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Import Penetration, Intermediate Inputs and Firms' Productivity in the EU Food Industry

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Objective and research questions

- To study the effect of **import competition** on **productivity** at firm's level
- By focusing on both industry and **upstream** sectors import competition

Three main research questions

1. Is the role of imports in intermediate inputs a source of productivity growth ?
2. Is there any prevalent effect between industry and upstream import competitions?
3. Are these effects conditional to the (initial) level of firms' productivity ?

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Outline

- **Motivations**
- Data and empirical strategy
- Main results
- Conclusions and implications

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Motivations

Why focusing on imported intermediate inputs ?

- First, **trade in intermediate** inputs key feature of current waves of globalization (e.g. Hummels et al. 2014)
- Endogenous growth theory → **foreign inputs** enhance **efficiency gains** at the aggregate level (Romer 1987)
- At **firm-level** productivity gains are realized through (Ethier, 1982; Markusen, 1989; Grossman and Helpman, 1991)
  - lower input **prices**
  - better **complementarities** of inputs
  - access to higher **quality** inputs
  - access to new **technologies** embodied in imported varieties (and capital goods)

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Motivations

Evidence

Micro-level evidence (largely on **developing** countries), confirmed that **imported inputs** lead to

- An increase in firms' **productivity growth** (e.g. Amiti and Konings 2007; Topalova and Khandelwal 2011, …)
- An increase in the number of **new domestic products** (e.g. Goldberg et al. 2010; Colantone and Crinò, 2014)
- An increase in the probability of firms' entry in the **export** market (Bas and Strauss-Kahn 2011; Chevassus et al. 2014).

To date only **Chevassus et al.** (2014) studied the effects of **upstream** trade liberalization on food firms' performances,…

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Motivations

One reason for this is data problem

1. EU **Input-Output** tables available at only 2-digit, …
2. The **structure of** intermediate firms' consumption is lacking in the majority of micro-data

- This forces the researcher to adopt **ad hoc solutions**
  - Chevassus et al. **combine trade and firm level data** to measure imported inputs used by a firm belonging to each NACE 4-digit
- However this approach presents some limitations:
  - Firm' **intermediate consumption structure** is based on the level of imports and not on the **true** Input-Output industry relationships
  - Moreover **it assumes** that all firms imports, in a given NACE 4-digit, are truly inputs used in the same industry

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Motivations

This paper Uses 2007 **US Input-Output** table (6-digit level) to measure a consistent index of **upstream** (or vertical) import penetration (Acemoglu et al. 2014; Altomonte et al. 2014)

- Key assumption: **comparability** between US and EU **technology** in the food processing industry
- Many other papers made the same assumption (e.g. Levchenko, 2007; Nunn, 2007)
  - **Basic presumption**: No matter where goods are produced they still require the same inputs and in the same proportions
- Potential **attenuation biases** in the estimation of **β** (Ciccone and Papaioannau, 2007)
- If this assumption holds, this strategy offers a relatively simple and **more consistent** solution than previous *ad hoc* approaches

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Motivations

Using **import penetration** instead of **tariffs** we depart from some previous papers (e.g. Chevassus et al.)

- In the **EU**, the use of a positive trade integration index like ***IP*** offers several advantages:
  - Differentiate foreign competition by (country) **origins**;
  - Take into account also for the **NTB** effects;
  - Finally, in the EU firms are primarily affected by import competition **coming from other EU countries**, thus using tariffs we **omit** from the analysis a large piece of reality.

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- **Data and empirical strategy**
- Main results
- Conclusions and implications

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Data and empirical strategy

Data

- **TFP**: Amadeus data on more than 20,000 **French** (18,623) and **Italian** (6,692) food firms;
  - Period **2004-2012**, more then 130,000 obs.
- **Import penetration (IP)**: Trade and production data from Comext/Prodcom (Eurostat) and FAO (inputs), aggregated to **NACE 4-digit** from CN 8-digit (or FAO)
  - **33 food sectors** (food industry)
- **Vertical IP**: 2007 US I-O tables (BEA), 6-digit converted to NACE 4-digit, to measure I-O **weights**
  - Overall **94 different** intermediate inputs

