Quality upgrading and firms' position in global value chains

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INRAE science for people, life & earth

BATModel better agri-food trade modelling for policy analysis

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Workshop "GVCs and Quality"

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Motivation

- **Product quality** plays an important role in explaining **international trade patterns**:
  - Higher income countries and more productive firms export higher quality goods (Schott, 2004; Hummels and Klenow, 2005; Baldwin and Harrigan, 2011; Fajgelbaum et al., 2011)
  - Quality upgrading permits firms to increase their export performance (Crozet et al. 2012)

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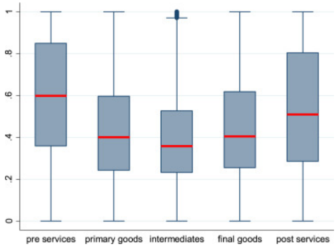
- **GVCs** have transformed international trade
  - Production processes are highly fragmented across country borders
  - An increasing number of firms organize production on a global scale
  - A higher content of imported inputs in exports and of services in manufacturing
    $\approx$ 45% of global trade in agricultural and food products goes to intermediate consumption
  - A reorganization (reshoring, regionalization, friendshoring) of GVCs since 2020

Motivation

- How firms **position in GVCs**?
  - Upper and lower ends of the value chain provide higher value added and profit margins (the *smile curve*: Mudambi, 2008; Rungi and del Prete, 2018; Baldwin and Ito, 2021)



Value added content as share of value added on sales.
Source: Fig. 1 from Rungi and del Prete, 2018

  - More productive firms internalize a larger span of production stages (Chor et al., 2021)

    ⇒ Chinese firms have increased their participation in GVCs by integrating more upstream stages.

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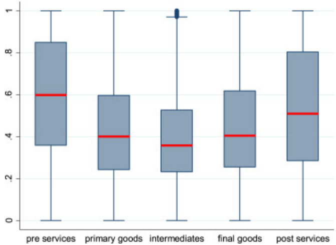

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  - More productive firms internalize a larger span of production stages (Chor et al., 2021)
    $\Rightarrow$ Chinese firms have increased their participation in GVCs by integrating more upstream stages.

- How **quality** affects **boundary choices** of firms involved in GVCs?

Outline of the presentation

Question: How product **quality** affects **boundary choices** of firms involved in GVCs?

1. Hypotheses
2. Theoretical model
3. Main prediction: effect of quality upgrading
4. Data
   - ★ Data sources
   - ★ Upstreamness / position in GVC
   - ★ Quality
5. Test main prediction: OLS, IV, different quality measures
6. Test other predictions
7. Conclusion

Main hypotheses

H1: Participation to GVCs = firm's joint involvement in import and export activities (Baldwin and Yan, 2014; Antras, 2020)

⇒ We focus on firms in GVCs, i.e. that both import and export in a given year.

H2: Firms' **imports** and **exports** reflect their **purchases** and **outputs** in terms of product composition

⇒ Imports (from all sources) ∼ firm's input purchases
⇒ Exports (to all destinations) ∼ firm's sales of produced output

We disregard the origin and destination of products and focus on the global market.

H3: Position in the chain = the level of transformation (processing) of goods used and produced by the firm.

(Fally, 2012; Antras et al., 2012; Antras and Chor, 2013)

⇒ Input-Output table data to identify the level of transformation of each industry

H4: More upstream products are traded at **lower prices**

H5: Quality is **costly** and **appreciated** by consumers

Model

- Consumers value quality (λ) and maximize a CES utility function over available varieties Ω_υ:

$$\Upsilon = \left(\int_{\Omega_\upsilon} [\lambda(\upsilon) q(\upsilon)]^{\frac{\varepsilon - 1}{\varepsilon}} \right)^{\frac{\varepsilon}{\varepsilon - 1}}$$

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- Production of each variety υ requires the completion of a continuum of tasks u, indexed by their remoteness from final demand (upstreamness), using a CES aggregator:

$$q = \theta \left(\int_{U^X}^{U^M} x(u)^{\frac{\sigma-1}{\sigma}} du + q_M^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\rho\sigma}{\sigma-1}}$$

θ – firm productivity
ρ – decreasing returns to scale

Production/value chain

∞ ——— U^M ——— U^X ——— 1

inputs purchased on the market	firm's in-house production	stages produced by other firms

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Producing higher-quality goods is harder ($0 \leq \gamma < 1$), Hallak and Sivadasan (2013) and incurs fixed costs λ^{α}.

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- Firms choose the quantity (q_M, $x(u)$) and processing level (U^M, U^X) of inputs they purchase and produce in-house, and the quality of output (λ) that maximize their profits:

$$\pi = pq - \left(p_M q_M + \int_{U^X}^{U^M} [c(u)x(u) + F(u)] \, du + \lambda^\alpha \right)$$

Mechanisms at work

- Demand effect: quality upgrading permits to charge a higher price: $\frac{dp}{d\lambda} > 0$

  $\Rightarrow$ a higher demand $\Rightarrow$ higher firm revenues: $\frac{d(pq)}{d\lambda} > 0$

- Cost effect: producing higher quality is binding and lowers market share:

  $\Rightarrow$ adverse selection towards low-quality varieties: $\frac{d(pq)}{d\lambda} < 0$

  $\Rightarrow$ requires more inputs: $\frac{dq_M}{d\lambda} > 0$, $\frac{dx(u)}{d\lambda} > 0$

  $\Rightarrow$ higher fixed costs: $\frac{d(F(u)+\lambda^{\alpha})}{d\lambda} > 0$

  $\Rightarrow$ higher marginal costs: $\frac{d(c(u)x(u))}{d\lambda} > 0$

- Ambiguous overall effect on profits: $\frac{d\pi}{d\lambda} \gtrless 0$

Model predictions

Under reasonable assumptions:

