Do food scares explain supplier concentration? An analysis of EU agri-food imports

Mélise Jaud, Olivier Cadot, Akiko Suwa-Eisenmann

PARIS SCHOOL OF ECONOMICS
ECOLE D'ECONOMIE DE PARIS

WORKING PAPER N° 2009 - 28

Do food scares explain supplier concentration?

An analysis of EU agri-food imports

Mélise Jaud

Olivier Cadot

Akiko Suwa-Eisenmann

JEL Codes: F1, O13, Q17, Q18
Keywords: European Union, import concentration, sanitary risk, food, agricultural trade

PARIS-JOURDAN SCIENCES ECONOMIQUES
LABORATOIRE D'ECONOMIE APPLIQUÉE - INRA

48, BD JOURDAN – E.N.S. – 75014 PARIS
TÉL. : 33(0) 1 43 13 63 00 – FAX : 33 (0) 1 43 13 63 10
www.pse.ens.fr

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE – ÉCOLE DES HAUTES ÉTUDES EN SCIENCES SOCIALES
ÉCOLE NATIONALE DES PONTS ET CHAUSSÉES – ÉCOLE NORMALE SUPÉRIEURE

Do Food Scares Explain Supplier Concentration? An Analysis of EU Agri-food Imports[§]

July 2009

Mélise Jaud[*]
Olivier Cadot[+]
Akiko Suwa Eisenmann+

Abstract

This paper documents a decreasing trend in the geographical concentration of EU agro-food imports. Decomposing the concentration indices into intensive and extensive margins components, we find that the decrease in overall concentration indices results from two diverging trends: the pattern of trade diversifies at the extensive margin (EU countries have been sourcing their agri-food products from a wider range of suppliers), while geographical concentration increases at the intensive-margin (EU countries have concentrated their imports on a few major suppliers). This leads to an increasing inequality in market shares between a small group of large suppliers and a majority of small suppliers. We then move on to exploit a database of food alerts at the EU border that had never been exploited before. After coding it into HS8 categories, we regress the incidence of food alerts by product on determinants including exporter dummies as well as HS8 product dummies. Coefficients on product dummies provide unbiased estimates of the intrinsic vulnerability of exported products to food alerts, as measured at the EU border. We incorporate the product risk coefficient as an explanatory variable in a regression of geographical concentration and show that concentration is higher for risky products.

Keywords: European Union, import concentration, sanitary risk, food, agricultural trade

JEL classification codes: F1, O13, Q17, Q18

[§] Without implicating them, we thank participants to a seminar at the Paris School of Economics, in particular Anne-Célia Disdier and Lionel Fontagné, for helpful comments on a earlier version.
[*] Paris School of Economics
[+] University of Lausanne, CEPR, CERDI and CEPREMAP.
[+] INRA, LEA , Paris School of Economics.

1. Introduction

After a series of highly publicized food scares (bovine spongiform encephalopathy or dioxin-contaminated chickens to name but two), public-health concerns have started to loom large in the buying policies of EU foodstuff distributors. These concerns have the potential to affect the evolution of EU foodstuff imports, and therefore the access that developing countries—in particular the poorest ones, who find it most difficult to comply with stringent sanitary standards—enjoy on EU markets (Maskus et al. 2005). This is particularly important for products like fruit & vegetables or fisheries products, which represent a growing share of EU food imports and are also of particular concern to the least developed countries (Jaffee et al 2004, World Bank 2005).

The impact of sanitary concerns on industrial-country foodstuff imports has been studied extensively, essentially by sticking standards as explanatory variables in gravity equations (see e.g. Moenius 1999, Maskus et al. 2000, Otzuki and Wilson 2001, Sheperd and Wilson 2007). Estimation of such models has highlighted the trade restrictiveness of such standards (Fontagné et al 2005, Disdier, Fontagné et al. 2008).

We differentiate ourselves from the existing literature in two ways. First, we shift focus from gravity modelling to an analysis of the geographical concentration of EU foodstuff imports, using conventional and non-conventional concentration measures (similar approaches can be found in Imbs and Wacziarg 2003 for production or in Cadot, Carrère and Strauss-Kahn 2007, and Dutt, Mihov and van Zandt 2008 for exports). We propose a decomposition of Theil's entropy index between active and potential suppliers with the property that variations in the index's within- and between-group components map directly into intensive- and extensive-margin variations. We also propose a variant of Hummels and Klenow's intensive and extensive margins (which they developed for the analysis of the product-wise concentration of exports) adapted to imports and to geographical concentration.

Our product-level analysis shows that, over the last two decades, EU foodstuff imports have concentrated, geographically, at the intensive margin. That is, on average, at the product-line (HS8) level, the market shares of active suppliers have *diverged*. However, we also observe a trend toward diversification at the extensive margin. That is, again at the product-line level, the EU sources its foodstuffs from an increasing number of exporting countries. These two observations appear, at first sight, to be contradictory. Using our adaptation of Hummels and Klenow's intensive and extensive margins, we show that the number of suppliers used by the EU is indeed increasing, but by addition of a fringe of small-volume exporters. Thus, EU foodstuff imports gradually evolve toward a two-tier distribution with a small number of increasingly dominant suppliers and a growing fringe of marginal ones.

Second, we shift focus from standards, which affect trade flows ex-ante, to alerts, which affect them ex-post. What we call here a "food alert" is the notification of a contaminated foodstuff shipment at the external border of an EU member state. Food alerts have the power to alter buyer perceptions of the quality of particular suppliers. They could either lead to reinforced concentration if buyers react by eliminating fringe suppliers perceived as dubious by analogy with the culprit, or, alternatively, to the destruction of dominant positions if they affect dominant suppliers. This is what we explore, using an original database constructed from the European Commission's Rapid Alert System for Food and Feed (RASSF) database. Technically, the EU Commission classifies contaminated-shipment notifications into two types: "informations", which lead to the destruction or re-routing of the concerned shipment, or "alerts" *stricto sensu* which lead to the destruction or re-routing of all shipments from the same exporting country at all EU borders. Since 2001, all informations (about 19'000 of them) have been recorded in a detailed database, which has never been used. We coded that database into HS8 product categories to make it compatible with trade data, generating a population of events each defined at the (product $\times$ exporter $\times$ year) level.

