	0-9
country FE	Yes	Yes	Yes	Yes
Observations	267,262	267,262	216,405	267,262
R-squared	0.099	0.426	0.447	0.428

Robust SEs in parentheses. *** $p < 0.01$. ** $p < 0.05$. * $p < 0.1$. constant not reported

Convergence at the product level

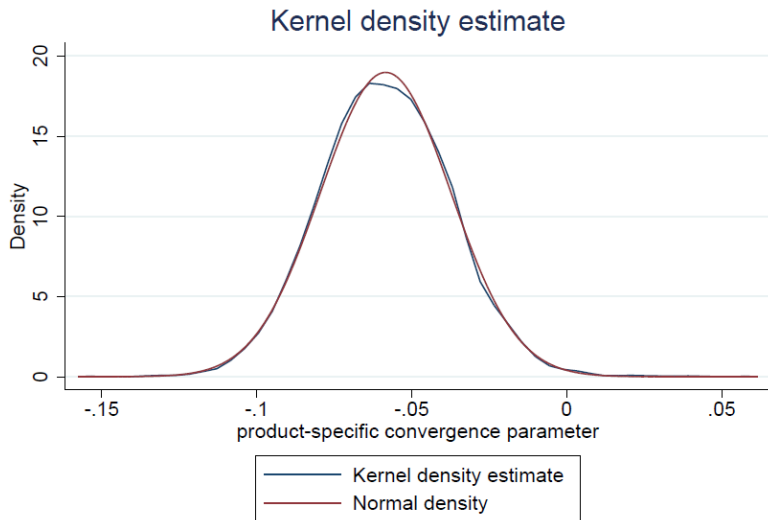
- estimate

$$\Delta \ln(UV_{ig_6t}) = a + \rho_{g_6} \ln(UV_{ig_6,t-1}) + \varepsilon_{ig_6t} \quad (2)$$

on the HS 6-digit product level (for each product with at least 10 exporters/observations)

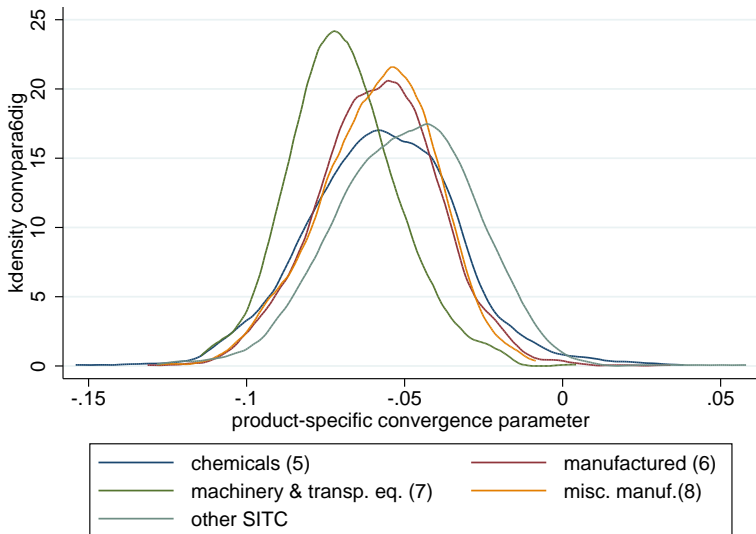
- take convergence parameters ρ and look at its distribution
 - for the whole economy
 - per sector

Distribution of convergence parameters



kernel = epanechnikov, bandwidth = 0.0035

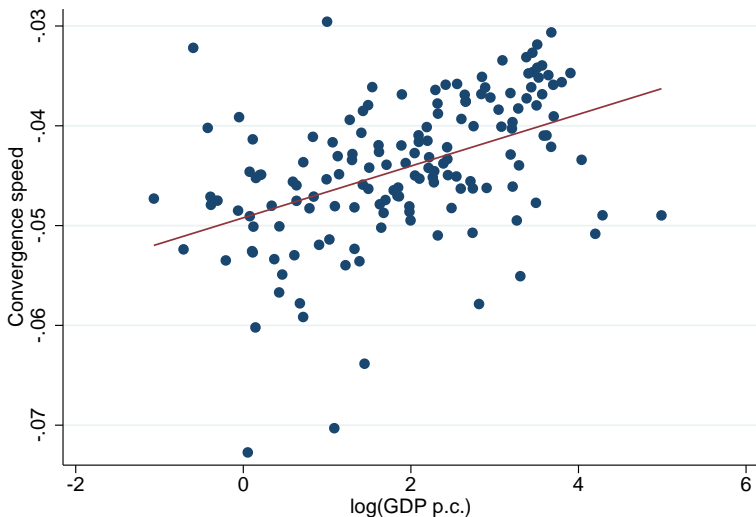
Distribution of convergence parameters across industries