- it is profitable to increase production in order to match a higher demand: $\rho > \frac{\sigma-1}{\sigma}$
- difference in the cost of inputs if purchased or produced in-house: $\frac{c(U^M)x(U^M)}{p_M q_M}$ and $\frac{F_M}{p_M q_M}$ are sufficiently small

1. Quality upgrading ($\lambda \uparrow$) determines firms to:

   – purchase more upstream (less processed) inputs: $\frac{dU^M}{d\lambda} > 0$

   – produce more downstream (more processed) goods: $\frac{dU^X}{d\lambda} < 0$

   $\Rightarrow$ perform in house a larger span of production stages: $\frac{d\left(U^M - U^X\right)}{d\lambda} > 0$

$$\underbrace{\infty \;\_\_\_\_\_\_\_\_\_\_\_\_\_\_}_{\text{inputs purchased on the market}} \; \overset{\curvearrowleft}{U^M} \; \underbrace{\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_}_{\text{firm's in-house production}} \; \overset{\curvearrowright}{U^X} \; \underbrace{\_\_\_\_\_\_\_\_\_\_ \; 1}_{\text{stages produced by other firms}}$$

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2. Quality upgrading $(\lambda \uparrow)$ and a larger span of in-house produced stages $\left(U^M - U^X \uparrow\right)$ leads to:

   – an increase in variable & fixed costs, input purchases, and value added;

   – an ambiguous effect on profits

Data

Necessary data (firm level):

- upstreamness ($\neg$ transformation) of purchased inputs and produced goods
- quality of produced goods
- firm level controls

Employed data:

▷ on French agri-food firms, 2004–2017

AMADEUS	turnover, # employees, ... , economic activity (NACE code)
	productivity = turnover per employee
	size class: small, medium, large
French customs	product-level bilateral imports and exports (q and p)
Sample:	4,595 importing $\bigcap$ 5,068 exporting = 3,111 firms in GVCs Exclusion of re-exports at 8-digit CN8 level

▷ US input-output table (BEA), 2012

+ US/French industry correspondences
+ for multiple correspondences, assume equal weights for all industry pairs

⇒ an input-output table at the level of French industries

405 US industries (42 agrifood) $\longrightarrow$ 604 NACE industries (88 agrifood) NACE I-O table

Upstreamness and position in GVC

- Follow Fally (2012), Antràs et al. (2012), Antràs and Chor (2013)

- Industry upstreamness = weighted average of the number of production stages from final demand for which the industry provides inputs:

$$\boldsymbol{U_r} = 1 \cdot \frac{F_r}{Y_r} + 2 \cdot \frac{\sum_s b_{rs} F_s}{Y_r} + 3 \cdot \frac{\sum_s \sum_k b_{rk} b_{ks} F_s}{Y_r} + \ldots \qquad \in [\mathbf{1}, \boldsymbol{\infty}]$$

F_r, Y_r, and b_{rs} from a highly disaggregated input-output table

high $\boldsymbol{U_r}$: close to production factors; **low $\boldsymbol{U_r}$**: close to final demand

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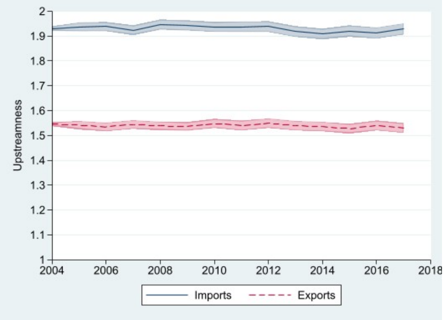
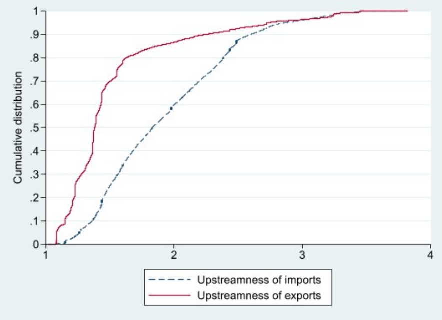
- Firm-level upstreamness: combine industry-level upstreamness with the product composition of firm's imports and exports

Upstreamness of imports:	$U_f^M = \sum_r \frac{M_{fr}}{M_f} U_r$	purchased inputs
Upstreamness of exports:	$U_f^X = \sum_r \frac{X_{fr}}{X_f} U_r$	produced output
Position in GVC:	$GVC_f = U_f^M - U_f^X$	span of in-house production stages

NACE industry	Upstreamness
Seed processing for propagation	3.61
Growing of cereals (except rice), leguminous crops and oil seeds	3.45
Raising of dairy cattle	2.98
Manufacture of oils and fats	2.72
Manufacture of starches and starch products	2.16
Processing of tea and coffee	1.47
Processing and preserving of meat	1.44
Manufacture of wine from grape	1.23
Manufacture of prepared meals and dishes	1.20
Manufacture of bread; manufacture of fresh pastry goods and cakes	1.10
Retail sale of bread, cakes, flour confectionery and sugar confectionery in specialised stores	1.01
Retail sale of fruit and vegetables in specialised stores	1.01



(a) Sector-level average



(b) Cumulative distribution of French firms

Quality of produced goods

- Trade literature: quality is identified relative to other firms for each product $\times$ destination.