The RASFF database shows substantial heterogeneity in the incidence of food alerts across exporting countries. This implies that a raw count of alerts by product cannot give a correct proxy for product-specific sanitary risk. For instance, a product imported overwhelmingly from a country with weak quality standards would appear as risky even though other exporters might have managed to make the product safe. In addition, the incidence of notifications is likely to be correlated with the frequency of controls. Those controls may not be purely random: they may reflect a particular exporter's past performance or hidden protectionism. Thus, regressing concentration indices on the frequency of notifications at the product level would say nothing without controlling for other factors.

In order to get an unbiased estimate of product-specific sanitary risk, we rely on a two-step procedure. In the first step, we estimate product-specific sanitary risk with a regression of the count of food alerts at EU borders over the sample period, using an original database described in the next section. The unit of observation is a product × exporter pair where alerts are summed over all years in the sample period. The regressors are exporting-country characteristics and product dummies. Estimated coefficients on those product dummies give us an estimated measure of product risk. In a second step, we regress the evolution of geographical concentration indices on our measure of product risk and time dummies.

Overall, we find that except for fisheries products no chapter stands out as having particularly high risk levels. Incorporating our constructed measure of product risk as an explanatory variable in a regression of geographical concentration confirms that product riskiness affects sourcing concentration. Product riskiness leads to reinforced concentration at the intensive margin and reinforced diversification at the extensive margin. Thus, the distribution of EU suppliers for riskiest agrofood imports is converging towards a pattern of increasingly dominant suppliers with a growing fringe of small-scale ones.

The paper proceeds as follows. The next Section analyses the trend in the geographical concentration of EU agro-food imports both at the intensive and extensive margin. We then outline the EU "Food Alerts" Database in Section 3, contrast it with previous data collection efforts, and present some descriptive results. Section 3 then explores the impact of product riskiness on the patterns of concentration. Section 4 concludes.

2. Agri-food supplier concentration

2.1 Overall diversification

2.1.1 The data

We use EUROSTAT agri-food import data covering EU-12 member states[1] (France, Belgium-Luxembourg, the Netherlands, Germany, Italy, Ireland, United Kingdom, Denmark, Greece, Portugal and Spain) between 1988 and 2005 at the HS8 level (the highest level of disaggregation available, as Eurostat does not make 10-digit data available to researchers). Agri-food products, excluding beverages and animal feed, are in chapters 1 to 21 of the HS system, which represent 3'073 potential export lines. With 146 partner countries (exporters) including 122 developing countries, we have a four-dimensional panel where the unit of observation is a product imported by an EU member state from an extra-EU partner in a given year.[2] For some calculations, however, we aggregate import data across EU member countries, reducing the panel's dimension to three (product $\times$ exporter $\times$ year).

At the HS8 level, reclassifications are frequent. Five types of reclassification can be distinguished: (i) creation of a new code corresponding to a new product; (ii) creation of several new codes by splitting a former one; (iii) creation of a new code by merging several former ones; (iv) creation of new codes resulting from a change in the coding system (HS harmonizations in 1988, 1996 and 2002); and finally (v) termination of old codes. Of the 3'073 HS8 codes available in our dataset, only 37.7% are unaffected by reclassification between 1988 and 2005. Of the remainder (62.3%), 1.6% are new products (type i), and 0.7% are terminated codes (type v). This leaves 60% of reclassifications of "continued"

[1] We use this restrictive definition for consistency of time series, as EUROSTAT does not provide data on member states before their accession.

[2] We drop intra-EU trade on the ground of the mutual recognition of standard. The principle ensures that a product lawfully produced in one Member State is acceptable without adaptation in another Member State, provided that both states pursue the same general objectives in health

products. Among those, half (30%) are type-ii reclassifications (splittings) and half are type-iv (system changes).

In order to reduce the inconsistencies introduced by type-iii and type-iv reclassifications to a minimum, we used EUROSTAT's documentation to re-reclassify new codes into initial ones; in case (iii), where a new code was made out of several old ones, we used the first parent's code in the HS order. This gives us a consistent database using the initial nomenclature throughout the sample period.

2.1.2 Trade relationships at the product level

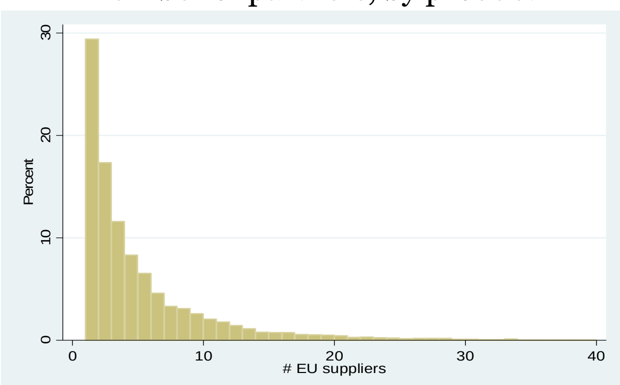
Table 1 shows the evolution of the structure of EU agri-food imports between 1988 and 2005. The share of developing countries, already dominant at 68% at the start of the sample period (1988), grew even more dominant, reaching 77% in 2005. Interestingly, this rise is not attributable to a rise in imports of traditional tropical products (coffee, cocoa, sugar, etc.) which, as a share of imports from developing countries, shrank from 25.2% to 15.7% over the sample period. Rather, it is due to a spectacular rise in imports of horticulture and fisheries products, whose share rose from 21.2% to 30% of EU agri-food imports from developing countries. This is remarkable given that fisheries and horticulture products are, in general, fairly sensitive to sanitary and phyto-sanitary issues, and the ability to meet stringent SPS standards is, in general, correlated with exporter income.