Convergence on the product level

- mean/median convergence parameter: -0.058/-0.059
- sd: 0.021
- negative for 4,735/4,762 products
 - significant in 4,350 cases (parameter/se \leq -1.96)
 - positive and significant only for 2 products (in SITC 3)
- faster convergence in manufacturing (-0.069 vs. -0.053, controlling for country FE)
- fastest convergence for differentiated products (followed by reference priced)
- convergence speed negatively related to countries' income level

Low-income exporters convergence even faster



$b=0.0026$, (robust) t-stat: 5.38, R-squared: 0.21

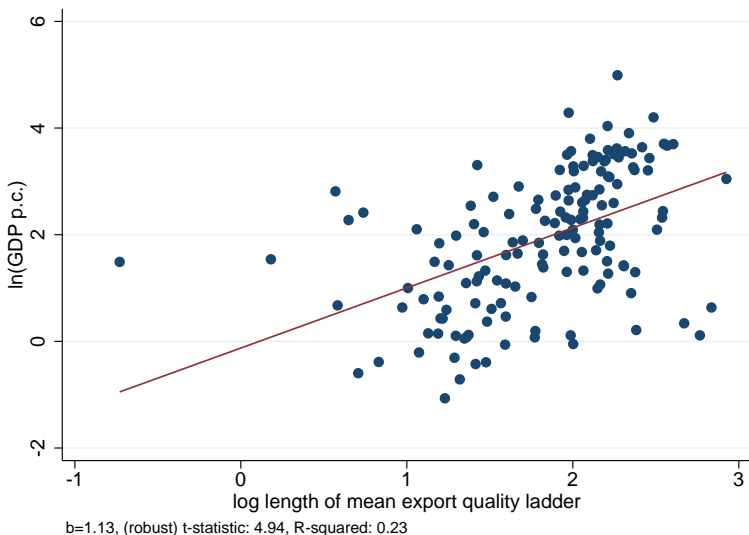
So, then why don't countries (unconditionally) converge?

- 1 Maybe ('within') unit value changes don't matter afterall.
 - neither easy to prove nor reject

$$\mathbf{E}(\text{growth}) = f(\Delta UV | \text{openness, natural resources etc.})$$

- hard to believe product quality doesn't matter at all...
- 2 Convergence within but not (so much) between products: convergence speed decays for higher-aggregation FEs (controlling for country FEs):
 - -0.066 at HS 6-digit level
 - -0.042 at 4-digit level
 - -0.027 at 2-digit level
 - -0.013 without sector FE level
 - 3 Convergence is fast, but quality ladders are short.

Higher-income countries have longer quality ladders



'Within convergence' vs. 'between effect'

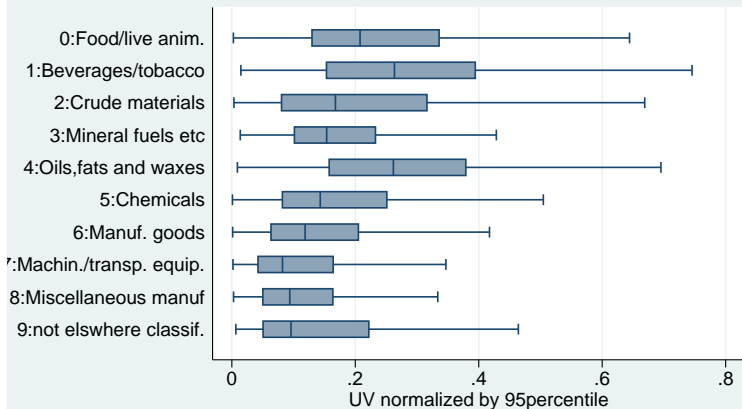
- Results suggest that vertical specialization is unlikely to be a sufficient development strategy for many countries...
 - ...because the upgrading potential in the products they produce is too small.
- ⇒ product types matter!
- ⇒ motivates analysis of pattern of 'within' vs. 'between' dynamics across countries.

A motivational example: Unit values across and within sectors in China and Germany

- we compare averages of 6-digit product unit values to the global frontier (= 95th percentile, 'normalized unit value')
- across the world
- for China vs. Germany

China: closer to frontier in few sectors with 'lower quality'

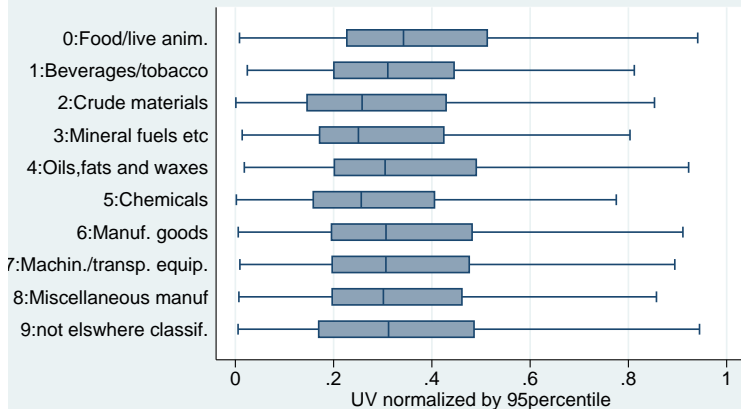
UV normalized, by SITC Rev.2 1-digit sectors; Chi
(by 95th percentile of UV HS Rev.92 6-digit products)



