

Business intangibles in global value chains: In search of export competitive advantage

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Intangibles in global value chains

- Intangible assets are related with dominant position in GVCs.
- Unequal value appropriation along the value chain.
 - Technological asymmetry between different economies (developed vs. developing)
 - The concept of the **smiling curve** (U-shaped).
 - The prominent role of **services** and **knowledge assets**.
 - The **stagnation** of **manufacturing industries** in the middle end.
 - The ongoing **servicification** as a response (also related with the digital transformation).



Control and utilization of intangibles become key elements for competitiveness

But what about the production of intangibles?

- Who produces the intangibles in global markets and who uses them?
- Is local production preferable due to geographical and **technological proximity**?
- Does this **technological proximity** result into **competitiveness gains**?
- Do global leaders rely on **local knowledge producers** to secure their position in GVCs?

Why focus on location?

- Firm level evidence suggest that '**intellectual monopolies**' are formulated based on the accumulation and control of key intangibles (Durand and Milberg, 2020).
- Macro level: the discussion between **headquarters** (knowledge and technology intensive) and **factories** (labor intensive) by Baldwin and Lopez-Gonzalez (2015).
- Technology asymmetry traverses to manufacturing activities as well → increased **knowledge content** in global **manufacturing supply chains** (Baldwin and Evenett, 2015).
- Del Petre and Rungi (2017) provided firm-level evidence (4000 firms, global scale, including EU, USA and Eastern Asia) that **dominant manufacturing firms** tend to **integrate proximate stages** into their **global value chain**.
- Two types of proximity:
 - ❖ Purely geographical
 - ❖ **Technological** (most common)
- **Dominant manufacturing firms** keep **adjacent** (in terms of technology) **activities close** and outsource dissimilar activities abroad.
 - ❖ **Knowledge intensive manufacturing** industries prefer **domestic knowledge inputs**.
- Timmer et al. (2014; 2019) argue that **firms** located in **developed economies** outsource unskilled labor abroad and **retain knowledge intensive strategic activities** at home.

The scope of this study

- This study aims to explore the **contribution of intangibles and GVC participation to competitiveness** for the **manufacturing industries** of the **G7 economies**.
- Special focus: On the **location of production** of intangibles (the **origin dimension**).
- **Main research hypothesis**: Domestic intangibles' utilization positively contributes to competitiveness due to technological proximity of the knowledge producers.
- Two competitiveness indicators:
 - Revealed comparative advantage (exports oriented)
 - Labor productivity for robustness analysis

Methodology breakdown

- To account of the origin dimension, we turn to the GLOBALINTO I-O Intangibles database (GIOD).
- We expand the database to account for the global G7 economies (Canada, Japan, the USA and some preliminary descriptives for Brazil, China and Rep. of Korea).
- We use two specifications:
 - **Export competitiveness** approach
 - Traditional **labor productivity approach** for robustness checks
- **Data sources:** GIOID and the World Input-Output Database (WIOD) (Timmer et al., 2015)
- **Sector coverage:** 18 NACE Rev. 2 2-digit manufacturing sectors from Canada, France, Germany, Italy, Japan, the UK and the USA
- **Time frame:** 2000-2014

G7 manufacturing sectors covered in the analysis

Sector Acronym	Detailed description
C10-C12	Mn. of food products, beverages and tobacco products
C13-C15	Mn. of textiles, wearing apparel and leather products
C16	Mn. of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
C17	Mn. of paper and paper products
C18	Printing and reproduction of recorded media
C19	Mn. of coke and refined petroleum products
C20	Mn. of chemicals and chemical products
C21	Mn. of basic pharmaceutical products and pharmaceutical preparations
C22	Mn. of rubber and plastic products
C23	Mn. of other non-metallic mineral products
C24	Mn. of basic metals
C25	Mn. of fabricated metal products, except machinery and equipment
C26	Mn. of computer, electronic and optical products
C27	Mn. of electrical equipment
C28	Mn. of machinery and equipment n.e.c.
C29	Mn. of motor vehicles, trailers and semi-trailers
C30	Mn. of other transport equipment
C31_C32	Mn. of furniture; other manufacturing