Table 1
Evolution of EU imports structure, between 1988 and 2005

	Developping countries		Developped countries		Total imports	
	1988	2005	1988	2005	1988	2005
Traditional tropical products						
Coffee, tea, mate and spices	16.6%	7.7%	0.1%	0.1%	16.7%	7.8%
Lacs; gums, resins	0.5%	0.7%	0.1%	0.2%	0.7%	0.9%
Sugars and sugar confectionery	3.0%	2.2%	0.3%	0.3%	3.2%	2.5%
Cocoa and cocoa preparations	5.1%	5.1%	0.1%	0.1%	5.2%	5.2%
Subtotal	*25.2%*	*15.7%*	*0.6%*	*0.7%*	*25.8%*	*16.4%*
Tempered zone products						
Live animals	0.1%	0.1%	0.5%	0.9%	0.6%	1.0%
Meat and edible meat offal	2.2%	3.3%	2.7%	2.4%	4.9%	5.7%
Dairy produce; birds' eggs; natu	0.3%	0.3%	1.0%	0.5%	1.3%	0.9%
Products of animal origin nes	1.0%	1.2%	0.7%	0.3%	1.7%	1.5%
Cereals	1.0%	1.9%	2.9%	1.6%	3.9%	3.5%
Subtotal	*4.5%*	*6.8%*	*7.9%*	*5.7%*	*12.5%*	*12.5%*
Fish and Horticulture						
Fish and crustaceans	5.6%	10.9%	5.7%	5.0%	11.3%	16.0%
Live trees and other plants	0.5%	1.6%	0.5%	0.4%	1.0%	2.0%
Edible vegetables	5.2%	3.6%	1.3%	1.3%	6.5%	4.9%
Edible fruit and nuts	9.5%	13.7%	3.8%	4.2%	13.3%	17.8%
Vegetable plaiting materials	0.3%	0.2%	0.1%	0.0%	0.4%	0.2%
Subtotal	*21.2%*	*30.0%*	*11.3%*	*11.0%*	*32.5%*	*41.0%*
Others						
Products of the milling industry	0.1%	0.1%	0.0%	0.0%	0.1%	0.1%
Oil seeds and oleaginous fruits	5.4%	6.5%	7.6%	2.6%	13.0%	9.1%
Animal or vegetable fats and oil	3.9%	7.0%	1.1%	0.3%	5.0%	7.4%
Preparations of meat, fish or cr	3.0%	5.2%	1.6%	0.8%	4.6%	6.0%
Preparations of cereals	0.1%	0.4%	0.2%	0.3%	0.2%	0.7%
Preparations of vegetables, fruit	4.0%	5.2%	1.5%	0.5%	5.5%	5.7%
Miscellaneous edible preparatic	0.5%	0.5%	0.3%	0.7%	0.7%	1.2%
Subtotal	*16.9%*	*25.0%*	*12.2%*	*5.2%*	*29.2%*	*30.2%*
Total	**68%**	**77%**	**32%**	**23%**	**100%**	**100%**

Figure 1 shows the distribution of EU imports by number of source countries. The distribution is strikingly skewed, with single-supplier–meaning source country; there may be several suppliers per exporting country—accounting for 30% of the total number of product lines.

Figure 1
Number of partners, by product



Panel A of Table 2 shows the proportion of products imported from a single country by HS chapter, and Panel B by importing country. A negative correlation – as expected —between importer size (total imports value) and proportion of single-supplier relationship is apparent, suggesting that exporters have fixed costs by destination market. Panel C shows the evolution over time: a decreasing trend clearly appears.

Table 2
Share of single-supplier products

Panel A

Sector HS 2-digit	% of single partner transactions
Dairy produce	48.39
Meat and edible meat offal	44.77
Products of the milling industry	41.28
Animal or vegetable fats and oils	33.69
Sugars and sugar confectionery	32.49
Live animals	32.47
Fish and crustaceans	30.06
Cereals	28.65
Cocoa and cocoa preparations	27.63
Preparations of vegetables, fruit, nuts	27.63
Preparations of meat, fish or crustaceans	26.13
Oil seeds and oleaginous fruits	25.80
Lacs; gums, resins	25.61
Miscellaneous edible preparations	23.73
Edible vegetables	22.46
Preparations of cereals	22.46
Edible fruit and nuts	20.07
Live trees and other plants	19.64
Coffee, tea, mate and spices	17.24
Products of animal origin nes	16.81
Vegetable plaiting materials	12.18
Mean	27.58
Median	26.13

Panel B

Importer	% of single partner transactions
Ireland	50.60
Greece	42.20
Portugal	41.53
Denmark	37.81
Bel-Lux	30.75
Spain	27.08
Italy	24.37
France	23.57
Netherlands	22.60
UK	20.42
Germany	20.01
Mean	30.99
Median	30.99

Panel C

Year	% of single partner transactions
1	30.41
2	30.66
3	29.85
4	29.04
5	28.20
6	28.83
7	28.48
8	29.25
9	28.73
10	28.78
11	28.34
12	27.29
13	27.50
14	26.73
15	25.65
16	23.93
17	23.77
18	22.94
Mean	27.69
Median	28.41

2.1.3 Concentration indices

We now turn to an analysis of the geographical concentration of sourcing, product by product. Our measures are standard ones: Herfindahl, Theil and Gini. The Herfindahl index for good *k*, normalized to range between zero and one, is

$$H_k^* = \frac{\sum_i \left(s_k^i\right)^2 - 1/n_k}{1 - 1/n_k} \qquad (1)$$

where $s_k^i = x_k^i / x_k$ is the share of origin country *i* in EU imports of product *k* and n_k is the total number of countries exporting good *k* (we will discuss in more detail below alternative definitions of the set of exporting countries).

Theil's entropy index (Theil 1972), again for good *k*, is given by

$$T_k = \frac{1}{n_k}\sum_{i=1}^{n_k}\frac{x_k^i}{\mu_k}\ln\left(\frac{x_k^i}{\mu_k}\right) \quad \text{where} \quad \mu_k = \frac{1}{n_k}\sum_{i=1}^{n_k} x_k^i \tag{2}$$

For Gini indices, we use Brown's formula; that is, for each product and year, we first sort exporting countries, indexed by *i*, by increasing order of trade value *x* so that $x_k^i < x_k^{i+1}$. Cumulative export shares are

$$X_k^i = \sum_{\ell=1}^{i} x_k^\ell \Big/ \sum_{\ell=1}^{n_k} x_k^\ell \tag{3}$$

and cumulative shares in the number of exporting countries are simply i / n_k. Brown's formula for the Gini coefficient is then

$$G_k = \left|1 - \sum_{i=1}^{n_k}\left(X_k^i - X_k^{i-1}\right)(2i-1)/n_k\right|. \tag{4}$$

All three indices are dependent on the definition of n_k, the number of "potential exporters". Our baseline definition of the set of potential exporters is the simplest one: it is the set of all countries having exported good *k* to some destination in the world (not necessarily EU countries) at least two years in a row over the sample period. We impose the requirement of two consecutive years of exports instead of just one in order to ensure that the exporter is a successful one (Besedes and Prusa 2006a, 2006b show that two years is the median duration of export spells; only one year might signal failure rather than the capacity to export). This definition has the advantage of being time- and importer- invariant. We will discuss alternative definitions and decompositions in Section 2.2 below.