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Data and empirical strategy

Empirical strategy: two stages approach

1. Estimate of firm-level **TFP**, for FRA and ITA food firms
2. Regress firm-level TFP on **horizontal** and **vertical** IP indices

Firm level TFP estimation

- TFP was estimated using the Levinsohn and Petrin (2003) alghoritm: $\varpi_{it} = y_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_m m_{it}$
- Where ϖ_{it} is the (log of) TFP of the firm *i*
  - Semi-parametric approach to account for the correlation between the inputs and productivity shocks, using the material costs (m_{it}) as exogenous source of inputs variation
  - ω_{it} measures both firm **performance** and **profitability**, i.e. physical efficiency and markup (De Loecker and Goldberg, 2007)

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Data and empirical strategy

Table 1. Descriptive Statistics Relative to TFP

	All			Italy			France		
	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.	Obs	Mean	Std. Dev.
(ln) TFP	129,454	3.26	0.91	36,050	4.23	0.89	93,404	2.88	0.58
(ln) Output	129,454	6.73	1.41	36,050	7.58	1.19	93,404	6.40	1.35
(ln) L	129,454	5.34	1.14	36,050	5.26	1.06	93,404	5.38	1.17
(ln) K	129,454	5.32	1.51	36,050	6.12	1.43	93,404	5.02	1.43
(ln) Materials	129,454	5.81	1.69	36,050	6.99	1.37	93,404	5.35	1.57

Estimated coefficients for the Italian sample are: **Labor (0.353), Capital (0.062)** and **Material Costs (0.523).** Return to scale equal to 0.94

Estimated coefficients for the French sample are: **Labor** (**0.389**), **Capital** (**0.069**) and **Material Costs** (**0.549**). Return to scale equal to 1.

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Data and empirical strategy

Import penetration measures

- **Horizontal** IP in industry *z* from origins *g* (World, EU15, NMS, Emerging, OECD, Others):

$$h\_imp_{zt}^{g} = \frac{imp_{zt}^{g}}{prod_{zt} + imp_{zt}^{g} - exp_{zt}^{g}}$$

- **Vertical** IP is an index of the foreign presence in industry *z* supplied by industry *j* → **weighted average** of the IP of its inputs

$$v\_imp_{zt}^{g} = \sum_{j \in z} d_{jz} h\_imp_{jt}^{g*}$$

  - $\mathbf{d_{jz}}$ is the **I-O weight** of inputs *j* as input in sector *z*;
  - $h\_imp_{jt}^{g*}$ include **only** those goods * that are classified as 'intermediate inputs' by the BEC classification

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Data and empirical strategy

Horizontal Import Penetration

	Italy			France		
Country groups	Mean	Standard Dev.	Avg Annual Growth	Mean	Standard Dev.	Avg Annual Growth
World	0.324	0.278	0.30%	0.427	0.326	0.84%
EU 15	0.271	0.278	-0.47%	0.349	0.294	0.05%
Emerging Countries	0.085	0.295	4.62%	0.042	0.113	5.18%
OECD	0.032	0.181	-4.59%	0.024	0.049	3.61%
NMS	0.026	0.143	18.83%	0.009	0.026	22.28%
Other Countries	0.026	0.143	-1.03%	0.009	0.026	-2.41%

Vertical Import Penetration

	Italy			France		
Country groups	Mean	Standard Dev.	Avg Annual Growth	Mean	Standard Dev.	Avg Annual Growth
World	0.540	0.260	1.88%	0.487	0.229	-1.37%
EU 15	0.425	0.239	1.43%	0.371	0.180	1.56%
Emerging Countries	0.229	0.209	5.75%	0.163	0.153	1.46%
OECD	0.165	0.168	-4.15%	0.322	0.320	0.62%
NMS	0.190	0.182	10.97%	0.115	0.211	3.55%
Other Countries	0.100	0.177	-13.73%	0.048	0.096	-24.66%

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Data and empirical strategy

Baseline empirical model (Altomonte et al. 2014):

$$y_{it} = \beta_0 + \beta_1 \log h\_imp^{g}_{zt-1} + \beta_2 \log v\_imp^{g}_{zt-1} + \alpha_i + \theta_t + \varepsilon_{izt}$$