  Khandelwal et al. (2013): at the same price, higher quality products face higher demand

$$\ln q_{fkj} + \varepsilon_k \ln p_{fkj} = \mathrm{FE}_{jkt} + e_{fkj} \qquad \Rightarrow \qquad \ln \widehat{\lambda}_{fkj} = \frac{\widehat{e}_{fkj}}{\varepsilon_k - 1}$$

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- Obtain firm-level quality by combining results across all products and destinations

  $\Rightarrow$ **Cumulative distribution** of estimated quality $\widehat{\lambda}_{fkj}$, obtained with ε_k from Ossa (2015)

  $F_{fkj} = Pr\left(\lambda \leq \widehat{\lambda}_{fkj}\right)$ the share of firms with lower quality than firm f

  $\widehat{\mathbf{Q}}_f = \max_{kj}\left(F_{fkj}\right)$ f's top-quality product ($0 < \widehat{\mathbf{Q}}_f \leq 1$) $\widehat{\mathbf{Q}}_f \uparrow =$ quality upgrading

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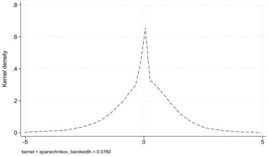
	Mean	StdDev	Median
$\ln \widehat{\lambda}_{fkj}$	0.003	1.284	0.000
F_{fkj}	0.605	0.303	0.614
$\widehat{\mathbf{Q}}_f$	0.860	0.230	1

$\widehat{\lambda}_{fkj}$



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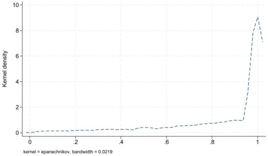


Empirical strategy

- **Test model prediction 1**

$$\{U^M_{ft},\ U^X_{ft},\ U^M_{ft} - U^X_{ft}\} = \beta + \delta\, \widehat{\mathbf{Q}}_{ft} + \Lambda\, \text{Controls}_{f,t-1} + FE_f + FE_{rt} + u_{ft}$$

$\widehat{\mathbf{Q}}_{ft}$	–	measure of product quality
U^M_{ft} (U^X_{ft})	=	*upstreamness* of imports (exports) of firms
$U^M_{ft} - U^X_{ft}$	=	Intensity of GVC participation
Controls$_{f,t\text{-}1}$	=	time-varying firm characteristics (productivity and size group)
FE_f	–	firm fixed effects
$FE_r t$	–	industry-by-year dummies (firm's main activity NACE Rev.2 4-digit)
u_{fjt}	–	error term

  - Reverse causality: endogeneity of quality
    - ⇒ Instrument: the change in foreign demand for firms' products.

$$Inst_{ft} = \ln\left(X_{f,t-1}\left(1 + \sum_{j\neq\text{France},k} \frac{X_{fjk,0}}{X_{f,0}} \cdot \frac{X_{\text{RoW},jkt} - X_{\text{RoW},jk,t-1}}{X_{\text{RoW},jk,t-1}}\right)\right)$$

  - OLS estimates and IV regressions

- **Test model predictions 2.1 and 2.2**

$$\Theta_{ft} = \beta + \delta\, \{\widehat{\mathbf{Q}}_{ft}, U^M_{ft},\ U^X_{ft},\ U^M_{ft} - U^X_{ft}\} + \Lambda\, \text{Controls}_{ft} + FE_f + FE_{rt} + u_{ft}$$

Θ_{ft} – log of raw material purchases, wage bill, value added and profits

  - OLS estimates

Test the model prediction 1: Quality $\uparrow \Rightarrow U^M \uparrow, U^X \downarrow, GVC \uparrow$

Table: Test of model predictions – Quality and firms' position in GVCs

Sample	OLS			IV			
	(1)	(2)	(3)	1st Stage (4)	(5)	(6)	(7)
	(U^M_{ft})	(U^X_{ft})	$(U^M_{ft} - U^X_{ft})$	Quality_{ft}	(U^M_{ft})	(U^X_{ft})	$(U^M_{ft} - U^X_{ft})$
Instrument_{ft}				0.0147***			
				(0.0021)			
Quality_{ft}	0.0448*	-0.0722**	0.1170***		0.2784	-0.8690***	1.1474***
	(0.0233)	(0.0338)	(0.0420)		(0.1906)	(0.2661)	(0.3320)
$\ln \text{Productivity}_{f,t-1}$	0.0128	-0.0209*	0.0337*	0.0184**	0.0087	-0.0064	0.0150
	(0.0155)	(0.0114)	(0.0201)	(0.0079)	(0.0165)	(0.0149)	(0.0230)
Firm size:							
$\text{Small}_{f,t-1}$	reference	reference	reference	reference	reference	reference	reference
$\text{medium}_{f,t-1}$	0.0291	-0.0121	0.0412	0.0126	0.0223	-0.0087	0.0310
	(0.0324)	(0.0233)	(0.0401)	(0.0149)	(0.0337)	(0.0291)	(0.0455)
$\text{large}_{f,t-1}$	0.0657	-0.0024	0.0681	0.0264	0.0574	0.0197	0.0377
	(0.0488)	(0.0409)	(0.0564)	(0.0221)	(0.0511)	(0.0488)	(0.0648)
Fixed effects	firm, industry-year				firm, industry-year		
Observations	8,358	8,358	8,358	7,872	7,872	7,872	7,872
R^2	0.777	0.822	0.726	0.600	0.779	0.832	0.737
F-stat					50.1864	50.1864	50.1864
Endogeneity test					1.5431	10.4039***	11.1024***

⇒ High quality firms import more upstream inputs and export more transformed products, therefore are engaged in more production stages. The between component Omission of controls

⇒ Weak or non significant effect of productivity on firms' *upstreamness* and intensity of GVC participation. Productivity effect

Test prediction 2.1: Quality ↑ ⇒ firms' costs ↑, value added ↑, profits ↑↓

Table: Test of model predictions – Quality, input costs, value added and profits

Dep. variables:	Log Raw Inputs		Log Wagbill		Log Value added		Log Profits	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Quality_{ft}$	0.1526***	0.0976***	0.0540***	0.0310*	0.0613**	0.0155	-0.0133	0.0368
	(0.0336)	(0.0363)	(0.0195)	(0.0178)	(0.0260)	(0.0277)	(0.0677)	(0.0868)
ln $Productivity_{ft}$		0.6912***		0.0663		0.2926***		0.6832***
		(0.0732)		(0.0451)		(0.0488)		(0.0727)
Firm size:								
$Small_{ft}$		reference		reference		reference		reference
$medium_{ft}$		0.5923***		0.4289***		0.4268***		0.3581***
		(0.0533)		(0.0377)		(0.0445)		(0.0995)
$large_{ft}$		1.4593***		1.0908***		0.9594***		0.7308***
		(0.1624)		(0.1237)		(0.1188)		(0.2082)
Fixed effects	firm, industry-year							
Observations	13,423	8,722	13,431	8,778	12,835	8,402	10,789	6,900
R^2	0.959	0.971	0.970	0.980	0.959	0.965	0.851	0.861

⇒ High quality firms increase total costs and value added mainly through scaling up of firms' operations.