Table 3 shows some descriptive statistics for the three concentration indices. The average number of *potential* suppliers is high, at around 74 suppliers. Concentration indices are very high, and this is consistent with our earlier observation that the distribution of the number of active suppliers is highly skewed. This has to do with the very detailed level of disaggregation. At the HS8 level, a large proportion of product lines are imported from a small number of suppliers.

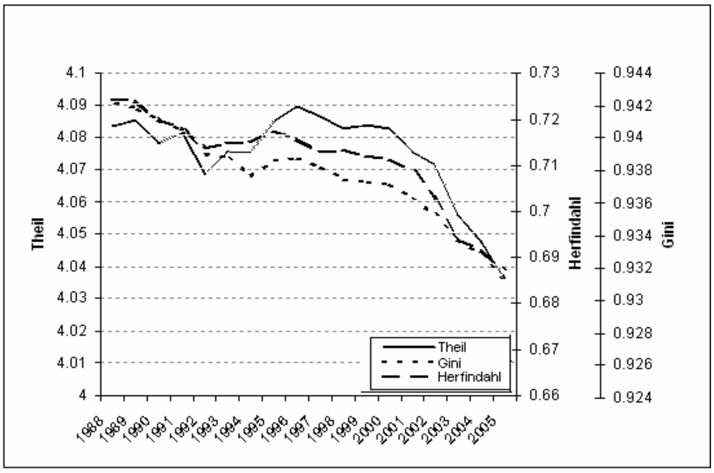
Table 3
Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
n_k a/	155'530	77.84	28.39	11	141
n_{kt}^{EU} b/	155'530	4.38	5.44	1	73
Herfindahl	155'530	0.28	0.31	0.000	1.00
Theil	155'530	0.45	0.50	0.000	3.24
Gini	155'530	0.35	0.30	0.000	0.96
Herfindahl	155'468	0.71	0.28	0.052	1.00
Theil	155'468	3.72	0.63	0.520	4.95
Gini	155'468	0.91	0.10	0.005	0.99
α c/	155'530	0.06	0.07	0.007	2.4
Importer's GDP pc d/	155'530	9.15E+11	6.70E+11	4.86E+10	2.20E+12

Note: All variables defined at the product (HS8) level.
a/ Number of countries having exported product k at least 2 years in a row to any destination during the sample period (time invariant)
b/ Number of countries exporting product k to the EU in year t
c/ $\alpha = n_{kt}^{EU} / n_k$
d/ GDP per capita in 2005 PPP dollars.

Figure 2 shows the evolution of simple averages, over all products, of our three concentration indices. A clear downward trend (diversification) is apparent for all indices, in particular after the mid-1990s.

Figure 2
Geographical concentration indices, 1988-2005



2.2 Intensive vs. extensive margins

2.2.1 "Raw" margins

We now use the additive decomposability property of Theil's index to get a first cut at the respective roles of the intensive and extensive margins in overall concentration trends. Both margins are defined geographically supplier-wise instead of product-wise.

In each year, we decompose our sample of EU suppliers into two groups, holding the importing member-state constant and un-indexed in order to avoid cluttering the notation. Group 1 is composed of active suppliers, numbering n_{kt}^{EU}, and group 0 is made of potential but inactive ones, numbering $n_k - n_{kt}^{EU}$.

Using this partition, we can decompose Theil's index into group, between and within components called respectively T_{kt}^{0}, T_{kt}^{1}, T_{kt}^{B} and T_{kt}^{W}.

The between-groups component of Theil's index is given by

$$T_{kt}^{B} = \sum_{j=0}^{1} \frac{n_{kt}^{j}}{n_k} \frac{\mu_{kt}^{j}}{\mu_k} \ln\left(\frac{\mu_{kt}^{j}}{\mu_k}\right). \tag{5}$$

That is, it is a weighted average of terms involving only group means (relative to the population mean). By L'Hôpital's rule,

$$\lim_{\mu_{kt}^{0} \to 0} \left[\frac{\mu_{kt}^{0}}{\mu_k} \ln\left(\frac{\mu_{kt}^{0}}{\mu_k}\right) \right] = 0 \tag{6}$$

so

$$T_{kt}^{B} = \frac{n_{kt}^{1}}{n_k} \frac{\mu_{kt}^{1}}{\mu_k} \ln\left(\frac{\mu_{kt}^{1}}{\mu_k}\right). \tag{7}$$

As $\mu_{kt}^{1} = \left(1/n_{kt}^{EU}\right) \sum_{i \in G_1} x_{ikt}$, $\mu_k = \left(1/n_k\right) \sum_{i} x_{ikt}$ and, by construction, $\sum_{i \in G_1} x_{ikt} = \sum_{i} x_{ikt}$, it follows that

$$T_{kt}^{B} = \ln\left(\frac{n_k}{n_{kt}^{EU}}\right). \tag{8}$$

As n_k is time-invariant, it follows that

$$\Delta T_{kt}^{B} = T_{kt}^{B} - T_{k,t-1}^{B} = -\Delta \ln n_{kt}^{EU} \; ; \qquad (9)$$

that is, changes in the between-groups components of Theil's index trace exactly percentage changes in the extensive margin defined as the number of suppliers.

We now turn to the within-groups component. The within-group Theil index is defined as

$$T_{kt}^{W} = \sum_{j=0,1} \frac{n_{kt}^{j}}{n_k} \frac{\mu_{kt}^{j}}{\mu_k} T_{kt}^{j} \, . \qquad (10)$$

As Theil's index is zero when all individuals have equal shares, $T_0 = 0$. As for group 1,

$$T_{kt}^{1} = \frac{1}{n_{kt}^{EU}} \sum_{i \in G^1} \frac{x_{ikt}}{\mu_{kt}^{EU}} \ln\left(\frac{x_{ikt}}{\mu_{kt}^{EU}} \right) \qquad (11)$$

