

Global value chains and productivity growth in advanced economies: does intangible capital matter?

C. Jona-Lasinio, (LUISS and ISTAT), Rome
V. Meliciani (LUISS), Rome

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- The shift to a knowledge-based economy has placed a novel attention on intangible capital capital as a source of productivity growth and a key element of global competition (Corrado et al. 2005, 2009).
- At the same time, the structural and organizational changes associated to the new technologies have led to widespread processes of globalisation of value chains which have also impacted on productivity in advanced and emerging countries (Criscuolo and Timmis, 2017).
- Two unrelated areas of research have emerged investigating, respectively, the productivity effect of intangible capital and of participation to GVCs.
 - Recent empirical evidence shows that intangible capital is an **increasing source** of productivity growth in most advanced economies (Corrado et al. 2017, 2018)
 - Theoretical models provide different predictions on the productivity gains from GVC participation (Li and Liu 2012; Baldwin and Robert-Nicoud 2014), but the empirical evidence supports the existence of a positive link (Kummritz 2016; Constantinescu et al., 2017).

- Intangible assets appear strategic for value added creation and appropriation.
 - Mudambi (2008) shows that intangible assets are essential to create value added in the supply chain both upstream (R&D, design) and downstream (marketing, advertising).
 - There are close linkages between innovation, value creation and economic growth with knowledge based capital being an important driver of GVC upgrading (OECD, 2013).
 - A key element to compete in high-value added activities is related to the capabilities to produce sophisticated products: **the endowment of intangible capital**.
- Intangible investments are widely recognized as a major determinant of innovation, growth and employment in the knowledge economy accounting for 20-33% of labour productivity growth in the market sector of the US and EU economies.

- The purpose of this paper is to bridge these two areas of research by investigating whether the positive impact of participation to GVCs on productivity growth is strengthened by knowledge based capital.
- We empirically address this new research question drawing on the firm level literature on the role of different intangible assets for value generation along the supply chain (Mudambi 2007; Shin et al. 2009, 2012; Dedrick et al. 2010).
- We expect some heterogeneity in the mediating role of intangible assets in the relationship between productivity growth and GVC participation.
 - In particular, assets involving more tacit forms of knowledge (economic competencies) can be exceptionally valuable being more difficult to replicate (OECD, 2013).
- The existence of synergies between GVC participation and knowledge based capital is tested in the framework of an augmented production function using data for 9 European countries and 18 industries over the period 2000-2013.

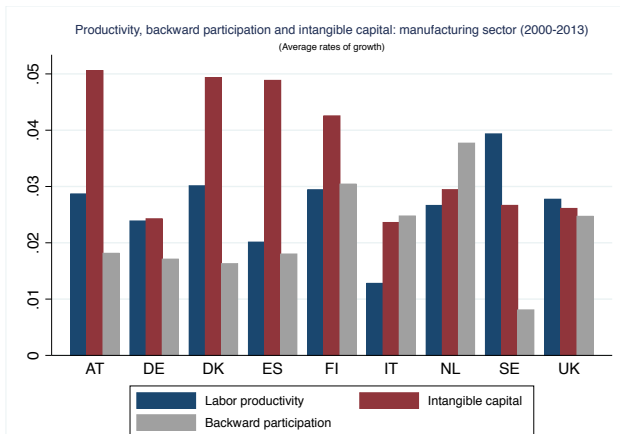
- **Forward** participation refers to "Domestic value added sent to third economies". It captures the domestic value added contained in inputs sent to third economies for further processing and export through the value chain (domestic value added embodied in foreign exports). This is the 'seller-related' measure or supply side in the GVC participation index.
- **Backward** participation indicates the "Foreign value added content of exports", it is the 'Buyer' perspective or sourcing side in GVCs, where an economy imports intermediates to produce exports (foreign value added embodied in domestic exports).