- $y_{it} \equiv \log (TFP_{it})$, α_i and θ_t are firm and time fixed effects
- ***IPs*** enter the equation lagged one year to account for idiosyncratic shocks that affect both TFP and IP
- The estimated coefficients β_1 and β_2 are **elasticities**

- **Expectations**:
  1. β_1 and $\beta_2 > 0$;
  2. $\beta_2 > \beta_1$;
  3. β_1 and β_2 increasing to the initial TFP level

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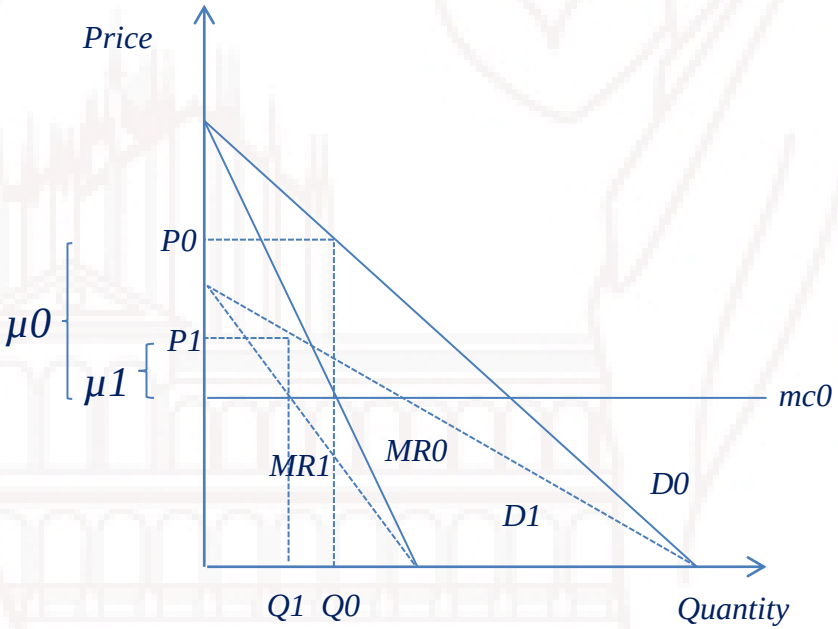
Data and empirical strategy