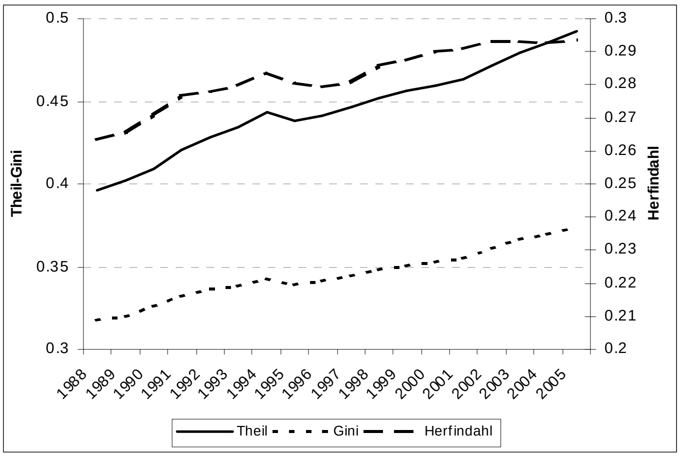
With $T_0 = 0$, T_{kt}^{W} reduces to

$$T_{kt}^{W} = \frac{n_{kt}^{EU}}{n_k} \frac{\mu_{kt}^{EU}}{\mu_k} T_{kt}^{1}. \qquad (12)$$

where $\mu_{kt}^{EU} = \sum_i x_{ikt} / \mu_{kt}^{EU}$. That is, the within component of Theil's index is equal to its group-1 sub-index (concentration among active suppliers).

In other words, given our partition of suppliers, the between-groups and within-groups components of Theil's index map directly into the extensive and intensive margins. Let us start the analysis with the within-groups component. Figure 3 shows the evolution of simple averages over all products of Theil's within-group component.

Figure 3
Within-group component of Theil's index, 1988-2005



There is clearly rising concentration among the EU's suppliers. The rising trend appears also if we calculate Gini and Herfindahl indices using n_{kt}^{EU} as the population size, which is the closest equivalent to Theil's within-group index.

In order to verify whether this trend is significant, and that it is not driven by between-product composition effects (i.e. a sectoral shift away from widely-procured products toward narrowly-procured ones), Table 4 shows the results of regressions of concentration indices on time and its square using (importer × product) fixed effects. Columns (1) to (3) show that overall concentration indices, computed using the number of potential suppliers n_k^W, display a monotone downward trend. For within indices, computed using the number of active suppliers n_{kt}^{EU}, columns (4) to (6) show that coefficients on time and its square confirm the monotone rising trend.[3]

[3] For all estimations where the coefficient on time square is significant, the turning point is outside the sample period. We are on the downward-sloping part of the parabola for overall concentration indices and on its upward-sloping part for within indices.

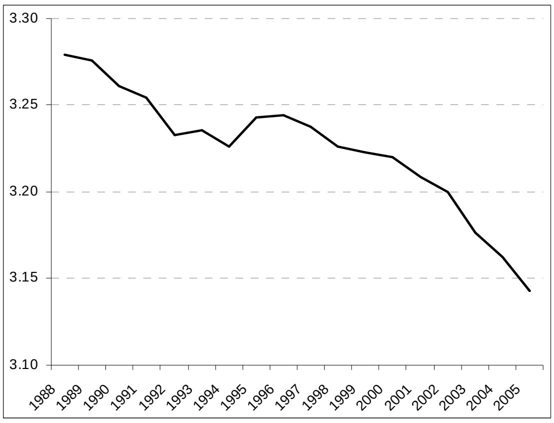
Table 4
Regression results, EU import concentration on time trend

	(1)	(2)	(3)	(4)	(5)	(6)
	Theil Overall	Hrfal Overall	Gini Overall	Theil Within	Hrfal Within	Gini Within
Time	0.001091	0.000992	-0.000778	0.006959	0.002601	0.002866
	[1.565]	[2.540]**	[7.984]***	[11.477]***	[4.836]***	[7.701]***
Time^2	-0.000397	-0.000203	-0.000035	0.000037	-0.000006	0.000088
	[11.237]***	[10.268]***	[7.158]***	[1.194]	[0.226]	[4.675]***
Constant	3.708313	0.724127	0.91898	0.374646	0.258379	0.307514
	[1269.443]***	[442.112]***	[2250.572]***	[147.390]***	[114.595]***	[197.090]***
Turning Point	1988	1989	1976	1893	2204	1971
Observations	155290	155290	155290	155334	155334	155334
R-squared	0.768	0.628	0.842	0.71	0.407	0.694
Fixed Effects	yes	yes	yes	yes	yes	yes

How about the extensive margin? Figure 4 shows the evolution of simple averages over all products of Theil's between-group component and EU's number of suppliers over time.

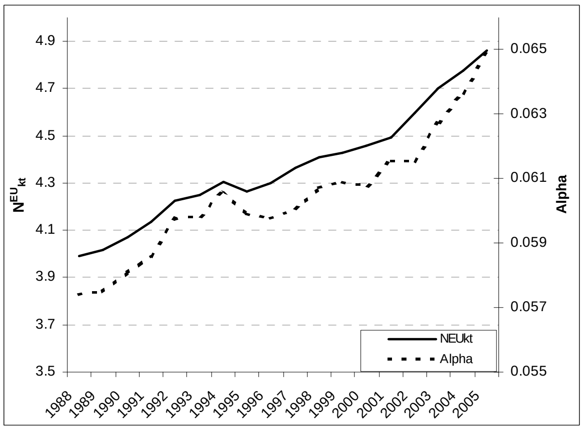
Figure 4
Extensive margin, 1988-2005

Theil's index Between component



Note: Simple averages of Theil-between components at the product (HS8) level.

Number of EU countries partners



Note: Simple averages of number of exporters to EU at the product (HS8) level.

The downward trend in the between component of the Theil index, along with the rising number of suppliers, now suggests *diversification* at the extensive margin. This is what one would have expected in view of declining transportation and trade costs (as suggested by the gravity literature), but it is somewhat conflicting with the rising concentration observed at the intensive margin.

A regression of the between component of the Theil index and the number of suppliers on a time trend (with, again, importer × product fixed effects) confirms the monotone increase. Table 5 reports the results for pooled and fixed-effects regressions of the between component of the Theil index and the number of suppliers to an EU member country on time and its square.