- In the first stage of our analysis, we use the backward participation indicator as a reference measure of GVC participation to be able to make comparisons with other studies (Taglioni and Wrinkler, 2014, Baldwin and Lopez-Gonzalez, 2015; Kowalski et al. 2015).
- The index of Backward participation is based on the work of Koopman et al. (2010, 2014) and extends the work of Hummels et al. (2001) and Johnson and Noguera (2012).
- However, this measure might not entirely capture the extent of GVC involvement since it does not take into account that a country exports intermediates that are used to produce final goods absorbed at home.
- A variant of this indicator decomposes value added, similarly across countries and sectors, but according to final demand (Timmer et al. 2013; Los et al. 2015).
- We plan to integrate our estimates testing also the final demand based indicator because it provides a less restrictive definition of a GVC.

- Intangibles are from INTAN - Invest (ed 2014) while output, labor and tangible capital are from EUKLEMS and National accounts.
- Measures of participation in global value chains are obtained from the World Input Output Database (WIOD).
- Geographical, industry and time coverage:
 - Nine European countries (AT, DE, DK, ES, FI, IT, NL, SE, UK)
 - Eighteen industries (A-T) NACE REV 2
 - Time 2000-2013

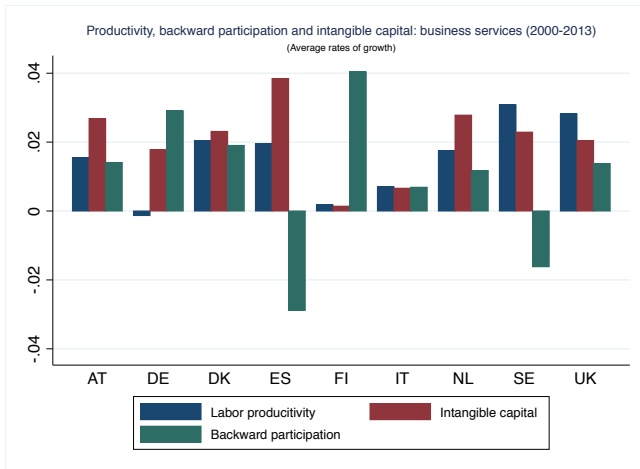
Productivity, backward participation and intangible capital: manufacturing sector 2000-2013

- On average, all sample countries experienced positive rates of growth of productivity, intangible capital accumulation and backward participation. With Austria, Denmark, Spain and Finland showing more dynamic intangibles and productivity growth rates.
- Participation increased substantially in the Netherlands (almost 4%) and rather modestly in Sweden (below 1%).



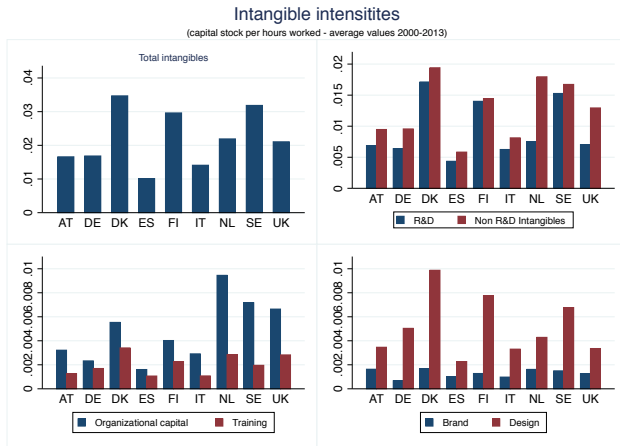
Productivity, backward participation and intangible capital: business services 2000-2013

- Backward participation has a rather heterogenous dynamics in business services: Spain and Sweden with declining rates and Finland with fast increasing rates.
- Mixed trends for productivity and intangibles across countries.



