Reassessing EU Comparative Advantage:

The Role of Technology

Filippo di Mauro
CompNet Chairperson

Marco Matani
IHEID

Gianmarco Ottaviano
Bocconi University

59th Annual Meetings of the Canadian Economics Association

CompNet Micro-aggregated Dataset: Research Applications

Montreal, May 31 2025

1. Motivation

2. A Ricardian Heckscher-Ohlin Model

3. Reassessing EU Comparative Advantage

4. Conclusions

CompNet The Competitiveness Research Network

IWH

Motivation

- **Competitiveness** is experiencing a renewed interest in Europe

- *The future of European competitiveness* (Draghi, 2024)
  - EU's **loss of technological prowess** with respect to US and China
  - **Active industrial policy** to reverse the trend

- OUR question: **how do we map the EU's relative state of technology** vis-à-vis the rest of the world?

- ⇒ **We focus on the concept of "Comparative Advantage" (CA)**

CompNet The Competitiveness Research Network

IWH

www.comp-net.org

The Notion of Comparative Advantage

For countries i, $i' \in I$, sectors $s, s' \in S$, output price p, unit **input requirement c,** and **export amount *exp***

Ricardian Comparative Advantage

i has a *Ricardian* comparative advantage w.r.t. i' in s IFF **in autarky**

$$\frac{c_{i,s}}{c_{i,s'}} < \frac{c_{i',s}}{c_{i',s'}}$$

Balassa "Revealed" Comparative Advantage

i has a *Revealed* comparative advantage in s IFF **in the open economy**

$$BRCA_{i,s} = \frac{exp_{i,s}}{\sum_s exp_{i,s}} \Bigg/ \frac{\sum_{i' \neq i} exp_{i',s}}{\sum_{i' \neq i} \sum_s exp_{i',s}} > 1$$

The Notion of Comparative Advantage

- "*Revealed*" comparative advantage is the ACTUAL result, BUT is polluted by **other concomitant drivers** of external competitiveness beyond technology

  - Input prices (Heckscher-Ohlin)
  - Scale economies and market power (Krugman)
  - Firm selection (Melitz)
  - Government intervention (institutions)

- Our aim is to obtain technology-based **Ricardian Comparative Advantages** purging trade information from other concomitant drivers

- i.e., back out **productivity** (internal competitiveness) from **foreign market shares** (external competitiveness)

CompNet The Competitiveness Research Network   IWH   www.comp-net.org

Roadmap

1. Motivation

2. A Ricardian Heckscher-Ohlin Model

3. Reassessing EU Comparative Advantage

4. Conclusions

CompNet The Competitiveness Research Network

IWH

Huang and Ottaviano (2024)

- State of the art model with cross-country differences in **factor prices**, **technologies**, and **market sizes** as well as pro-competitive effects of **firm and product selection** and **market power** from imperfect competition

- Model-based methodology with minimal data, estimation, and computation requirements (**Sufficient statistics** approach)

- Retrieves measures of **Ricardian Comparative Advantage from trade data**

- First applied to Chinese firm level and custom data

Huang and Ottaviano (2024)

- **Two factors**: labor and capital

- **Two countries**: Home and Foreign (Rest of the World) different in terms of technology, factor endowments, market size

- **Continuum of industries**: different in terms of relative productivity and relative factor intensity; indexed by z in increasing order of Home's export propensity

- **Market structure**: monopolistic competition with demand exhibiting elasticity of substitution either variable (VES) of constant (CES: $\sigma(z)$)

- **Scale economies**, **firm heterogeneity**, **multi-product firms**, and **endogenous selection**

CompNet The Competitiveness Research Network

IWH

Huang and Ottaviano (2024)

- Firms enter the market by paying a sunk cost and produce at a **marginal cost *cm*** (unit input requirement, i.e., **inverse of TFP**)

- Depending on their ***c*** with respect to the *survival cut-off:*

  - Above.... They **exit** without producing;

  - Below... produce for the **domestic market**;

  - Below bilateral country-sector export cutoff**....** they also **export** ("double selection")

- *CM(z)*, is the distribution upper bound, the home's "***Relative State of Technology***" **(RST)**

Huang and Ottaviano (2024)

Variables requirement is modest….