Table 5
Regression results, Theil-between and number of EU suppliers

	(1) Theil Between	(2) Theil Between	(3) Nbre Active Suppliers	(4) Nbre Active Suppliers	(5) Ln(N Active Suppliers)
Time	-0.000335	-0.005861	0.023829	0.039415	0.0141719
	[0.176]	[6.575]***	[2.131]**	[10.033]***	[66.49]***
Time^2	-0.000315	-0.000434	0.00116	0.001554	
	[3.267]***	[9.601]***	[2.012]**	[7.807]***	
Constant	3.265007	3.33285	4.007372	3.808936	0.8659872
	[413.271]***	[891.745]***	[87.890]***	[231.277]***	[374.19]***
Turning Point	1986	1980	1977	1974	-
Observations	155334	155334	155334	155334	155334
R-squared	0.001	0.813	0.002	0.899	0.798
Fixed Effects	no	yes	no	yes	yes

The coefficients in column (5) imply that the number of E.U. suppliers rises by 1,5% a year. This is a slow rise: Given that the average number of suppliers per product is a little less than 5 for the representative E.U. member, it takes about 14 years for the E.U. to add one more supplier.

So far, thus, we get the following picture: on the one hand, supplier concentration is *rising* at the *intensive* margin, meaning that the largest existing suppliers get larger relative to the average. On the other hand, concentration is *decreasing* at the *extensive* margin, as more and more suppliers are added—albeit slowly—to the EU's portfolio of suppliers. These observations can be reconciled as follows. Suppose first that a group of three incumbent suppliers each supply \$3 to the E.U., with two more potential suppliers waiting in the wings with zero exports to the EU. The within Theil index for group 1 (active suppliers) is zero. Suppose now that one of the two potential suppliers gets in at a scale of \$3. Group 1 enlarges to 4 members, group 0 shrinks to 1 member, and the within Theil index for group 1 stays at zero.

Consider now a different setup where the three initial incumbents have unequal export levels; say, \$4, \$3 and \$2 respectively. The group Theil index for group 1 is 0.04. Suppose now that the entrant from group zero enters with exports of only \$1. Then the within Theil index for group 1 *rises* to 0.2. The reason is that the group is now more unequal, as the largest exporter has 4/2.5 = 1.6 times the group average instead of 4/3 = 1.33 previously. Thus, there has been diversification at the extensive margin but the within-group Theil index calculated on active exporters is showing rising concentration.

That entrants enter small-scale is natural if they are being tested or if they themselves want to "try the market" small scale before taking big risks (on this, see e.g. Rauch and Watson 2003). But is it the case that new entrants in the EU's portfolio of suppliers are small in world trade? In order to look at this, we now turn to an adaptation of Hummels and Klenow's definition of the intensive and extensive margins.

2.2.2 Using Hummels and Klenow's decomposition

We use a slightly different definition of the extensive margin due to Hummels and Klenow (2005, henceforth HK). They defined the intensive and extensive export margins of country *i*, product-wise, as

$$IM^i = \frac{\sum_{k \in \aleph^i} X_k^i}{\sum_{k \in \aleph^i} X_k^W} \tag{13}$$

and

$$EM^i = \frac{\sum_{k \in \aleph^i} X_k^W}{\sum_k X_k^W} \tag{14}$$

respectively. In words, country *i*'s intensive margin is its share of world trade in what it exports (how big it is in what it exports), whereas its extensive margin is the share in world trade of the products that it exports (how important is what it exports). The difference between EM^i and just counting the active export lines is that if country 1 exports, say, carrots and potatoes, whereas country 2 exports cars and computers, they have the same number of active lines, but the extensive margin measured à la HK would be higher for country 2 because what it exports is larger in world trade. It is easily verified that multiplying the extensive margin by the intensive one gives country *i*'s share in world trade.

We adapt the concept to imports and to a geographical instead of product-wise measure. In our setting, the equivalents of HK's intensive and extensive margins are

$$IM_k = \frac{\sum_{i \in S_k} M_k^{i,EU}}{\sum_{i \in S_k} M_k^{i,W}} \tag{15}$$

and

$$EM_k = \frac{\sum_{i \in S_k} M_k^{i,W}}{\sum_i M_k^{i,W}} . \tag{16}$$

That is, product *k*'s intensive margin for the EU is the EU's share of its suppliers' exports (how big it is in its suppliers' exports of good *k*), whereas its extensive margin is the share of its suppliers in world trade of good *k* (how important are its suppliers in good *k*). Whereas in HK's case, multiplying the intensive margin by the extensive margin gives the exporter's share in world trade, here it gives the importer's share in world imports of good *k*. Our extensive margin differs from counting the number of supplier countries as follows. If the EU imports wheat from the US and Australia, and rice from Niger and the Mali, both products are sourced from two countries. However the US and Australia are much larger in wheat trade than are Niger and Mali in rice trade. The extensive margin is, accordingly, higher for wheat than for rice.

Table 6 reports the results of pooled and fixed-effects regressions of the extensive and intensive margins on time and its square. The negative trend at the extensive margin is only significant with the introduction of importer × product fixed effects. The decrease in the intensive margin is significant and robust to the introduction of fixed effects.

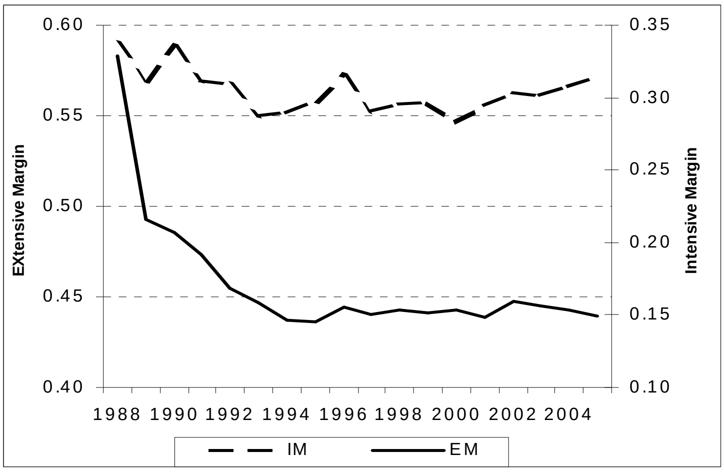
Table 6
Regression results, Intensive and Extensive margins of EU country imports

	(1)	(2)	(3)	(4)
	Extensive Margin	Extensive Margin	Intensive Margin	Intensive Margin
Time	-0.000029	-0.007404	-0.020632	-0.020213
	[0.024]	[10.934]***	[23.982]***	[37.906]***
Time^2	-0.000047	0.000309	0.000777	0.000745
	[0.830]	[9.884]***	[20.650]***	[30.260]***
Constant	0.537564	0.567948	0.200292	0.200116
	[88.946]***	[170.718]***	[44.286]***	[76.385]***
Observations	78665	78665	78665	78665
R-squared	0	0.737	0.019	0.493
Fixed Effects (Importer*product)	no	yes	no	yes

* significant at 10%; ** significant at 5%; *** significant at 1%
Absolute value of t statistics in brackets

However, econometric results must be interpreted very cautiously here. Figure 5 shows fitted curves corresponding to columns (2) and (4) of Table 6. They head down only between 1988 and 1994-5, during which the COMTRADE database was progressively enlarging to new countries. Once COMTRADE reaches steady-state, there is no trend anymore. We take this to be the correct answer to our question.