⇒ Non-significant relationship between quality and profits: "demand effect" and "cost effect" offeset each other

⇒ The between component of the effect of quality on firm's attributes is stronger, even in the profit regression which become significantly positive. Between effect

Test prediction 2.2: $GVC \uparrow \Rightarrow$ firms' costs $\uparrow$, value added $\uparrow$, profits $\uparrow\downarrow$

Table: Firms' position in GVCs, input costs, value added and profits – The *within* effect

Dep. variables:	Log Raw Inputs		Log Wagbill		Log Value added		Log Profits	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$(U^M_{ft} - U^X_{ft})$	0.0214	0.0108	0.0060	0.0027	0.0106	0.0014	0.0153	0.0068
	(0.0132)	(0.0124)	(0.0119)	(0.0092)	(0.0129)	(0.0124)	(0.0285)	(0.0345)
ln Productivity$_{ft}$		0.6915***		0.0690		0.2981***		0.6730***
		(0.0719)		(0.0442)		(0.0480)		(0.0714)
Firm size:								
Small$_{ft}$		reference		reference		reference		reference
medium$_{ft}$		0.5813***		0.4170***		0.4197***		0.3569***
		(0.0520)		(0.0370)		(0.0432)		(0.0967)
large$_{ft}$		1.4460***		1.0780***		0.9522***		0.7306***
		(0.1627)		(0.1236)		(0.1185)		(0.2069)
Fixed effects	firm, industry-year							
Observations	13,956	8,983	13,967	9,043	13,349	8,662	11,224	7,106
R^2	0.960	0.971	0.970	0.981	0.959	0.965	0.848	0.861

⇒ No confirmation of model prediction 2.2 (the *within effect*)

⇒ However, confirmation mainly through scaling up of firms' operations with the *between* component . Between effect

Robust tests

- Infer quality measure by exploiting the trade elasticity parameters from Fontagné et al. (2022).

  ⇒ Similar results with elasticity parameters from Fontagné et al. (2022).
  Robust Prediction 1 Robust Prediction 2.1

- Alternative measures of quality

  Recall: $\ln \widehat{\lambda}_{fjk}$ - estimated quality of firm f output for product k sold in destination j

  ⇒ **Exports-weighted average quality**: Standardize $\ln \widehat{\lambda}_{fjk}$: $\Xi_{fjk} = \frac{\ln \widehat{\lambda}_{fjk} - \overline{\ln \widehat{\lambda}_{fjk}}}{SE\left[\ln \widehat{\lambda}_{fjk}\right]}$

  $$\widehat{\mathbf{Q1}}_f = \sum_{j,k} \frac{X_{fjk}}{X_f} \cdot \Xi_{fjk}$$

  ⇒ **Average** (standardized) value of **firm-level component** of estimated quality $\widehat{\lambda}_{fkj}$

  $$\ln q_{fkj} + \varepsilon_k \ln p_{fkj} = \mathrm{FE}_{jk} + \mathrm{FE}_f + e_{fkj} \quad \Rightarrow \quad \widehat{\mathbf{Q2}}_f = \frac{\widehat{\mathrm{FE}}_f - \overline{\widehat{\mathrm{FE}}_f}}{\mathrm{StdErr}\left(\widehat{\mathrm{FE}}_f\right)}$$

  $\widehat{\mathbf{Q2}}_f =$ the average standardized quality produced by firm (across product and destinations)

⇒ Similar results with alternative quality measures.
Robust Prediction 1 Robust Prediction 2.1

Conclusion

Question: How product **quality** affects **firms' position in GVCs**?

Approach and results:

- Extend Chor, Manova and Yu (2021) to include firms' decision on product quality

  Prediction 1: Quality ↑ $\Rightarrow$ a larger span of in-house production stages

  Prediction 2.1: Quality ↑ $\Rightarrow$ an increase in firms' costs and value-added
  ambiguous (no) effect on profits

  Prediction 2.2: Production stages ↑ $\Rightarrow$ an increase in firms' costs and value-added
  ambiguous (no) effect on profits

- Test predictions with data on French agri-food firms
- Reverse causality between quality and position in GVC
- Predictions confirmed by data with different quality measures
- More decisive role of quality than productivity in agri-food industry

What strategies for food processors firms and countries?

- How can the industrial policies of developed countries aimed at reconsidering global supply chain decisions towards more reshoring and regionalization be fostered?
- How does quality allow firms to be successful in GVCs?
- Promote high-quality production through optimal trade policies and individual and sectoral innovation.