Export competitiveness

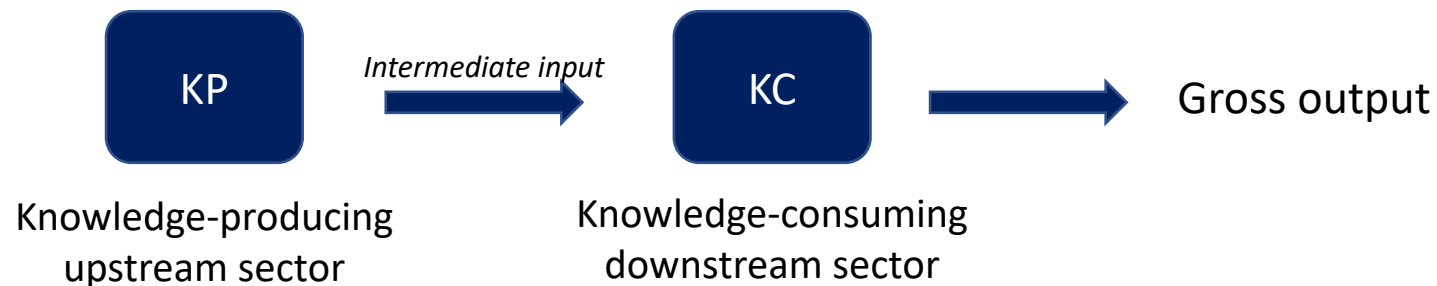
- We use an adjusted Revealed Comparative Advantage indicator using export data for WIOD:

$$RCA_{i,c} = \frac{\frac{GX_{i,c}}{GX_{M,c}}}{\frac{GX_{i,w}}{GX_{M,w}}}$$

where $GX_{i,c}$ represents the gross exports of sector i in country c , $GX_{M,c}$ the gross exports of the manufacturing sector in country c , $GX_{i,w}$ are the gross exports of the world sector i and $GX_{M,w}$ are the gross exports of the world manufacturing sector.

The knowledge producer sector concept of the GLOBALINTO database

- GIOD identifies intangibles as producer’s services.
- They are produced by knowledge producing sectors (following the Corrado et al. (2013) paradigm) → KIBS industries
- And consumed by knowledge using industries (in our case manufacturing industries)
- When these sectors are located in **different** economies this **knowledge transaction** crosses borders for **production purposes** → qualifies as a **GVC activity!**



Intangible inputs

- Intangible inputs data derive from GLOBALINTO I-O Intangibles Database (constructed based on raw data from the WIOD)
 - *Provided by* NACE Rev. 2 KIBS sectors: **J62-J63** -Computer programming, consultancy and related activities; **M72** - Scientific R&D; **M73** Advertising and market research; **N** Administrative and support service activities;
 - *Made in* 42 countries (all EU members included) and RoW; Aggregates for BRIC, EA, EU27 aggregates
 - *Used by* 56 2-digit NACE Rev.2 sectors in each EU country
 - *Time coverage:* 2000 – 2014
- Account for purchased intangible capital and not in-house production.
- **Key novelty**: The origin dimension (domestic and imported intangibles).
- **International expansion**: data for Brazil, Canada, China, Rep. of Korea, Japan, and the USA

...to account for the knowledge content of production

- Total intensity

$$t_intan_{i,c} = \frac{I_{i,c}^{tot}}{Z_{i,c}}$$

- Domestic intensity

$$d_intan_{i,c} = \frac{I_{i,c}^{dom}}{Z_{i,c}}$$

- Imported intensity

$$i_intan_{i,c} = \frac{I_{i,c}^{imp}}{Z_{i,c}}$$

- Where $I_{i,c}$ refers to the type of intangible inputs of sector i in country c and $Z_{i,c}$ to total intermediate consumption of sector i in country c
- These indicators capture the '**knowledge content of production**'.
- They account for **origin**.
- Provide measures of the share of intangibles compared to other intermediates.
- Diminish the effects of an increase (or decrease) in the overall intermediate consumption and focus only on intangibles.

GVC participation

- **Backward participation** in GVCs is the most used index of GVC participation (i.e., in Baldwin and Lopez-Gonzalez 2015; OECD 2013; Amador et al. 2015).
- It measures roughly the **import content of exports**.
- Calculations based on the Hummels et al. (2001) Vertical Specialization (VS) indicator approach and Koopman et al. (2014) decomposition approach:

$$gvc_b_{i,c} = \frac{FVA \text{ embodied in gross exports}_{i,c}}{gross \text{ exports}_{i,c}}$$

where FVA embodied in gross exports and gross exports are calculated at the 2-digit NACE Rev.2 sector level for each manufacturing sector i in each country c using relevant I-O data from WIOD

Traditional trade

- Apart from GVC trade, we also consider traditional trade activities* through a trade openness indicator:

$$tradeo_{i,c} = \frac{GM_{i,c} + GX_{i,c}}{Y_{i,c}}$$

where $GM_{i,c}$, $GX_{i,c}$ and $Y_{i,c}$ represent the gross imports, gross exports, and total output of sector i in country c respectively.