- **Export Propensity (share of exporting firms):** $\chi(z)$ and $\chi^*(z)$

  - Ordering industries: $\frac{\partial \chi(z)}{\partial z} > 0$

- **Export Intensity (share of export on revenues):** $\theta(z)$ and $\theta^*(z)$

- **Income:** I and I^*

- **Population:** L and L^*

- **Trade Freeness:** $\rho(z)$

- **Technology Skewness (inverse measure of heterogeneity):** $k(z)$

- **Unit Input Price:** $\omega(z)$ and $\omega^*(z)$

The model delivers sufficient statistics for **Home's industry *z*'s productivity** at different stages:

State 0: <u>Exogenous Relative State of Technology</u> in the <u>still economy</u>
(before domestic selection)....The upper bound of relative marginal cost

Technology Skewness

$$\frac{C_M^*(z)}{C_M(z)} = \left(\frac{\omega(z)}{\omega^*(z)}\right)^{\frac{k+1}{k}} \left[\rho(1-\theta(z)) + \rho^{-1}\theta(z)\right]^{\frac{1}{k}}$$

Relative Unit Input Price

Export Intensity (share of export)

Trade Freeness

State 1: <u>Ricardian CA</u> in the <u>autarkic economy</u>
(after domestic selection, before trade)...The Pre-trade relative TFP

Export Propensity (share of exporters)

$$\frac{\Phi^A(z)}{\Phi^{A*}(z)} = \left(\frac{C_M^*(z)}{C_M(z)}\right)^{\frac{k}{k+1}} \left(\frac{1-\theta(z)}{\theta(z)}\right)^{\frac{1}{k+1}} \chi(z)^{\frac{1}{k}} \rho^{-\frac{1}{k(k+1)}}$$

State 2: <u>Relative TFPQ</u> in the <u>open economy</u>
(after trade)

Ex-Post Amplifying (Higher share of exporters on input usage)

Ex-Ante

Ex-Post Dampening (Weaker selection among exporters)