Price and Markup Changes



Output tariff liberalization

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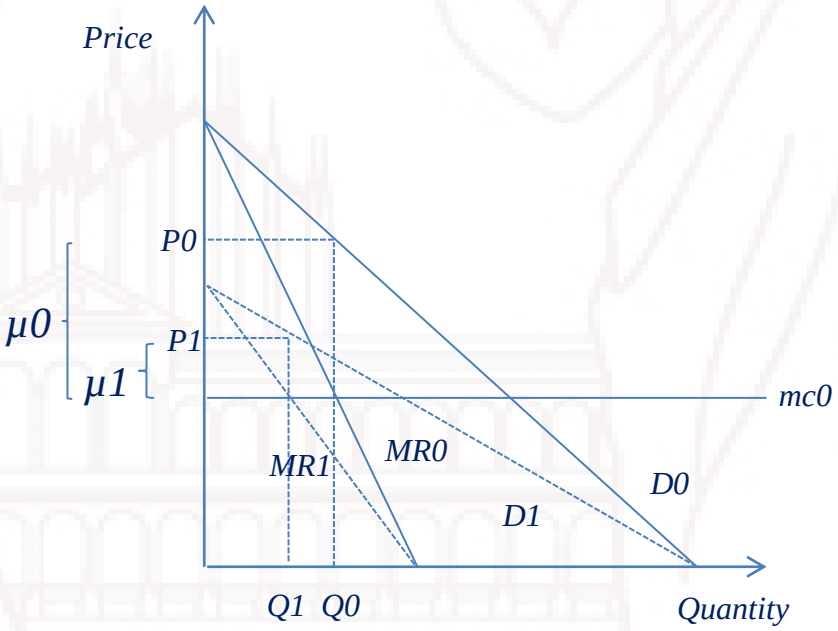
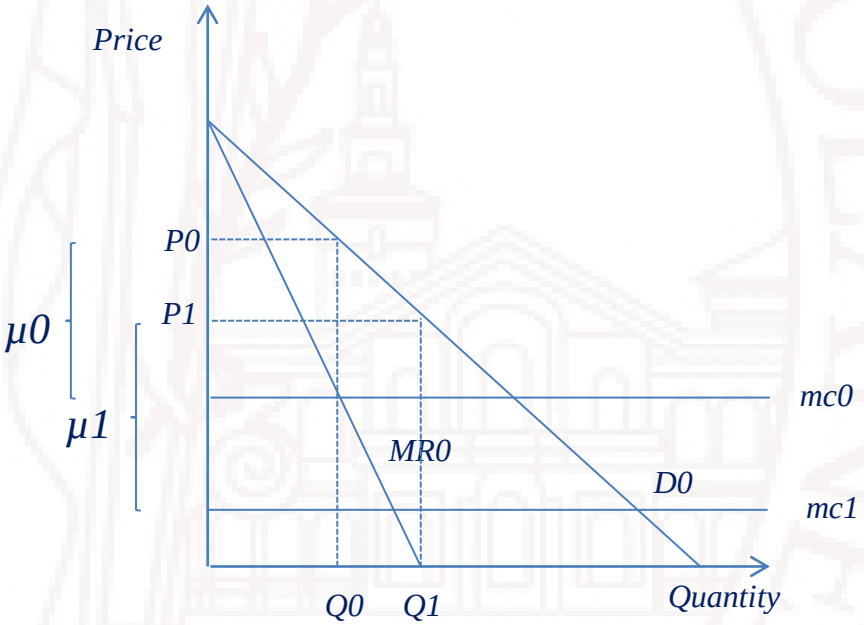
Data and empirical strategy

Price and Markup Changes



Output tariff liberalization



Input tariff liberalization

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Outline

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Main results
(Pooling Italian and France data)

Import penetration and TFP: **baseline** results

Dependent variable: log of TFP	(1) World	(2) EU 15	(3) Emerging Countries	(4) OECD	(5) NMS	(6) Other Countries
Log Horizontal IP (t-1)	0.0073***	0.0233***	0.0142***	0.0238***	-0.0075***	0.0131***
	(0.0027)	(0.0028)	(0.0026)	(0.0030)	(0.0015)	(0.0011)
Log Vertical IP (t-1)	0.213***	0.104***	0.112***	-0.0073**	-0.0096***	0.0165***
	(0.0088)	(0.0068)	(0.0091)	(0.0034)	(0.0016)	(0.0015)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	129454	131025	131011	131014	131021	131000
R-square	0.922	0.921	0.921	0.921	0.921	0.921

The TFP growth effect of vertical IP is **10 times** higher that the one of horizontal IP;

EU15, Emerging and OECD give a higher contribution in terms of magnitude of the effects

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Main results
(Pooling Italian and France data)

Import penetration and TFP: **GMM** results

	(1)	(2)	(3)	(4)
	Satatic	Dynamic panel model		
	Fixed effects	LSDV	AB2	AB3
Log Horizontal IP (t-1)	0.0073***	0.009***	0.040***	0.042***
	(0.00266)	(0.0022)	(0.00696)	(0.00763)
Log Vertical IP (t-1)	0.213***	0.102***	0.152***	0.122***
	(0.00878)	(0.0075)	(0.0220)	(0.0349)
Log TFP (t-1)		0.444***	0.424***	0.387***
		(0.0059)	(0.0362)	(0.0374)
AR1 (p-value)			0.084	0.086
AR2 (p-value)			0.372	0.394
Hansen Test (p-value)			0.179	0.191
Observations	129454	129454	104802	104802

The main results still hold using a GMM estimator;

