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Vertical and Horizontal Dynamics in Export Unit Values

Konstantin Wacker

Johannes Gutenberg University (JGU) Mainz, Germany

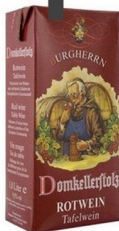The presentation is based on a paper co-authored with Jan Trenczek (JGU Mainz).

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Konstantin M. Wacker & Jan Trenczek
International Economics, JGU Mainz
http://www.trade.economics.uni-mainz.de/

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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 prodce 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
    - $\Rightarrow$ ~ 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

$$\Delta \ln(UV_{ig.t}) = a + \rho_{ig.} \ln(UV_{ig.,t-1}) + \alpha_{g.} + \gamma_i + \varepsilon_{ig.t} \qquad (1)$$

- convergence parameter ρ may or may not be country or product (group) specific
- conditional interpretation:
  - inclusion of product-specific effect $\alpha_{g.}$
    $\rightarrow$ ρ captures convergence in UVs *within* products
  - exclusion of $\alpha_{g.}$ $\rightarrow$ ρ *additionally* captures convergence in UVs *between* products

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

Convergence (within and between)
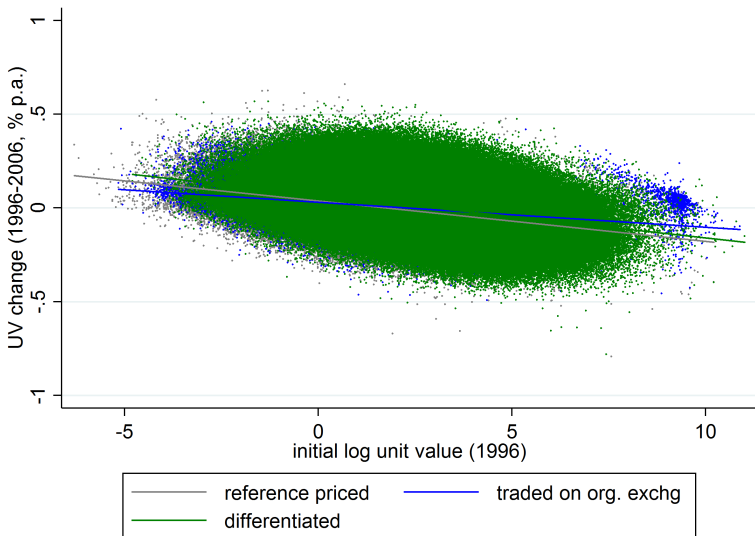
Convergence in UVs: key results

VARIABLES	(1) $\Delta \ln(UV)$	(2) $\Delta \ln(UV)$	(3) $\Delta \ln(UV)$	(4) $\Delta \ln(UV)$
$\ln(UV_{t-1})$	-0.0126***	-0.0656***	-0.0692***	
	(9.84e-05)	(0.000240)	(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
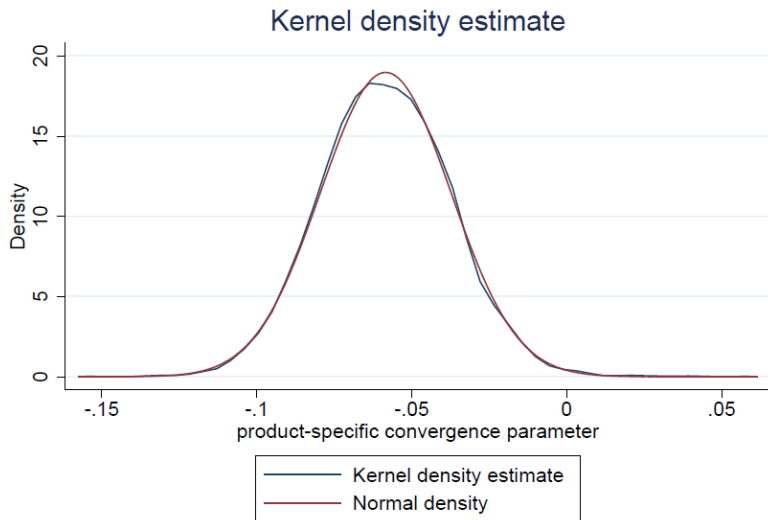
Convergence at the product level