$$\frac{\Phi(z)}{\Phi^*(z)} = \frac{\Phi^A(z)}{\Phi^{A*}(z)} \left(\frac{\frac{L}{L^*}\rho + \left(\frac{\chi(z)}{\rho}\right)^{\frac{k+1}{k}}}{\frac{L^*}{L}\rho + \left(\frac{\chi(z)}{\rho}\right)^{-\frac{k+1}{k}}}\right)^{\frac{k}{k+1}} \frac{\rho\chi(z)^{-1} + \frac{L^*}{L}\rho}{\rho^{-1}\chi(z) + \frac{L}{L^*}\rho}$$
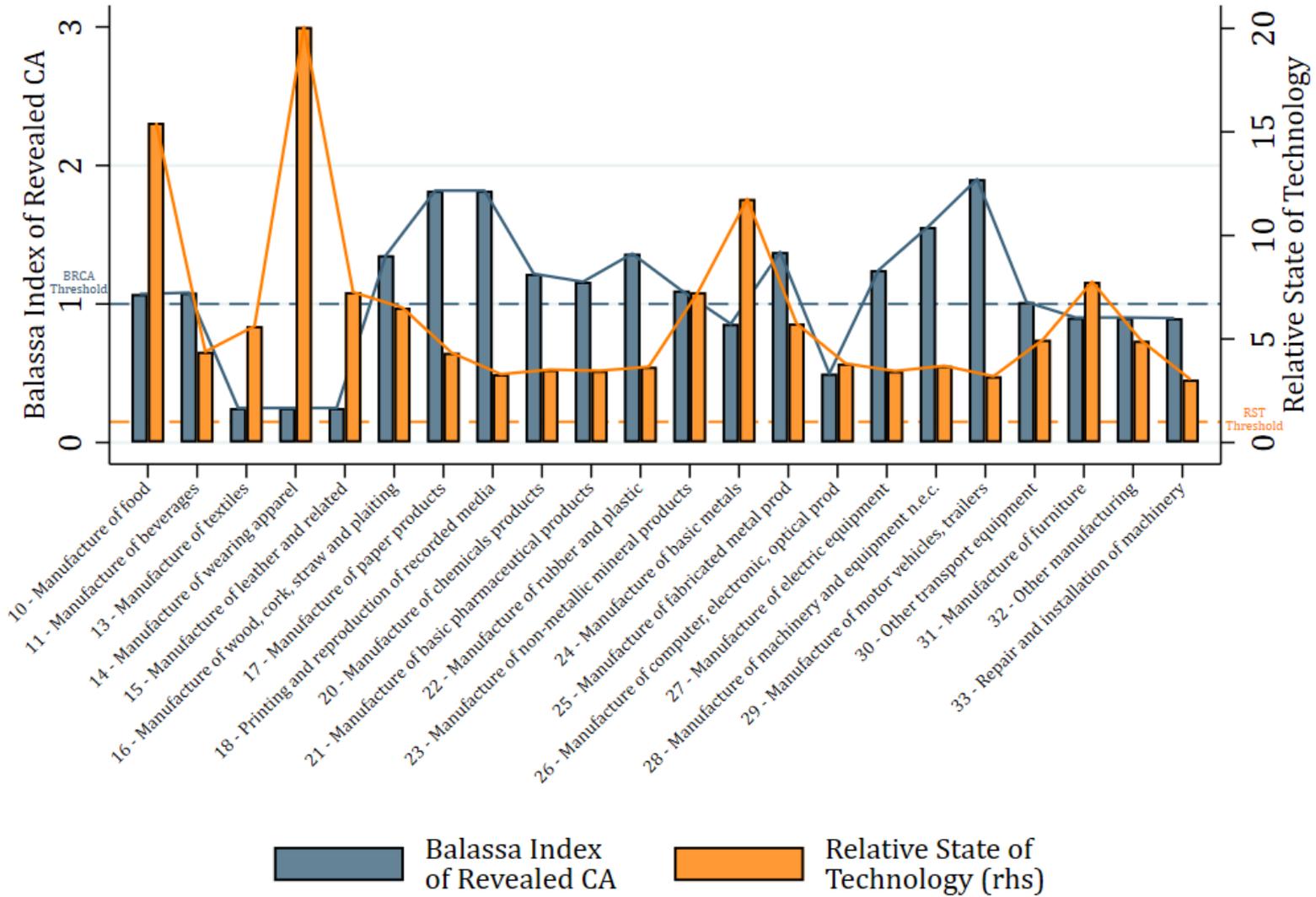
Relative Market Size