Intangibles intensities: capital stocks per hour worked (average values 2000-2013)

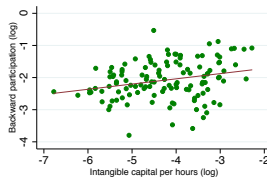
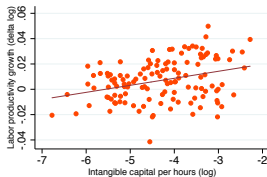
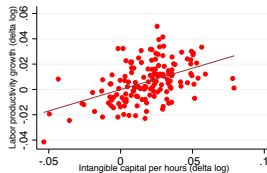
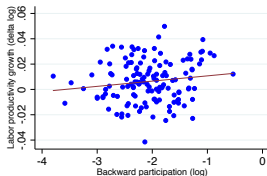
- Nordic countries (Denmark, Finland and Sweden) are more intangible intensive than Mediterranean economies (Italy and Spain).
- Non R&D intangibles more relevant than R&D in all sample economies.



Productivity, intangible capital and backward participation: all sample, 2000-2013

- Strong and positive correlation between labour productivity and intangible capital.
- Lower but positive correlation between the level of backward participation and labour productivity.
- How and to what extent this relationship depends on countries-industries intangible intensities?

Backward participation and Labor productivity growth and Intangible capital



- We explore the relationship between GVC participation, intangible capital and productivity growth in a production function framework including intangibles and augmented with a measure of participation (Kummritz, 2016).
- First we test the direct linkage between participation and productivity growth
- Then we evaluate the extent to which the productivity returns of participation are conditional on the intensity of intangible capital across countries-industries.
- The estimate is a difference-in-difference model a la Rajan and Zingales, (1998).

$$\Delta \ln(Y/H)_{c,i,t} = \alpha_1 \Delta \ln(K^J/H)_{c,i,t} + \alpha_2 \Delta \ln(K^I/H)_{c,i,t} + \alpha_3 \ln P_{c,i,t}^{GVC} \quad (1)$$

$$+ \alpha_4 \ln(K^I/H)_{c,i} + \alpha_5 \ln(K^I/H)_{c,i} * \ln P_{c,i,t}^{GVC} + \delta_t + \gamma_i + \epsilon$$

where:

- c=country, i=industries, t=time
- Y denotes value added adjusted to include intangible capital (as in Corrado, Hulten, and Sichel 2005, 2009)
- H is total hours worked, K^J is for J=ICT, NonICT capital, K^I is for I=Total intangible, Brand, Training, Design, R&D and Organizational capital;
- P^{GVC} is backward participation and δ_t and γ_i are time and industry dummies
- Estimates are generalized least squares (GLS) on data pooled across countries, industries and over time, controlling for industry and time fixed effects.
- Robustness checks include GMM estimates.

- Backward participation is positively correlated with productivity growth and correlation is strengthened by the conditional effect of intangibles, mainly NonR&D.

	(1)	(2)	(3)	(4)
VARIABLES	Production function	Production fcn augmented with t-2 backp(level)	Production fcn augmented with t-2 backp(level) and intang interaction	Production fcn augmented with t-2 backp(level) and intang Non R&D interaction
$\Delta \ln(K^I/H)$	0.204*** (0.017)	0.154*** (0.019)	0.142*** (0.019)	
$\Delta \ln(K^{CT}/H)$	0.032*** (0.008)	0.049*** (0.009)	0.041*** (0.010)	0.048*** (0.010)
$\Delta \ln(K^{NonICT}/H)$	0.176*** (0.020)	0.175*** (0.024)	0.176*** (0.025)	0.179*** (0.024)
$\Delta \ln(L/H)$	0.088*** (0.031)	0.109*** (0.037)	0.094** (0.039)	0.098*** (0.038)
$\ln(\text{BackP})_{t,2}$		0.005** (0.002)	0.022*** (0.007)	0.027*** (0.008)
$\ln(K^I/H)_{avg}$			0.010** (0.004)	
$\ln(K^I/H)_{avg} * \ln(\text{BackP})_{t,2}$			0.004** (0.002)	
$\Delta \ln(K^{RRD}/H)$				0.158*** (0.019)
$\ln(K^{RRD}/H)_{avg}$				0.010** (0.004)
$\ln(K^{RRD}/H)_{avg} * \ln(\text{BackP})_{t,2}$				0.005*** (0.002)
Observations	1,958	1,507	1,375	1,483
Number of ctrysec	142	126	115	124