Figure 5
Predicted HK's intensive and extensive margins, 1988-2005



The flat trend of the extensive margin over 1995-2005 suggests that the combined share of EU suppliers in world trade is constant, even though their number is growing. That is, newcomers into EU supply chains are so small in world trade that they make no difference in the extensive margin. This confirms our interpretation of the rise in the group-1 (active-exporters) value of Theil's index: inequality is rising among EU suppliers, not because large suppliers acquire increasingly dominant positions, but because small suppliers keep on coming on a very small scale.

All in all, in spite of the rise in Theil indices among active suppliers, the picture we get is one of increasingly *diversified* geographical sourcing, albeit by addition of a fringe of very small exporters. We now turn to an analysis of the relationship between public-health concerns and the concentration and identity of EU suppliers.

3. Do food alerts cause supplier concentration?

Trade theory predicts that if trade costs go down or if productivity rises exogenously in a pool of potential suppliers with heterogeneous productivity levels, the number of suppliers will enlarge (Helpman, Melitz and Rubinstein 2008). An exogenous taste for variety, or a desire to limit monopoly positions, would also lead to a larger number of suppliers, although these forces are static. In the presence of heterogenous quality, however, the dynamics of diversification/concentration can be different.

As new exporting countries get on the EU's list of suppliers of good k, they need to build a reputation of quality for their products. The value of information on the level of health risk of a good k drives the search for quality. There is then a trade-off between concentrating on top quality suppliers and keeping several suppliers in order to "test" them.

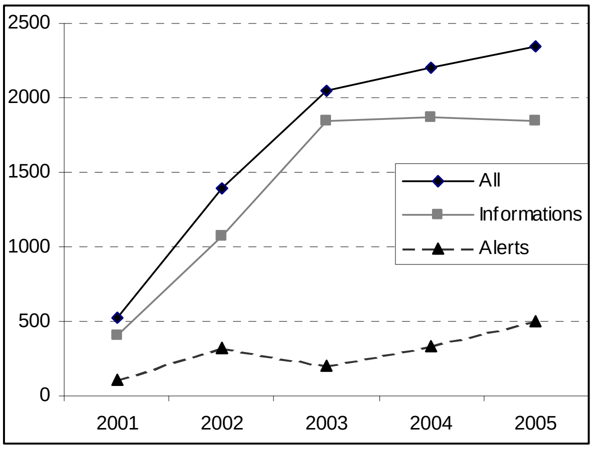
3.1 The food alert data

We use Eurostat's Rapid Alert System for Food and Feed (RASFF). The RASFF is a system of notification and information exchange on emergency sanitary measures taken at the border by EU member states in place since 1979. The database we use records all notifications (19'000 of them) between 2001 and 2008 with the identity of the importing EU member state, exporting country, product, hazard, type of notification, and type of measure. Notifications can be of two types: "information" or "alerts". In the former case, the hazard is deemed limited; the importing member state imposes a measure (e.g. destruction of the shipment) and informs the rest of the Community of the problem, but other members do not follow suit. In the latter case, the hazard is deemed sufficiently serious to warrant action at the Community level. Measures are thus taken simultaneously by all member states against the exporting country for the product concerned.

The database contains complete information regarding products, but in verbal form, as products are not coded into the HS system. We painstakingly coded all incriminated products into HS8 categories over the period 2001-2005 (8'895 observations), and created an entirely new database, which we now briefly describe.

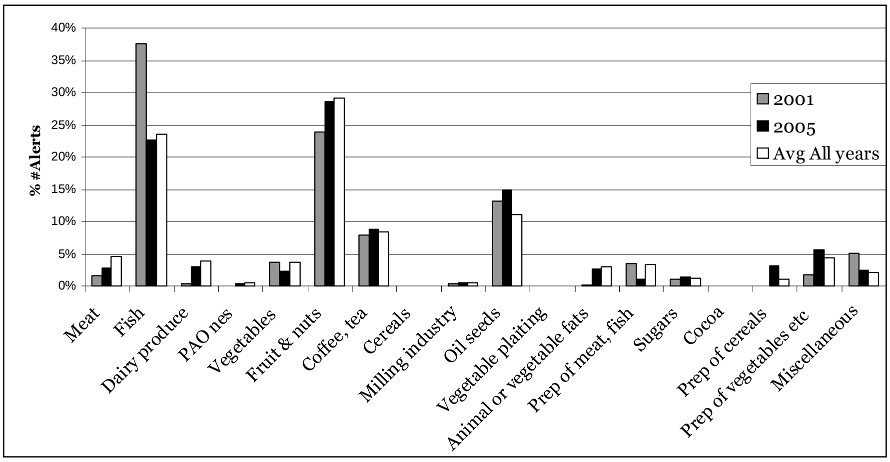
Figure 6 shows the evolution over time of the number of notifications (including informations and alerts). Informations outnumber alerts by a ratio of more than four to one, and represent 82% of all notifications. Both informations and alerts show a sharply rising trend, although somewhat decelerating for informations after 2003.

Figure 6
Total SPS, Alerts and Information notifications, between 2001-2005



There is substantial prima-facie heterogeneity among notifying EU states in the frequency of notifications. Germany (25% of observations), Italy (21%) and Spain (17%) are the top notifying countries, while Ireland accounts for only 0.61% of them. Figure 7 shows that there is also heterogeneity in terms of products. Fishery products (30%), Fruit and Nuts (23%) and Coffee & Herbs and spices (10%) rank highest in terms of reported notifications.