Roadmap

1. Motivation

2. A Ricardian Heckscher-Ohlin Model

3. Reassessing EU Comparative Advantage

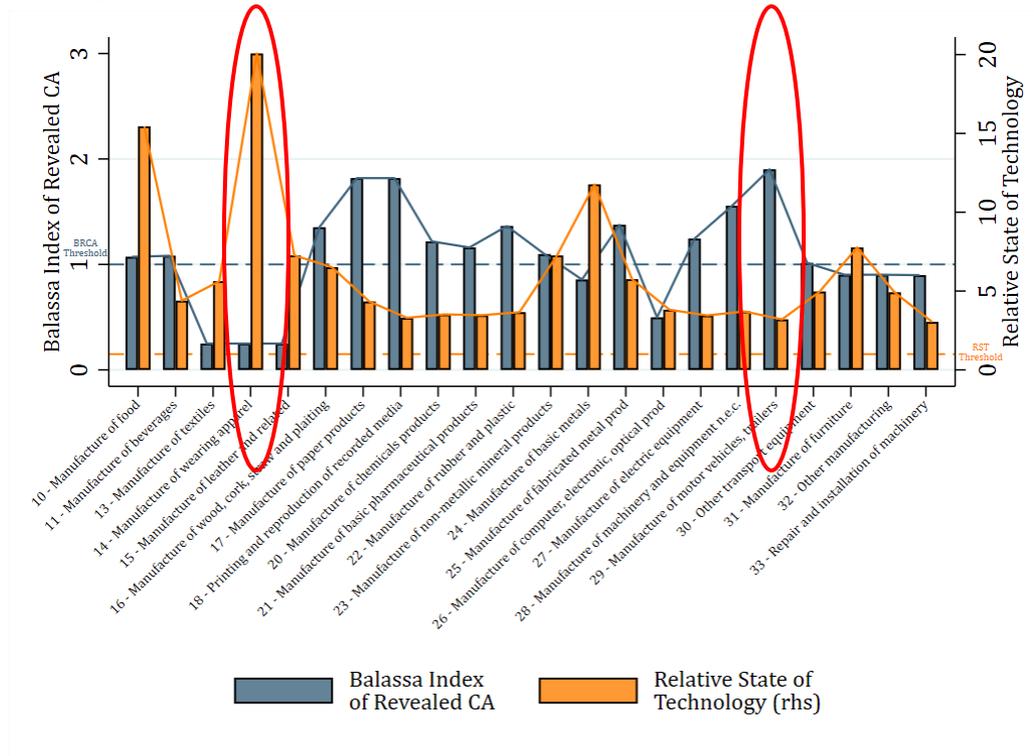4. Conclusions

di Mauro et al. (2024)

Application to **CompNet** to retrieve the **relative productivity measures** at each stage **in Europe**

- **Countries:** Croatia, Czech Republic, Denmark, Finland, France, Germany, Hungary, Lithuania, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden

- **Industries:** 22 NACE Rev. 2 Divisions (2 digits)

- **Years:** Balanced sample 2010-2018

- We start from the **real-world export specialization**
    - Balassa Revealed Comparative Advantage (BRCA) from the 2020 OECD Inter Country Input Output tables

- Then we use CompNet to compute **relative State of technology**
    - Micro-aggregated data ($\chi(z)$, $\theta(z)$, $k(z)$, factor shares to compute $\omega(z)$)
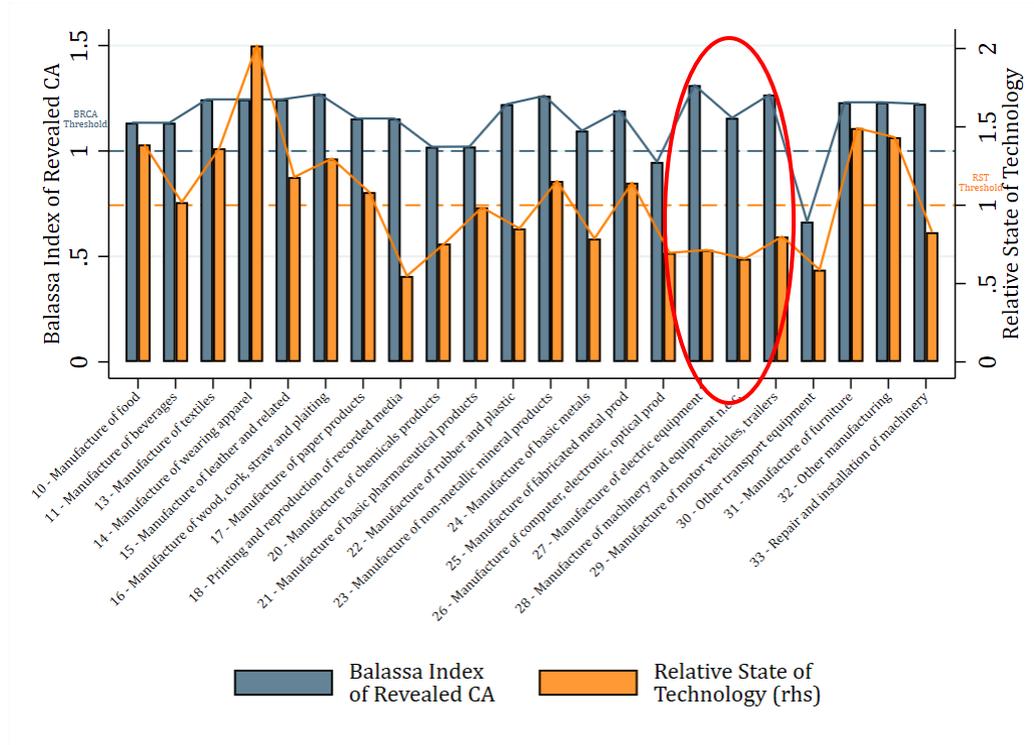
di Mauro et al. (2024)