- estimate

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

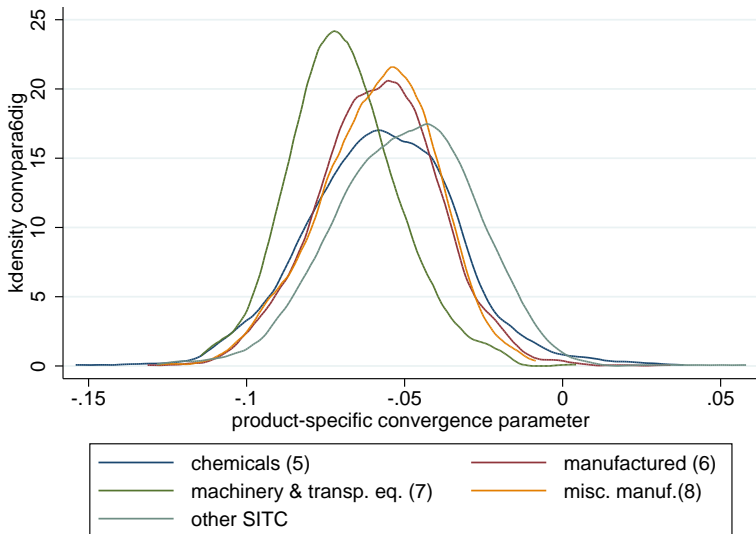on the HS 6-digit product level (for each product with at least 10 exporters/observations)

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

Distribution of convergence parameters

Kernel density estimate

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
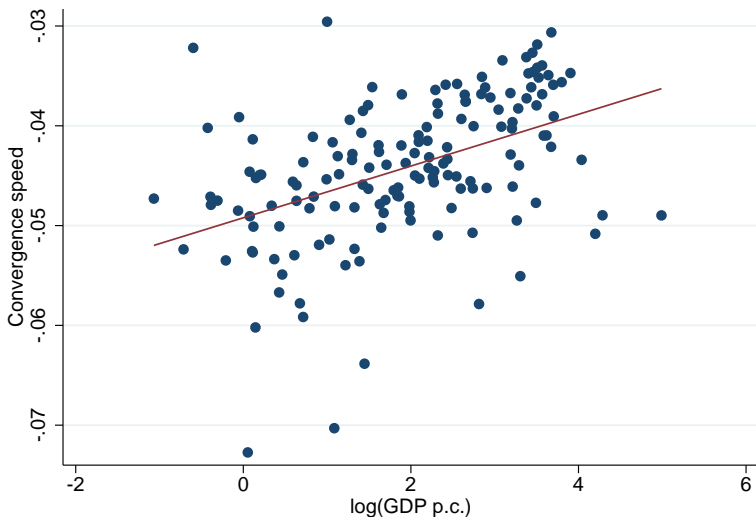

b=0.0026, (robust) t-stat: 5.38, R-squared: 0.21

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

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

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

   - 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
   (controling 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

b=1.13, (robust) t-statistic: 4.94, R-squared: 0.23
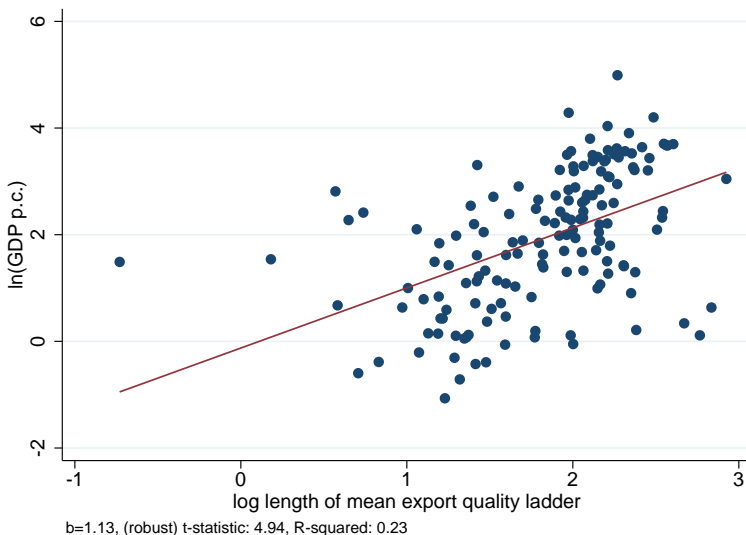
'Within convergence' vs. 'between effect'