Source: BACI Dataset

Germany: no clear specialization across broad sectors

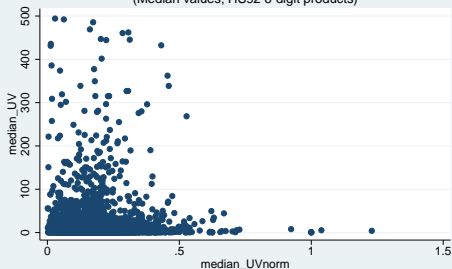
UV normalized, by SITC Rev.2 1-digit sectors; DE
(by 95th percentile of UV HS Rev.92 6-digit products)



Source: BACI Dataset

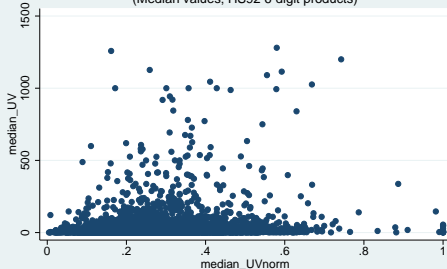
Germany at the frontier in higher-unit-value products

UV versus normalized UV; China
(Median values; HS92 6-digit products)



Source: BACI Dataset

UV versus normalized UV; DEU
(Median values; HS92 6-digit products)



Source: BACI Dataset

Vertical and horizontal changes in unit values

A decomposition exercise

- possible to decompose overall (country) change in export unit value into
 - vertical change *within* sectors (from TetraPak wine to Chateau Margaux, incl. 'price effect')
 - horizontal change *between* sectors (from wine to electronics)
- methodology inspired by literature on structural change and firm productivity (especially Griliches and Regev, 1995 JoEctrics; Foster et al., 2008 AER)

Unit value decomposition

Changes Δ in a country's aggregate share-weighted unit values \overline{UV}^s can be decomposed into:

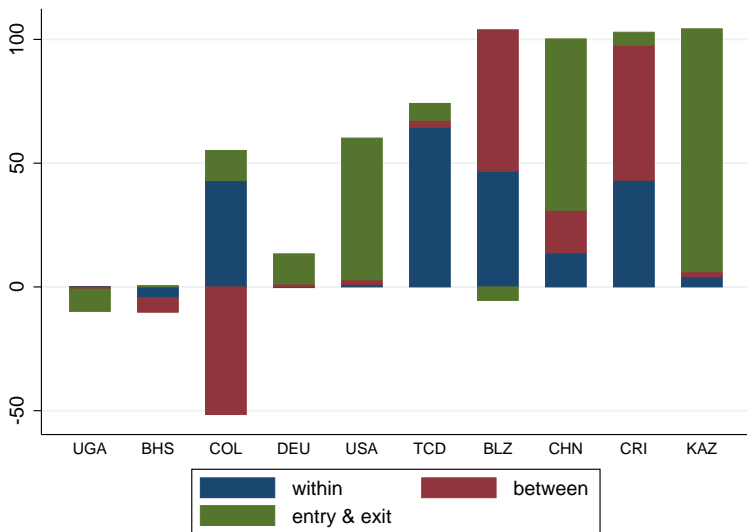
$$\begin{aligned} \Delta \overline{UV}_t^s &= \underbrace{\sum_{i \in C} \bar{s}_i \Delta UV_{it}}_{\text{within effect}} + \underbrace{\sum_{i \in C} \Delta s_{it} (\overline{UV}_i - \overline{UV}^s)}_{\text{between effect}} \\ &+ \underbrace{\sum_{i \in N} s_{it} (UV_{it} - \overline{UV}^s)}_{\text{entry}} - \underbrace{\sum_{i \in X} s_{i,t-k} (UV_{i,t-k} - \overline{UV}^s)}_{\text{exit}}, \end{aligned}$$

where C are disjoint sets of continuing sectors, N are entering categories, X are exiting categories, s are shares.

Decomposition: interpretation

- *within* changes at the 6-digit level are quality improvements ('vertical specialization')
- *between* changes and *entry* and *exit* are harder to interpret but capture more dynamics between sectors (assumption: higher UV = 'upgrading')

Some country examples



Vertical upgrading plays minor role in overall UV change

Table : Correlations between different dimensions of unit value changes (1996 - 2006)

	overall UV	within	between	entry & exit
overall UV	1			
within	-0.0457	1		
between	0.945***	-0.0404	1	
entry & exit	0.996***	-0.0466	0.910***	1

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$, N=154

A tentative conclusion

- 1** strong tendency for unit values to converge *within* subsectors
 - 2** but developing countries export goods with less potential to increase unit values over the longer term
- ⇒ vertical upgrading without horizontal dynamics probably not enough
- 3** different patterns of vertical specialization vs. horizontal sectoral dynamics across countries
 - important contribution of entry & exit