*according to Antràs (2019), traditional trade encompasses the full range of trade activities while GVC trade focuses on the trade of intermediates.

Model specifications for export competitiveness

- **Three** different specifications per **type of intangibles' intensity**.
- The set of explanatories further includes **capital stock** (as a share of hours worked for each industry, $k_{h_{i,c}}$) using data from WIOD's SEA accounts and the **dependent variable lagged by one period**.
- **Trade** and **GVC indicators** are **lagged by one period** in the specifications following the assumption that the benefits from participation in global markets are not reaped immediately (Constantinescu et al., 2019).
- We introduce time and country fixed effects for unobserved macroeconomic effects.
- Variables are taken into natural logarithms for scaling.
- Benchmark specification:

$$\ln (RCA)_{i,c,t} = a_0 + a_1 \ln (RCA)_{i,c,t-1} + a_2 \ln (t_intan)_{i,c,t} + a_3 \ln (gvc_b)_{i,c,t-1} + a_4 \ln (tradeo)_{i,c,t-1} + a_5 \ln (k_h)_{i,c,t} + \lambda_c + \lambda_t + \varepsilon_{i,t}$$

A traditional production function approach

- We consider a production function that expresses VA as a function of labor ($L_{i,c,t}$), capital ($K_{i,c,t}$) and technology ($A_{i,c,t}$):

$$VA_{i,c,t} = f(A_{i,c,t}K_{i,c,t}L_{i,c,t})$$

- We consider $A_{i,c,t}$ as a function of exogenous technological factors (notated as $\tau_1, \tau_2, \dots, \tau_j$).
- Technological factors include:
 - Intangible inputs based on their nature as knowledge factors of production,
 - $gvc_b_{i,c}$ and $tradeo_{i,c}$ lagged by one period, in line with Constantinescu et al. (2019) and under the assumption that knowledge and technology transfer between industries is integrated in their trading transactions, especially in the case of GVC trade.
- Dividing by labor (i.e., hours worked)* and taking logs, we have the benchmark specification:

$$\ln (prod)_{i,c,t} = a_0 + a_1 \ln (t_intan_h)_{i,c,t} + a_2 \ln (gvc_b_h)_{i,c,t-1} + a_3 \ln (tradeo_h)_{i,c,t-1} + a_4 \ln (k_h)_{i,c,t} + \lambda_c + \lambda_t + \varepsilon_{i,t}$$

*Intangible inputs, GVC participation and trade openness are also included in the specification divided per hours worked in order to provide robust and comparable results with the traditional elements of the growth accounting model.