Standard errors in parentheses

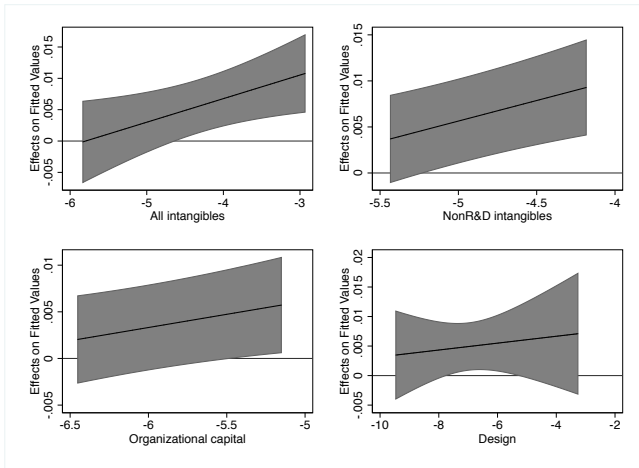
*** p<0.01, ** p<0.05, * p<0.1

- Among NonR&D intangibles, the complementarity between organizational capital and backward participation is significantly stronger

VARIABLES	(1)	(2)	(3)	(4)	(5)
$\Delta \ln(K^I/H)$	0.167*** (0.020)	0.184*** (0.020)	0.170*** (0.020)	0.184*** (0.020)	0.183*** (0.021)
$\Delta \ln(K^{CT}/H)$	0.043*** (0.009)	0.046*** (0.009)	0.045*** (0.009)	0.046*** (0.009)	0.046*** (0.009)
$\ln(\text{BackP})_{1,2}$	0.013** (0.006)	0.024*** (0.008)	0.020*** (0.007)	-0.004 (0.009)	0.017** (0.007)
$\ln(K^{\text{R\&D}}/H)_{\text{avg}}$	0.003 (0.003)				
$\ln(K^{\text{R\&D}}/H)_{\text{avg}} * \ln(\text{BackP})_{1,2}$	0.001 (0.001)				
$\ln(K^{\text{O\&C}}/H)_{\text{avg}}$		0.009*** (0.003)			
$\ln(K^{\text{O\&C}}/H)_{\text{avg}} * \ln(\text{BackP})_{1,2}$		0.003** (0.001)			
$\ln(K^T/H)_{\text{avg}}$			0.002 (0.003)		
$\ln(K^T/H)_{\text{avg}} * \ln(\text{BackP})_{1,2}$			0.002* (0.001)		
$\ln(K^P/H)_{\text{avg}}$				-0.002 (0.003)	
$\ln(K^P/H)_{\text{avg}} * \ln(\text{BackP})_{1,2}$				-0.001 (0.001)	
$\ln(K^{\text{D\&I}}/H)_{\text{avg}}$					0.005** (0.002)
$\ln(K^{\text{D\&I}}/H)_{\text{avg}} * \ln(\text{BackP})_{1,2}$					0.002* (0.001)
Observations	1,519	1,687	1,547	1,687	1,525
Number of ctrysec	127	141	141	141	139

Standard errors in parentheses

- The marginal effect of backward participation increases as the degree of intangible intensity increases.



- Backward participation and productivity growth are statistically and positively correlated
- Intangible capital intensity (Non R&D) amplifies the positive productivity returns of backward participation
- The conditional effect of Organizational capital looks stronger.
- Our analysis is a first attempt at bridging two streams of literature by investigating whether intangible capital contributes to foster countries' capability to appropriate value added along the supply chain.
- Overall, our findings are broadly consistent (and complementary) with the growing literature showing the key role of intangible investment as a main driver of productivity growth (Corrado et al. 2009, 2013) and GVC upgrading (OECD, 2013).

- Next steps of our analysis include:
 - Test different measures of GVC participation (Timmer et al 2013)
 - Explore complementarities with ICT and skills
 - Evaluate complementarities between different intangible assets and different modes of participation (backward and forward)