Balassa Revealed Comparative Advantage and Relative State of Technology in the EU vs RoW

- Europe has better state of technology than the rest of the world (RST>1) in all manufacturing sectors

- But, widespread **disalignment** between RST and BRCA

  - Manufacture of **wearing apparel**: **much higher RST relatively to BRCA**
  - Manufacture of **motor vehicles**: **much lower RST relatively to BRCA**

CompNet The Competitiveness Research Network

IWH

di Mauro et al. (2024)

Balassa Revealed Comparative Advantage and Relative State of Technology in the EU vs USA

- **Alignment** between RST and BRCA improves when **only comparing with the USA**
- Europe **loses technological advantage in some industries** (RST<1)
- For Manufacture of **electric equipment**, of **machinery and equipment n.e.c.**, and of **motor vehicles** the **disalignment between RST and BRCA** remains

di Mauro et al. (2024)

- Is this this discrepancy still there if we consider other measure of productivity?

- We rank industries within **all country-year combinations** (↓ underlying value ↔ ↑ ranking)

- BRCA ranking is **systematically negatively** correlated with rankings for RST, RCA, and TFPQ

Pairwise Correlations between Productivity Measures

	(1) Ricardian CA $\frac{\phi^A(z)}{\phi^{A*}(z)}$	(2) TFPQ $\frac{\phi(z)}{\phi^*(z)}$	(3) CompNet Productivity	(4) Balassa Revealed CA $\frac{\frac{Exp(z)}{\Sigma_z\,Exp(z)}}{\frac{Exp^*(z)}{\Sigma_z\,Exp^*(z)}}$
Relative State of Technology $\frac{C^*_M(z)}{C_M(z)}$	0.189***	0.348***	-0.040**	-0.034***
	(0.017)	(0.016)	(0.016)	(0.011)
R^2	0.92	0.93	0.93	0.97
Obs.	2,576	2,576	2,576	2,576
Ricardian CA $\frac{\phi^A(z)}{\phi^{A*}(z)}$		0.754***	0.044**	-0.039***
		(0.015)	(0.019)	(0.013)
R^2		0.96	0.93	0.97
Obs.		2,576	2,576	2,576
TFPQ $\frac{\phi(z)}{\phi^*(z)}$			0.045**	-0.048***
			(0.019)	(0.013)
R^2			0.93	0.97
Obs.			2,576	2,576
CompNet Productivity				-0.015
				(0.014)
R^2				0.97
Obs.				2,576

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. A unit of observation is a year-country-industry combination. Country-industry fixed effects.