Test the model prediction 1: The between component

Table: Quality and firms' position in GVCs – *The between effect*

Sample	OLS			IV			
	(1)	(2)	(3)	1st Stage (4)	(5)	(6)	(7)
	(U^M_{ft})	(U^X_{ft})	$(U^M_{ft} - U^X_{ft})$	Quality_{ft}	(U^M_{ft})	(U^X_{ft})	$(U^M_{ft} - U^X_{ft})$
Instrument_{ft}				0.0364***			
				(0.0015)			
Quality_{ft}	0.0436	-0.0811**	0.1247***		0.3214***	-0.4243***	0.7457***
	(0.0331)	(0.0351)	(0.0471)		(0.1145)	(0.0998)	(0.1467)
$\ln \text{Productivity}_{f,t-1}$	0.0322*	0.0446***	-0.0123	0.0016	0.0274	0.0546***	-0.0272
	(0.0165)	(0.0137)	(0.0189)	(0.0042)	(0.0173)	(0.0150)	(0.0199)
Firm size:							
$\text{Small}_{f,t-1}$	reference	reference	reference	reference	reference	reference	reference
$\text{medium}_{f,t-1}$	0.0191	0.0123	0.0068	0.0237***	0.0002	0.0416*	-0.0415
	(0.0218)	(0.0191)	(0.0265)	(0.0067)	(0.0237)	(0.0218)	(0.0303)
$\text{large}_{f,t-1}$	0.1039***	0.0300	0.0740*	0.0316***	0.0674*	0.0777**	-0.0102
	(0.0353)	(0.0292)	(0.0438)	(0.0093)	(0.0382)	(0.0318)	(0.0485)
Fixed effects		industry-year				industry-year	
Observations	8,834	8,834	8,834	8,306	8,306	8,306	8,306
R^2	0.222	0.421	0.152	0.277	0.213	0.426	0.167
F-stat					598.1634	598.1634	598.1634
Endogeneity test					7.2388***	15.1403***	22.8765***

Back

Test the model prediction 1: Without controls

Table: Quality and firms' position in GVCs

Sample	OLS			IV			
	(1)	(2)	(3)	1st Stage (4)	(5)	(6)	(7)
	(U^M_{ft})	(U^X_{ft})	$(U^M_{ft} - U^X_{ft})$	Quality_{ft}	(U^M_{ft})	(U^X_{ft})	$(U^M_{ft} - U^X_{ft})$
Sample	Panel A: Sample with observed controls only						
Instrument_{ft}				0.0164^{***} (0.0021)			
Quality_{ft}	0.0546^{**} (0.0236)	-0.0806^{**} (0.0324)	0.1352^{***} (0.0408)		0.3037^{*} (0.1821)	-0.9146^{***} (0.2419)	1.2182^{***} (0.2998)
Observations	8,803	8,803	8,803	8,183	8,183	8,183	8,183
R^2	0.773	0.813	0.714	0.612	0.771	0.828	0.726
F-stat					63.5697	63.5697	63.5697
Endogeneity test					2.0132	14.1762^{***}	15.6961^{***}
Sample	Panel B: Sample with observed and unobserved controls						
Instrument_{ft}				0.0167^{***} (0.0015)			
Quality_{ft}	0.0194 (0.0150)	-0.0481^{**} (0.0215)	0.0675^{**} (0.0265)		0.1343 (0.1233)	-0.7380^{***} (0.1598)	0.8723^{***} (0.1962)
Observations	18,204	18,204	18,204	16,710	16,710	16,710	16,710
R^2	0.745	0.792	0.685	0.588	0.742	0.809	0.697
F-stat					121.1356	121.1356	121.1356
Endogeneity test					0.9193	21.5429^{***}	19.1468^{***}
Fixed effects	firm, industry-year			firm, industry-year			
$\ln \text{Productivity}_{ft}$	N	N	N	N	N	N	N
Firm size	N	N	N	N	N	N	N

Back

Productivity effect: Productivity $\uparrow \Rightarrow U^M \uparrow, U^X \downarrow, GVC \uparrow$

Table: Productivity and firms' position in GVCs

Sample	OLS			IV			
	(1)	(2)	(3)	1st Stage (4)	(5)	(6)	(7)
	(U^M_{ft})	(U^X_{ft})	$(U^M_{ft} - U^X_{ft})$	Quality$_{ft}$	(U^M_{ft})	(U^X_{ft})	$(U^M_{ft} - U^X_{ft})$
Instrument$_{ft}$				0.0092*** (0.0035)			
ln Productivity$_{ft}$	0.0405** (0.0170)	-0.0142 (0.0115)	0.0547*** (0.0208)		0.6692* (0.3799)	-1.6613** (0.7672)	2.3304** (0.9982)
Firm size:							
Small$_{ft}$	reference	reference	reference	reference	reference	reference	reference
medium$_{ft}$	0.0698** (0.0276)	-0.0028 (0.0208)	0.0727** (0.0361)	-0.4329*** (0.0615)	0.3250* (0.1722)	-0.7098** (0.3565)	1.0348** (0.4668)
large$_{ft}$	0.0933* (0.0488)	0.0231 (0.0382)	0.0702 (0.0605)	-0.6849*** (0.1573)	0.5044* (0.2826)	-1.0992* (0.6241)	1.6037** (0.8153)
Fixed effects	firm, industry-year				firm, industry-year		
Observations	9,068	9,068	9,068	8,416	8,416	8,416	8,416
R^2	0.772	0.812	0.716	0.911	0.770	0.829	0.728
F-stat					6.9958	6.9958	6.9958
Endogeneity test					4.1260**	17.2461***	21.3290***

⇒ High productivity firms perform in-house a larger span of production stages (CMY 2021).