- 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

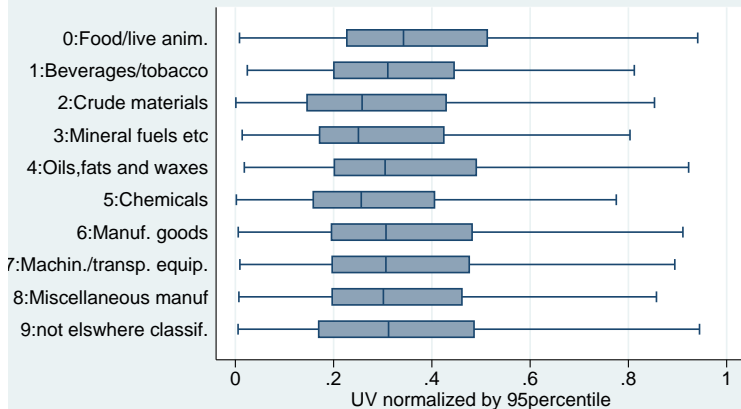# China: closer to frontier in few sectors with 'lower quality'

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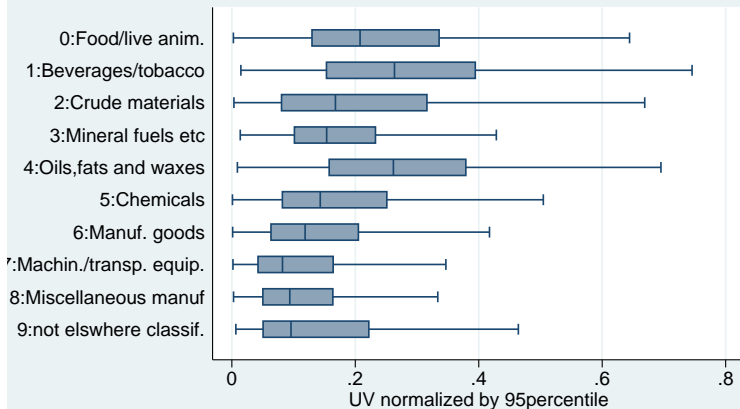
Source: BACI Dataset

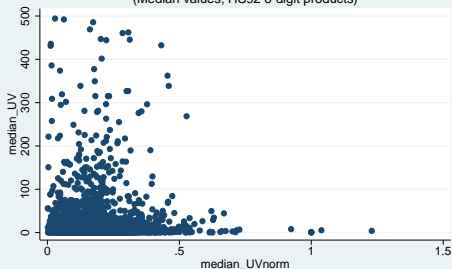# Germany: no clear specialization across broad sectors

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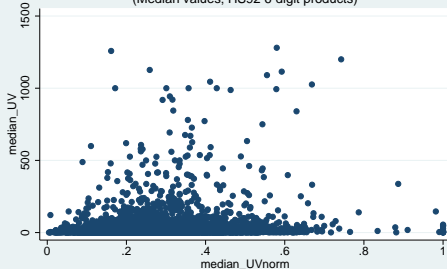
Source: BACI Dataset

Germany at the frontier in higher-unit-value products

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:

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

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')

Entry & exit plays an important role

Some country examples
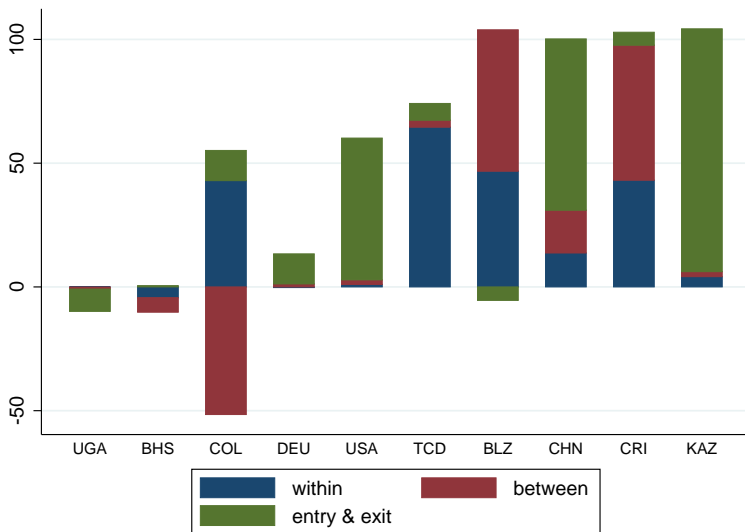
Vertical upgrading plays minor role in overall UV change

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