CompNet The Competitiveness Research Network

IWH

di Mauro et al. (2024)

- **What drives the divergence?** ..between **theoretical** measures of **productivity** and **real** world data on **export specialization**

- A regression on the relative rankings (column 3) will show that BRCA improves w.r.t RST with:

  - Higher **trade freeness**

  - Lower **firms heterogeneity**

  - Higher **relative market size**

Estimation of Components of Productivity Measures

	(1) Relative State of Technology $\frac{C_M^*(z)}{C_M(z)}$	(2) Balassa Revealed CA	(3) RST - BRCA
Relative Unit Input Price $\frac{\omega(z)}{\omega^*(z)}$	0.142*** (0.012)	0.009 (0.008)	0.136*** (0.015)
Firms Heterogeneity $k(z)$	-0.398*** (0.016)	-0.019* (0.010)	-0.388*** (0.021)
Trade Freeness ρ	-0.415*** (0.029)	0.125*** (0.019)	-0.519*** (0.038)
Relative Market Size $\frac{L}{L^*}$		-0.011 (0.014)	-0.098*** (0.028)
Export Intensity $\theta(z)$	0.375*** (0.021)		
R^2	0.92	0.97	0.94
Obs.	2,576	2,576	2,576

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. A unit of observation is a year-country-industry combination. Country-industry and year fixed effects. (3)=(1)-(2).

CompNet The Competitiveness Research Network   IWH

di Mauro et al. (2024)

- Export specialization is thus associated with the **interplay of all the main sources highlighted in the literature**, in the expected direction:

  - relative state of technology (Ricardo, 1817)

  - relative factor endowments (Heckscher and Ohlin, 1933)

  - relative market size and market access (Krugman, 1980)

  - relative competitive pressure and firm selection (Melitz, 2003)

- The results provide a theory-consistent **crosswalk between** industries' **export performance and technological prowess** controlling for **other factors**

CompNet The Competitiveness Research Network

IWH

di Mauro et al. (2024)

- Achieving export specialization necessitates favorable conditions **beyond just technological superiority**:

  - affordable access to production factors and intermediate inputs
  - a substantial domestic market
  - a dynamic industrial environment

- Policy efforts should then **strategically target**:

  - workforce skills development
  - effective deployment of capital investments
  - intelligent supply chains structuring
  - deep single market integration
  - streamlined firm entry and exit process

CompNet The Competitiveness Research Network

IWH

1. Motivation

2. A Ricardian Heckscher-Ohlin Model

3. Reassessing EU Comparative Advantage

4. Conclusions

CompNet The Competitiveness Research Network

IWH

Conclusions

- CompNet offers tools for analyzing European competitiveness and for contributing to the policy debate

- Lack of systematic cross-industry correlation between relative export specialization and technological advantage in Europe

- Concurrent influences of factor prices, market size, markups, firm selection and market share reallocation

- Achieving export specialization in key sectors requires more than just technological superiority

Thanks for your attention

References

di Mauro, F., M. Matani, and G. I. Ottaviano, "*Reassessing EU Comparative Advantage: The Role of Technology*," IWH Discussion Papers, 2024, 26.

Dornbusch, R., S. Fischer, and P. A. Samuelson, "*Comparative Advantage, Trade, and Payments in a Ricardian Model with a Continuum of Goods*," American Economic Review, 1977, 67 (5), 823–839.

Dornbusch, R., S. Fischer, and P. A. Samuelson, "*Heckscher-Ohlin Trade Theory with a Continuum of Goods*," Quarterly Journal of Economics, 1980, 95 (2), 203–224.

Draghi, M., "*The future of European competitiveness*," Technical Report, European Commission 2024.

Heckscher, E. and B. Ohlin, "*International and Inter-Regional Trade*", Cambridge: Harvard University Press, 1933.

Huang, H. and G. I. Ottaviano, "*Revealing Ricardian comparative advantage with micro and macro data*," CEPR, 2024, Discussion Paper (18935).

Krugman, P., "*Scale Economies, Product Differentiation, and the Pattern of Trade*," American Economic Review, 1980, 70 (5), 950–959.

Mayer, T., M. J. Melitz, and G. I. Ottaviano, "*Market Size, Competition, and the Product Mix of Exporters*," American Economic Review, 2014, 104 (2), 495–536.

Melitz, M. J., "*The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity*," Econometrica, 2003, 71 (6), 1695–1725.

Ricardo, D., "*On the Principles of Political Economy and Taxation*", London: John Murray, 1817.