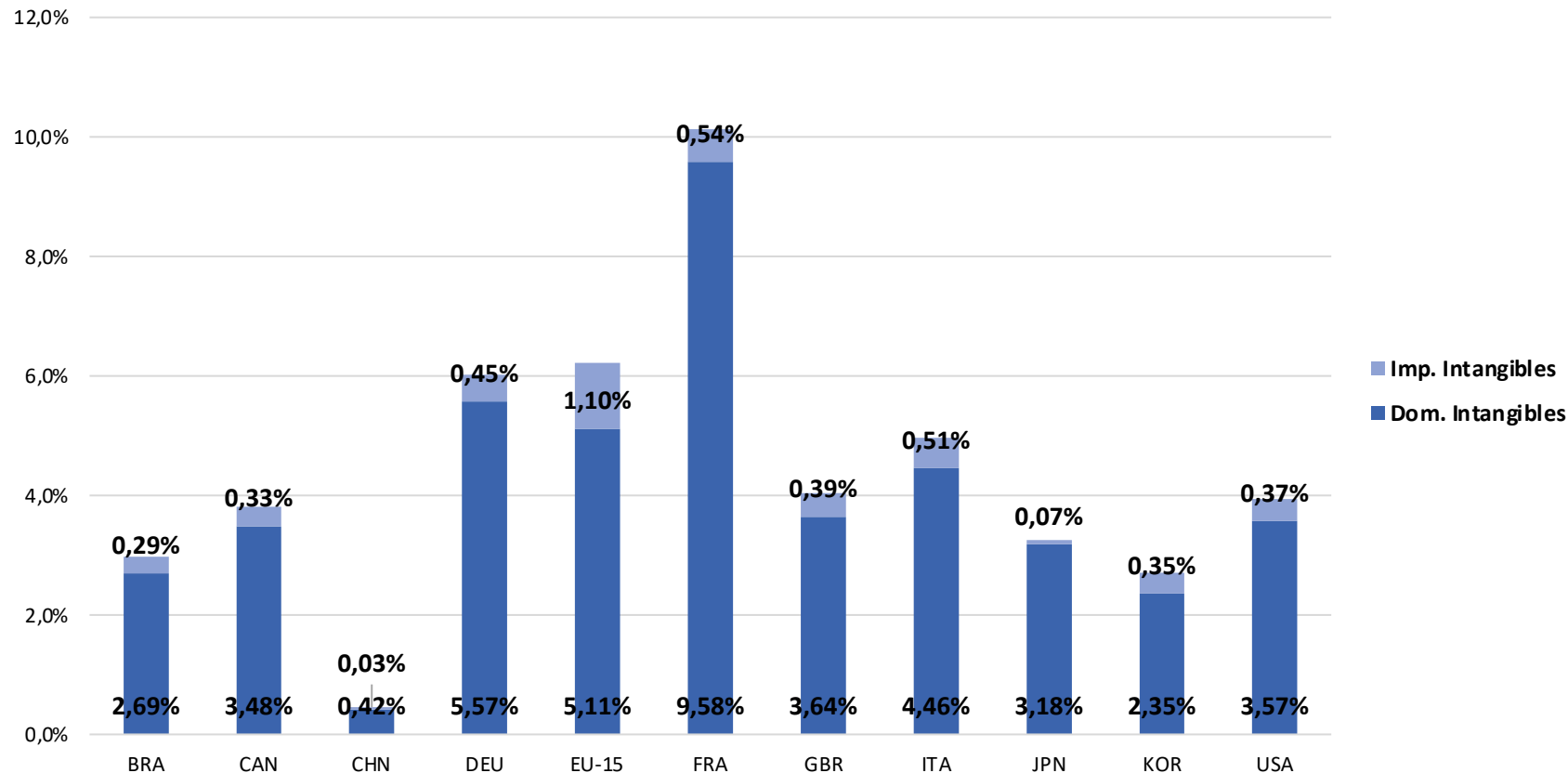
Estimation strategy

- Both specifications are sensitive to endogeneity problems due to the nature of the construction of the variables (especially trade and GVC participation indicators).
- Possible reverse causality in both specifications
- Remedy actions:
 1. Lagged terms for reverse causality-sensitive variables.
 2. Two-step system GMM estimators* (also accounting for autocorrelation and heteroskedasticity)

*Two-step difference GMM estimators were also tested but system GMM estimators were selected based on their improved efficiency and Bond's (2001) rule of thumb. Additional regressions using **pooled OLS**, and **fixed effects** estimators also provided for robustness checks.

Some descriptive statistics on a global scale (intensity)

Intangibles' intensity (per origin) for the aggregate manufacturing sectors (2000-2014 average)



- France's manufacturing sector is the most intangible intensive.
- The **G7 economies** appear to rely heavily on **domestic intangible inputs** (most notably Japan) → **knowledge and technology proximity**.
- EU-15 presents the higher share of imported intangibles
 - Diversified sample
 - Evidently driven by economies outside of France, Germany, Italy and the UK.
- Asian economies are quite local.
- China ranks at the bottom hinting at the labor-intensive nature of manufacturing activities (more recent data should probably diverge from that finding).

Econometric results

Export competitiveness

<i>ln(RCA)</i>	Two-step system GMM		
	(1.1)	(1.2)	(1.3)
<i>ln(RCA)_{t-1}</i>	0.944*** (0.019)	0.945*** (0.019)	0.960*** (0.019)
<i>ln(t_intan)</i>	0.035*** (0.011)		
<i>ln(d_intan)</i>		0.033*** (0.010)	
<i>ln(i_intan)</i>			0.022* (0.012)
<i>ln(gvc_b)_{t-1}</i>	0.164*** (0.030)	0.163*** (0.030)	0.120*** (0.031)
<i>ln(tradeo)_{t-1}</i>	-0.143*** (0.026)	-0.143*** (0.026)	-0.109*** (0.024)
<i>ln(k_h)</i>	-0.007 (0.009)	-0.007 (0.009)	-0.016 (0.011)
constant	0.272** (0.063)	0.268*** (0.061)	0.283** (0.085)
Time fixed effects	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes
Observations	1764	1764	1764
No. of groups	126	126	126
F-test (model)	554.39***	550.73***	744.63***
No. of instruments	78	78	78
Arellano-Bond AR(2) test (p-value)	0.276	0.275	0.280
Hansen's J test (p-value)	0.288	0.288	0.205