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Main results

Results Split by **French** and **Italian** Firms

Dependent variable: log of TFP	(1) World	(2) EU 15	(3) Emerging Countries	(4) OECD	(5) NMS	(6) Other Countries
Log Horizontal IP (t-1) FR	0.0088***	0.0223***	0.0017	0.0474***	-0.0184***	0.0113***
	(0.0026)	(0.0029)	(0.0028)	(0.0033)	(0.0016)	(0.0013)
Log Horizontal IP (t-1) IT	0.0048	0.0213	0.0303***	-0.0061	0.0214***	0.0143***
	(0.0147)	(0.0149)	(0.0049)	(0.0054)	(0.0030)	(0.0020)
Log Vertical IP (t-1) FR	0.234***	0.0934***	0.0170	-0.0098**	-0.0137***	0.0387***
	(0.0107)	(0.0079)	(0.0110)	(0.0044)	(0.0017)	(0.0018)
Log Vertical IP (t-1) IT	0.175***	0.128***	0.216***	-0.0058	0.0792***	-0.0104***
	(0.0209)	(0.0147)	(0.0161)	(0.0047)	(0.0071)	(0.0024)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	129454	131025	131011	131014	131021	131000
R-squared	0.922	0.921	0.921	0.921	0.921	0.921

Relevant effects consistent in the two samples, although some interesting differences emerge

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Main results

Results Split by **Initial Level** of TFP

Dependent variable: Log of TFP	Horizontal	Vertical
Log IP (t-1) first quartile of TFP	-0.0012	0.128***
	(0.0030)	(0.0142)
Log IP (t-1) second quartile of TFP	0.0133***	0.163***
	(0.0043)	(0.0127)
Log IP (t-1) third quartile of TFP	0.0196***	0.227***
	(0.0062)	(0.0128)
Log IP (t-1) fourth quartile of TFP	0.0209**	0.325***
	(0.0097)	(0.0190)
Firm FE	Yes	
Time FE	Yes	
Observations	98221	
R-squared	0.918	

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Conclusions and implications

- We show that **firms' exposure to international trade translates into firms' productivity growth**
  - Consistent with firm heteogeneity models (Melitz, 2003; Bernard et al., 2003)
- **Productivity growth** effect of **upstream** trade integration is important for the food industry
- And, importantly, **overcomes** a similar effect induced by horizontal import competition
  - Consistent with recent evidence (Amiti and Konings 2007; Goldberg et al. 2010, etc.)

Conclusions and implications

- The effect is largely due to imported material inputs from **EU15** and **emerging** countries
- Finally, the magnitude of the economic effect **is increasing with the initial level of firms' productivity**

Main implications:

  - If the objective of European institutions is to spur productivity in the food industry, **further liberalization** in the upstream (agri-food) sectors could be a valuable strategy
  - Because not all imports affect all firms to the same extent, public policies should be **tailored** to the needs of heterogeneous firms

Further developments

Working on the channels through which *upstream* IP affects productivity growth

- Our strategy is twofold
  1. Estimation of the effect of the **extensive margin** of imported input varieties on firms' productivity (Hummels and Klenow, 2005; Feenstra and Kee, 2008)
  2. Estimation of the effect of price variation between new and old imported inputs on firms' productivity (Goldberg et al. 2010)
- This procedure allows us to separate the effect of the Vertical IP on firms' productivity into a "*price*" and a "*variety*" channels

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Thank you!

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Import penetration and TFP by sector

NACE	Description	Horiz IP	Vertical IP
10.1	Processing and preserving of meat and production of meat products	0.008	**0.323*** **
		(0.005)	*(0.043)*
10.2	Processing and preserving of fish, crustaceans and molluscs	-0.106	0.099
		(0.123)	*(0.171)*
10.3	Processing and preserving of fruit and vegetables	**0.061*** **	0.022
		(0.021)	*(0.040)*
10.4	Manufacture of vegetable and animal oils and fats	0.059	**-0.600** **
		(0.108)	*(0.239)*
10.5	Manufacture of dairy products	0.008	0.078
		(0.037)	*(0.062)*
10.6	Manufacture of grain mill products, starches and starch products	0.063*	**0.524*** **
		(0.033)	*(0.052)*
10.7	Manufacture of bakery and farinaceous products	**-0.075*** **	**0.327*** **
		(0.017)	*(0.012)*
10.8	Manufacture of other food products	**0.052*** **	-0.002
		(0.006)	*(0.025)*
10.9	Manufacture of prepared animal feeds	**-0.170*** **	0.260
		(0.054)	*(0.161)*
11.0	Manufacture of beverages	0.011	**0.102*** **
		(0.024)	*(0.020)*
N		129,454	
R-sq		0.923	