⇒ However, more decisive role of higher quality than productivity . Back

Test prediction 2.1: The between component

Table: Quality, input costs, value added and profits – Cross-firm specification

Dep. variables:	Log Raw Inputs		Log Wagbill		Log Value added		Log Profits	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Quality_{ft}	1.8792***	0.2939***	1.6970***	0.3843***	1.7169***	0.3953***	2.1243***	0.6702***
	(0.1073)	(0.0601)	(0.0999)	(0.0635)	(0.1044)	(0.0741)	(0.1474)	(0.1415)
$\ln \text{Productivity}_{ft}$		1.1525***		0.1941***		0.4134***		0.8515***
		(0.0273)		(0.0238)		(0.0321)		(0.0722)
Firm size:								
Small_{ft}		reference		reference		reference		reference
medium_{ft}		1.7941***		1.7733***		1.6698***		1.5351***
		(0.0376)		(0.0354)		(0.0389)		(0.0702)
large_{ft}		3.6937***		3.9045***		3.8354***		4.0293***
		(0.0607)		(0.0763)		(0.0869)		(0.1638)
Fixed effects				industry-year				
Observations	13,934	9,179	13,929	9,234	13,290	8,831	11,327	7,411
R^2	0.232	0.815	0.172	0.767	0.170	0.740	0.155	0.523

⇒ The effect of quality on firm's attributes is stronger, even in the profit regression which become significantly positive. Back

Test prediction 2.2: The between component

Table: Firms' position in GVCs, input costs, value added and profits – The *between* effect

Dep. variables:	Log Raw Inputs		Log Wagbill		Log Value added		Log Profits	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$(U^M_{ft} - U^X_{ft})$	0.1134**	0.0300	0.1333***	0.0112	0.1066**	-0.0021	-0.0215	-0.0821
	(0.0522)	(0.0264)	(0.0472)	(0.0247)	(0.0479)	(0.0266)	(0.0635)	(0.0530)
ln Productivity$_{ft}$		1.1638***		0.2086***		0.4318***		0.8867***
		(0.0269)		(0.0240)		(0.0321)		(0.0716)
Firm size:								
Small$_{ft}$		reference		reference		reference		reference
medium$_{ft}$		1.8215***		1.8109***		1.7127***		1.6280***
		(0.0370)		(0.0358)		(0.0394)		(0.0712)
large$_{ft}$		3.7431***		3.9699***		3.9044***		4.1718***
		(0.0599)		(0.0731)		(0.0831)		(0.1595)
Fixed effects	industry-year							
Observations	14,466	9,446	14,462	9,505	13,801	9,092	11,770	7,618
R^2	0.172	0.813	0.111	0.762	0.102	0.736	0.092	0.518

⇒ Weak confirmation mainly through scaling up of firms' operations with the *between* component. Back

Robustness of Prediction 1: Elasticity from Fontagné et al. (2022)

Table: Quality and firms' position in GVCs – Estimated quality using elasticities from Fontagné et al. (2022)

Sample	OLS			IV			
	(1)	(2)	(3)	1st Stage	(1)	(2)	(3)
	(U^M_{ft})	(U^X_{ft})	$(U^M_{ft} - U^X_{ft})$	Quality$_{ft}$	(U^M_{ft})	(U^X_{ft})	$(U^M_{ft} - U^X_{ft})$
Instrument$_{ft}$				0.0136***			
				(0.0020)			
Quality$_{ft}$	0.0182	-0.0728**	0.0910**		0.3046	-0.9781***	1.2828***
	(0.0241)	(0.0323)	(0.0410)		(0.2063)	(0.2922)	(0.3645)
ln Productivity$_{f,t-1}$	0.0153	-0.0236**	0.0390*	0.0228***	0.0065	0.0004	0.0061
	(0.0159)	(0.0118)	(0.0206)	(0.0082)	(0.0170)	(0.0163)	(0.0246)
Firm size:							
Small$_{f,t-1}$	reference	reference	reference	reference	reference	reference	reference
medium$_{f,t-1}$	0.0314	-0.0053	0.0367	0.0182	0.0212	0.0057	0.0155
	(0.0328)	(0.0238)	(0.0411)	(0.0155)	(0.0346)	(0.0306)	(0.0480)
large$_{f,t-1}$	0.0684	0.0002	0.0682	0.0291	0.0554	0.0313	0.0241
	(0.0491)	(0.0406)	(0.0565)	(0.0216)	(0.0519)	(0.0468)	(0.0647)
Fixed effects	firm, industry-year			firm, industry-year			
Observations	8,271	8,271	8,271	7,813	7,813	7,813	7,813
R^2	0.777	0.823	0.726	0.608	0.779	0.833	0.737
F-stat					47.4342	47.4342	47.4342
Endogeneity test					2.1200	10.9452***	12.4967***

Back

Robustness of Prediction 1: Alternative measure of quality

Table: Quality and firms' position in GVCs –Alternative measure of quality

Sample	OLS			IV			
	(1)	(2)	(3)	1st Stage (4)	(5)	(6)	(7)
	(U^M_{ft})	(U^X_{ft})	$(U^M_{ft} - U^X_{ft})$	Quality$_{ft}$	(U^M_{ft})	(U^X_{ft})	$(U^M_{ft} - U^X_{ft})$
Quality$_{ft}$				Panel A: Weighted quality			
Instrument$_{ft}$				0.0604*** (0.0072)			
Quality$_{ft}$	-0.0031 (0.0070)	-0.0254** (0.0106)	0.0222* (0.0129)		0.0673 (0.0468)	-0.2051*** (0.0617)	0.2724*** (0.0778)
Observations	8,284	8,284	8,284	7,828	7,828	7,828	7,828
R^2	0.776	0.826	0.728	0.633	0.778	0.833	0.737
F-stat					70.5047	70.5047	70.5047
Endogeneity test					2.6551	9.4400***	11.6112***
Quality				Panel B: Average standardized quality			
Instrument$_{ft}$				0.0357*** (0.0079)			
Quality$_{ft}$	-0.0043 (0.0072)	-0.0174** (0.0079)	0.0132 (0.0112)		0.1197 (0.0875)	-0.3249*** (0.1049)	0.4446*** (0.1430)
Observations	7,150	7,150	7,150	6,968	6,968	6,968	6,968
R^2	0.769	0.851	0.736	0.650	0.772	0.853	0.740
F-stat					20.5186	20.5186	20.5186
Endogeneity test					2.1880	9.4775***	10.2720***
Fixed effects	firm, industry-year				firm, industry-year		
ln Productivity$_{f,t-1}$	Y	Y	Y	Y	Y	Y	Y
Firm size$_{f,t-1}$	Y	Y	Y	Y	Y	Y	Y