Labor productivity

<i>ln(prod)</i>	Two-step system GMM		
	(1.4)	(1.5)	(1.6)
<i>ln(t_intan_h)</i>	0.223*** (0.031)		
<i>ln(d_intan_h)</i>		0.216*** (0.031)	
<i>ln(i_intan_h)</i>			0.067*** (0.018)
<i>ln(gvc_b_h)_{t-1}</i>	-0.082*** (0.024)	-0.085*** (0.024)	-0.105*** (0.023)
<i>ln(tradeo_h)_{t-1}</i>	0.219*** (0.040)	0.220*** (0.13)	0.234*** (0.037)
<i>ln(k_h)</i>	0.323*** (0.058)	0.331*** (0.057)	0.530*** (0.053)
constant	1.651*** (0.133)	1.650*** (0.134)	1.445*** (0.150)
Time fixed effects	Yes	Yes	Yes
Country fixed effects	Yes	Yes	Yes
Observations	1764	1764	1764
No. of groups	126	126	126
F-test (model, p-value)	8058.49***	7943.62***	7565.03***
No. of instruments	64	64	64
Arellano-Bond AR(2) test (p-value)	0.101	0.102	0.119
Hansen's J test (p-value)	0.003	0.003	0.001

Main findings

- Intangible inputs – both **domestic** and **imported** – are identified as major drivers for **export performance** and **labor productivity** in the G7 manufacturing sectors → findings in line with the overall contribution of intangibles to growth by relevant literature.
- **Domestic intangibles** appear to have a stronger positive effect on **competitiveness** and **growth** compared to imported → **supporting** the knowledge and technology **proximity hypothesis**.
 - **For export performance:** both in terms of effect and significance.
 - **For labor productivity:** in terms of effect.
- Decoupling of the effects of traditional trade vs. trade in global value chains:
 - **For export performance: positive contribution** from **GVC trade** → manufacturing economies from the G7 economies benefit more from participation in GVCs rather than traditional trade.
 - **For labor productivity: positive contribution** from **traditional trade** → consistent with relevant literature (Amiti and Konings, 2007; de Loecker, 2013).
- **Backward participation in GVCs** has a **negative effect** on **labor productivity** (persistent finding in all our relevant studies).

Discussion and conclusions

- Knowledge inputs provide a positive contribution to growth and competitiveness for dominant economies → aligns with their classification as *headquarter* economies.
- The origin of intangibles does matter → domestic intangibles provide enhanced gains due to knowledge and technological proximity.
- Increased backward integration in the global production network is significant driver for competitiveness **but** different elements (exports vs. value-added) require different approaches.
- The negative effect of backward participation in GVCs is related with the nature of the activities that these industries undertake:
 - ❖ Lower sophistication of imported intermediates (we separate the effect of the imported knowledge content via imported intangibles intensity).
 - ❖ Most of the value '*added*' in the product comes from either domestic suppliers or the industry itself.
 - ❖ Significance of the positioning in the GVC: manufacturing industries from G7 economies could occupy upstream (knowledge intensive) stages in the production chain → oriented towards forward participation (Antr s, 2019; World Bank, 2020).
- **Future research:**
 - Integrate the implications of upstreamness and downstreamness in GVCs (Antr s and Chor, 2017).
 - Revisit export performance using sophistication indicators (including forward participation to GVCs).

An overview of the work so far...

- Development of the GLOBALINTO I-O Intangibles database (GIOD).
- Use of the database for deliverables 6.1, 6.2, 6.3.
- D6.3 presented at the 33rd annual EAEPE conference (2-4 September 2021, online).
- A new version of D6.3 submitted to *Technological Forecasting and Social Change* (currently revisions under review).
- GIOD to be presented in the 17th Globelics conference in Costa Rica (online participation, 5-7 November 2021).
- GIOD to be submitted to Elsevier's *Data-in-Brief* Journal (database repository) and receive DOI.
- International expansion of the database for this study
 - ❖ Accepted for oral presentation at the upcoming DRUID conference (to be held in Copenhagen, 18-20 October 2021).
- Ongoing research and future steps:
 - Further expansion of the database to include also sector M69_70 and segments from sectors M71 and M74 (based on the KLEMS approach on intangibles in Stehrer et al. 2019).
 - Application of the dataset in industry vs. services analysis (future work with Felix Roth)
 - Exploration of alternative dimensions of knowledge dissemination in GVCs (i.e., in the production linkages of all industries)

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