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List of emerging markets – MSCI classification 2014

Emerging Markets

Country Name	Total number of securities	# of MSCI Constituents	# of non-MSCI Constituents
Brazil	395	158	237
Chile	122	41	81
China	3353	483	2870
Colombia	50	17	33
Czech Republic	12	7	5
Egypt	104	19	85
Greece	122	21	101
Hungary	17	4	13
India	818	215	603
Indonesia	237	106	131
Korea	1016	422	594
Malaysia	306	148	158
Mexico	137	48	89
Peru	76	7	69
Philippines	110	43	67
Poland	137	42	95
Qatar	42	25	17
Russia	230	37	193
South Africa	199	113	86
Taiwan	908	480	428
Thailand	295	120	175
Turkey	202	93	109
United Arab Emirates	90	16	74
Totals	8888	2649	6239

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Vertical Import Penetration by Nace 3-digit sector

Vertical Import Penetration		Italy			France		
NACE	Description	Mean	Standard Dev.	Avg Annual Growth	Mean	Standard Dev.	Avg Annual Growth
10.1	Processing and preserving of meat and production of meat products	1.017	0.209	2.27%	0.168	0.061	0.65%
10.2	Processing and preserving of fish, crustaceans and molluscs	0.191	0.012	-1.00%	0.055	0.002	1.56%
10.3	Processing and preserving of fruit and vegetables	0.448	0.135	-0.18%	0.623	0.188	-2.22%
10.4	Manufacture of vegetable and animal oils and fats	0.911	0.026	0.65%	0.337	0.024	-1.14%
10.5	Manufacture of dairy products	0.735	0.013	-0.87%	0.159	0.014	-9.25%
10.6	Manufacture of grain mill products, starches and starch products	0.487	0.049	2.79%	0.566	0.064	-0.47%
10.7	Manufacture of bakery and farinaceous products	0.463	0.071	2.80%	0.638	0.104	-2.43%
10.8	Manufacture of other food products	0.447	0.169	2.76%	0.450	0.144	-1.40%
10.9	Manufacture of prepared animal feeds	0.666	0.147	0.45%	0.551	0.131	0.41%
11.0	Manufacture of beverages	0.364	0.136	4.06%	0.645	0.162	-0.34%
12.0	Manufacture of tobacco products	0.101	0.010	-1.79%	0.804	0.127	-0.68%

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Horizontal Import Penetration by Nace 3-digit sector

Horizontal Import Penetration		Italy			France		
NACE	Description	Mean	Standard Dev.	Avg Annual Growth	Mean	Standard Dev.	Avg Annual Growth
10.1	Processing and preserving of meat and production of meat products	0.168	0.171	1.37%	0.238	0.152	-1.22%
10.2	Processing and preserving of fish, crustaceans and molluscs	0.837	0.078	-2.50%	0.727	0.060	-1.84%
10.3	Processing and preserving of fruit and vegetables	0.409	0.142	-3.68%	0.857	0.359	0.87%
10.4	Manufacture of vegetable and animal oils and fats	0.499	0.210	3.16%	0.769	0.214	1.37%
10.5	Manufacture of dairy products	0.166	0.080	4.44%	0.184	0.051	2.63%
10.6	Manufacture of grain mill products, starches and starch products	0.257	0.169	8.92%	0.393	0.062	3.84%
10.7	Manufacture of bakery and farinaceous products	0.055	0.046	5.99%	0.224	0.141	5.94%
10.8	Manufacture of other food products	0.266	0.185	5.71%	0.421	0.282	-2.63%
10.9	Manufacture of prepared animal feeds	0.187	0.220	-3.50%	0.087	0.089	3.54%
11.0	Manufacture of beverages	0.305	0.354	-2.41%	0.290	0.241	1.96%
12.0	Manufacture of tobacco products	0.960	0.006	0.53%	0.988	0.156	4.61%

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