Back

Robustness of Prediction 2.1: Elasticity from Fontagné et al. (2022)

Table: Quality, input costs, value added and profits – Estimated quality using elasticities from Fontagné et al. (2022)

Dep. variables:	Log Raw Inputs		Log Wagbill		Log Value added		Log Profits	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Quality_{ft}$	0.1235***	0.0816**	0.0735***	0.0450***	0.0504**	0.0299	0.0081	0.0367
	(0.0334)	(0.0369)	(0.0216)	(0.0167)	(0.0242)	(0.0262)	(0.0641)	(0.0815)
ln $Productivity_{ft}$		0.6895***		0.0675		0.2938***		0.6684***
		(0.0732)		(0.0452)		(0.0487)		(0.0721)
Firm size:								
$Small_{ft}$		reference		reference		reference		reference
$medium_{ft}$		0.5961***		0.4268***		0.4239***		0.3568***
		(0.0540)		(0.0379)		(0.0446)		(0.1010)
$large_{ft}$		1.4526***		1.0861***		0.9553***		0.6979***
		(0.1601)		(0.1252)		(0.1204)		(0.2100)
Fixed effects				firm, industry-year				
Observations	13,247	8,637	13,257	8,695	12,683	8,327	10,653	6,836
R^2	0.959	0.971	0.972	0.981	0.959	0.965	0.851	0.862

Back

Robustness of Prediction 2.1: Alternative measure of quality

Table: Quality, input costs, value added and profits – Alternative measures of quality

Dep. variables:	Log Raw Inputs		Log Wagbill		Log Value added		Log Profits	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Quality	Panel A: Weighted quality							
Quality_{ft}	0.0483***	0.0311***	0.0145*	0.0114*	0.0155**	0.0050	0.0327	0.0452*
	(0.0111)	(0.0108)	(0.0075)	(0.0058)	(0.0072)	(0.0087)	(0.0201)	(0.0250)
Observations	13,309	8,652	13,320	8,709	12,734	8,340	10,697	6,843
R^2	0.959	0.971	0.970	0.981	0.959	0.965	0.851	0.863
Quality	Panel B: Average standardized quality							
Quality_{ft}	0.0139	0.0101	0.0017	0.0006	-0.0034	-0.0112	0.0470**	0.0341
	(0.0127)	(0.0095)	(0.0063)	(0.0059)	(0.0073)	(0.0088)	(0.0202)	(0.0250)
Observations	11,252	7,430	11,271	7,474	10,861	7,193	9,101	5,940
R^2	0.961	0.973	0.974	0.980	0.959	0.966	0.853	0.866
Fixed effects	firm, industry-year							
ln Productivity_{ft}	N	Y	N	Y	N	Y	N	Y
Firm size	N	Y	N	Y	N	Y	N	Y

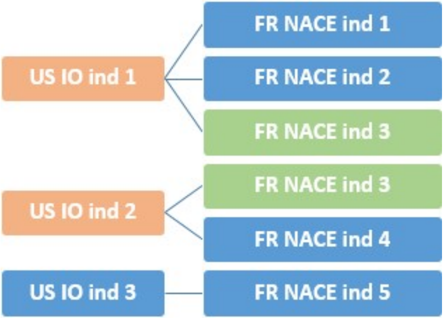
Back

Build a detailed input-output table for France

French input-output table: 37 industries; US input-output table: 405 industries (BEA)
$\Longrightarrow$ an input-output table with 604 NACE industries (88 agrifood)

		Used inputs and value added			Final use	Total use
		US IO ind 1	US IO ind 2	US IO ind 3		
Supply of intermediate inputs	US IO ind 1	a_{11}	a_{12}	a_{13}	F_1	Y_1
	US IO ind 2	a_{21}	a_{22}	a_{13}	F_2	Y_2
	US IO ind 3	a_{31}	a_{21}	a_{33}	F_3	Y_3
Value added		VA_1	VA_2	VA_3		
Total output		Y_1	Y_2	Y_3		

(a) US input-output table



(b) Multiple industry correspondences

Figure: US input-output table structure and correspondences with NACE Rev.2

Build a detailed input-output table for France

		US IO ind 1			US IO ind 2		US IO ind 3
		FR NACE ind 1	FR NACE ind 2	FR NACE ind 3	FR NACE ind 3	FR NACE ind 4	FR NACE ind 5
US IO ind 1	FR NACE ind 1	$\frac{1}{9}a_{11}$	$\frac{1}{9}a_{11}$	$\frac{1}{9}a_{11}$	$\frac{1}{6}a_{12}$	$\frac{1}{6}a_{12}$	$\frac{1}{3}a_{13}$
	FR NACE ind 2	$\frac{1}{9}a_{11}$	$\frac{1}{9}a_{11}$	$\frac{1}{9}a_{11}$	$\frac{1}{6}a_{12}$	$\frac{1}{6}a_{12}$	$\frac{1}{3}a_{13}$
	FR NACE ind 3	$\frac{1}{9}a_{11}$	$\frac{1}{9}a_{11}$	$\frac{1}{9}a_{11}$	$\frac{1}{6}a_{12}$	$\frac{1}{6}a_{12}$	$\frac{1}{3}a_{13}$
US IO ind 2	FR NACE ind 3	$\frac{1}{6}a_{21}$	$\frac{1}{6}a_{21}$	$\frac{1}{6}a_{21}$	$\frac{1}{4}a_{22}$	$\frac{1}{4}a_{22}$	$\frac{1}{2}a_{13}$
	FR NACE ind 4	$\frac{1}{6}a_{21}$	$\frac{1}{6}a_{21}$	$\frac{1}{6}a_{21}$	$\frac{1}{4}a_{22}$	$\frac{1}{4}a_{22}$	$\frac{1}{2}a_{13}$
US IO ind 3	FR NACE ind 5	$\frac{1}{3}a_{31}$	$\frac{1}{3}a_{31}$	$\frac{1}{3}a_{31}$	$\frac{1}{2}a_{21}$	$\frac{1}{2}a_{21}$	a_{33}

Figure: Equal weights for all correspondences within each pair of industry codes

Build a detailed input-output table for France

	FR NACE ind 1	FR NACE ind 2	FR NACE ind 3	FR NACE ind 4	FR NACE ind 5
FR NACE ind 1	$b_{11} = \frac{1}{9} a_{11}$	$b_{12} = \frac{1}{9} a_{11}$	$b_{13} = \frac{1}{9} a_{11} + \frac{1}{6} a_{12}$	$b_{14} = \frac{1}{6} a_{12}$	$b_{15} = \frac{1}{3} a_{13}$
FR NACE ind 2	$b_{21} = \frac{1}{9} a_{11}$	$b_{22} = \frac{1}{9} a_{11}$	$b_{23} = \frac{1}{9} a_{11} + \frac{1}{6} a_{12}$	$b_{24} = \frac{1}{6} a_{12}$	$b_{25} = \frac{1}{3} a_{13}$
FR NACE ind 3	$b_{31} = \frac{1}{9} a_{11} + \frac{1}{6} a_{21}$	$b_{32} = \frac{1}{9} a_{11} + \frac{1}{6} a_{12}$	$b_{33} = \frac{1}{9} a_{11} + \frac{1}{6} a_{12} + \frac{1}{6} a_{21} + \frac{1}{4} a_{22}$	$b_{34} = \frac{1}{6} a_{12} + \frac{1}{4} a_{22}$	$b_{35} = \frac{1}{3} a_{13} + \frac{1}{2} a_{13}$
FR NACE ind 4	$b_{41} = \frac{1}{6} a_{21}$	$b_{42} = \frac{1}{6} a_{21}$	$b_{43} = \frac{1}{6} a_{21} + \frac{1}{4} a_{22}$	$b_{44} = \frac{1}{4} a_{22}$	$b_{45} = \frac{1}{2} a_{13}$
FR NACE ind 5	$b_{51} = \frac{1}{3} a_{31}$	$b_{52} = \frac{1}{3} a_{31}$	$b_{53} = \frac{1}{3} a_{31} + \frac{1}{2} a_{21}$	$b_{54} = \frac{1}{2} a_{21}$	$b_{55} = a_{33}$

Figure: Group weights across NACE industries

back

Industry upstreamness

NACE industry	Upstreamness
Seed processing for propagation	3.61
Growing of cereals (except rice), leguminous crops and oil seeds	3.45
Raising of dairy cattle	2.98
Manufacture of oils and fats	2.72
Manufacture of starches and starch products	2.16
Raising of swine/pigs	2.10
Marine fishing	1.66
Processing and preserving of fish, crustaceans and molluscs	1.60
Manufacture of fruit and vegetable juice	1.47
Processing of tea and coffee	1.47
Growing of pome fruits and stone fruits	1.46
Processing and preserving of meat	1.44
Manufacture of cocoa, chocolate and sugar confectionery	1.39
Growing of vegetables and melons, roots and tubers	1.28
Manufacture of wine from grape	1.23
Manufacture of prepared meals and dishes	1.20
Manufacture of bread; manufacture of fresh pastry goods and cakes	1.10
Manufacture of rusks and biscuits; manufacture of preserved pastry goods and cakes	1.08
Retail sale of bread, cakes, flour confectionery and sugar confectionery in specialised	1.01
Retail sale of meat and meat products in specialised stores	1.01
Retail sale of fruit and vegetables in specialised stores	1.01

Decomposition of sector-level upstreamness

$$\Delta U_t^M = \sum_{f \in \Xi_t^M} \frac{M_{ft}}{M_t} \cdot U_{ft}^M - \sum_{f \in \Psi_t^M} \frac{M_{f,t-1}}{M_{t-1}} \cdot U_{f,t-1}^M + \sum_{f \in \Gamma_t^M} \frac{M_{f,t-1}}{M_{t-1}} \cdot \Delta U_{ft}^M + \sum_{f \in \Gamma_t^M} \Delta \frac{M_{ft}}{M_t} \cdot U_{ft}^M$$

$$\Delta U_t^X = \underbrace{\underbrace{\sum_{f \in \Xi_t^X} \frac{X_{ft}}{X_t} \cdot U_{ft}^X}_{\text{starting firms}} - \underbrace{\sum_{f \in \Psi_t^X} \frac{X_{f,t-1}}{X_{t-1}} \cdot U_{f,t-1}^X}_{\text{stopping firms}}}_{\text{extensive margin}} + \underbrace{\underbrace{\sum_{f \in \Gamma_t^X} \frac{X_{f,t-1}}{X_{t-1}} \cdot \Delta U_{ft}^X}_{\Delta\text{upstreamness}} + \underbrace{\sum_{f \in \Gamma_t^X} \Delta \frac{X_{ft}}{X_t} \cdot U_{ft}^X}_{\Delta\text{mkt share}}}_{\text{intensive margin}}$$

	Extensive margin			Intensive margin (incumbent)			Overall
	Starting firms	Stopping firms	Net effect	change in firm's upstreamness	change in firm's mkt share	Net effect	
ΔU_t^M	0,2474	-0,0828	0.1646	0.1034	-0.3181	-0.2147	-0.0501
ΔU_t^X	0.2215	-0.1461	0.0754	0.2497	-0.3521	-0.1024	-0.0270
$\Delta U_t^M - \Delta U_t^X$	0.0259	0.0633	0.0892	-0.1463	0.0340	-0.1123	-0.0231

$\Rightarrow$ Annual changes in sector-level upstreamness explained mainly by the extensive margin (firms that start/stop exporting/importing) and changes in firms' market shares.

$\Rightarrow$ Small changes in firms' upstreamness.

back