Figure 7
Main Sectors concerned by SPS notifications



Note: Simple average of the number of notifications at the product (HS8) level

In terms of hazards, considering all years and importers, the main cause of notifications for agricultural products is contamination by mycotoxins (mainly aflatoxin), which alone accounts for 40% of the notifications. The second cause is contamination by residues of veterinary medicinal products (chloramphenicol, nitrofuran, and tetracycline) which together account for 13% of the notifications. Then comes the presence of pathogenic micro-organisms (10%) and contamination by pesticide residues (3%).

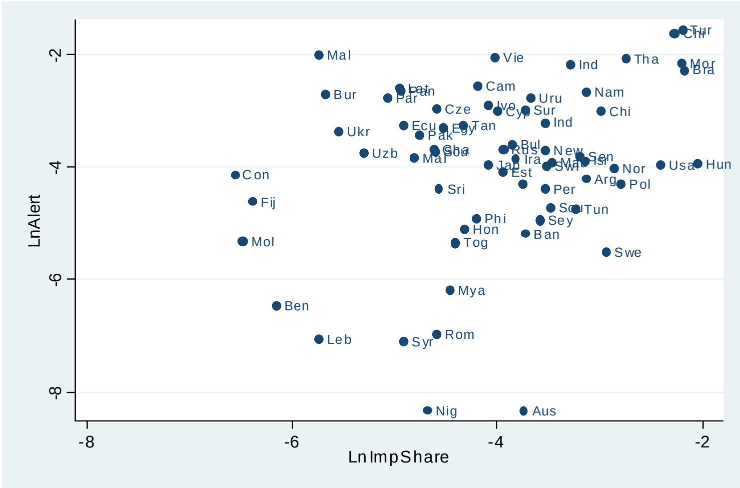
The dataset also details the action taken after each notification. Overall, 92.7% of notified shipments are stopped at the border. In 42.2% of the cases, they are destroyed. The rest (50.5%) are re-dispatched to other destinations; that is, they do not penetrate the EU market but will nevertheless end up in somebody's mouth. An additional 0.4% of imports are banned (Table 7). Thus, whether alerts or informations, notifications are extremely restrictive.

Table 7
Main actions taken following notifications, 2001-2005

	2001		2002		2003		2004		2005			
	Info	Alert	Info	Alert	Info	Alert	Info	Alert	Info	Alert	**Total**	**%**
Physical treatment	0	0	1	0	6	0	27	2	61	0	**97**	**1.3%**
Product seized & destroyed	264	66	614	131	616	109	410	222	451	353	**3236**	**42.2%**
Product re-dispatched	120	31	197	28	1049	29	1189	44	1137	56	**3880**	**50.5%**
Ban	0	0	1	2	1	0	4	5	7	12	**32**	**0.4%**
Reinforced checking & screening	9	1	6	5	17	0	5	0	40	4	**87**	**1.1%**
Others	6	0	44	6	54	10	106	11	72	36	**345**	**4.5%**
Total	**399**	**98**	**863**	**172**	**1743**	**148**	**1741**	**284**	**1768**	**461**	**7677**	**100%**

The level of sanitary risk associated with imported agri-food products can result from (i) intrinsic product characteristics, as some products are more vulnerable than others to contamination, (ii) supplier characteristics, as some producers are more able than others to apply necessary controls, or a combination of both. Figure 10 shows a scatter plot of exporter shares in notifications against their share in EU imports, both in logs and averaged over years and products. Along the diagonal, China, Turkey and Brazil are most affected by SPS notifications, but they are also the EU's largest suppliers. Dispersion around the diagonal is substantial; countries like Poland, Hungary or the US are large exporters, but subject to relatively few notifications; at the other end of the spectrum, Vietnam, India and Indonesia suffer a disproportionate number of notifications given their relatively lower import shares.

Figure 10
Mains exporters concerned by SPS notifications, all years and products



The dispersion around the diagonal suggests that important country-specific characteristics, over and above their sales volumes, affect the number of times their exports are affected by notifications. These characteristics include of course the product composition of their exports, but they may include as well characteristics of national production systems which must be taken into account when assessing the level of product-specific sanitary risk.

In the econometric analysis that follows, we combine the RASFF database with the EUROSTAT data on EU agri-food imports analyzed in the first part of this paper. The sample period is restricted to 2001-2005 where both trade and notification data are available.

3.2 Product risk and concentration

As explained in the introduction, we use a two-stage procedure where observed product riskiness, used as explanatory variable in the second-stage regression, is estimated in a first-stage auxiliary regression. The procedure goes like this:

Step 1.

For a product k and an exporter i, the dependent variable is A_{ik}, the combined count of notifications from all EU member states between 2001 and 2005. Thus, the unit of observation is an exporter $\times$ product pair and the regression is cross-sectional. Regressors include S_{ik}, exporter i's initial share in EU imports of product k; τ_k, the ad-valorem equivalent of the EU's MFN tariff on product k;

Q_k, a dummy variable indicating whether product k is affected by a quota during the sample period; D_k, a dummy variable indicating whether product k has been the object of a dispute at the WTO between the EU and any other country. Variables τ_k, Q_k, and D_k control for a possible protectionist agenda. We also include B_k, a dummy variable indicating whether exporter i is affected by a ban on product k during the sample period. B_k controls for decreases in the incidence of notification resulting from reduced imports rather than reduced risk. Finally, the regression includes product and exporter effects δ_k and δ_i. Formally,

$$A_{ik} = f\left(\alpha_0 + \alpha_1\tau_k + \alpha_2 Q_k + \alpha_3 D_k + \alpha_4 B_k + \delta_i + \delta_k + u_{ik}\right) \tag{17}$$

where u_{ik} is an error term. Because the number of notifications is a count (with a huge proportion of zeroes), estimation is by Poisson or negative binomial.[4]

We also control for the initial value of EU imports of product k in the year 2000 (one year before the sample start), as products imported in large volumes are likely to be inspected (and therefore to fail inspections) more often than others.[5]

Step 2.

Estimated coefficients on product dummies, $\hat{\delta}_k$, are retrieved from Step 1 and used as explanatory variables in a panel regression of concentration indices, where the unit of observation is a product $\times$ year pair.[6] That is, the second-stage equation is

---

[4] This is largely inconsequential, as consistency of second-stage estimates does not depend on the correct specification of the first-stage equation.

[5] This is done using the "exposure" option for count models in STATA, which is equivalent to including the initial volume of imports as a regressor with a coefficient constrained to be one.

[6] When estimated coefficients were not significant at the 10% level, they were set equal to zero.

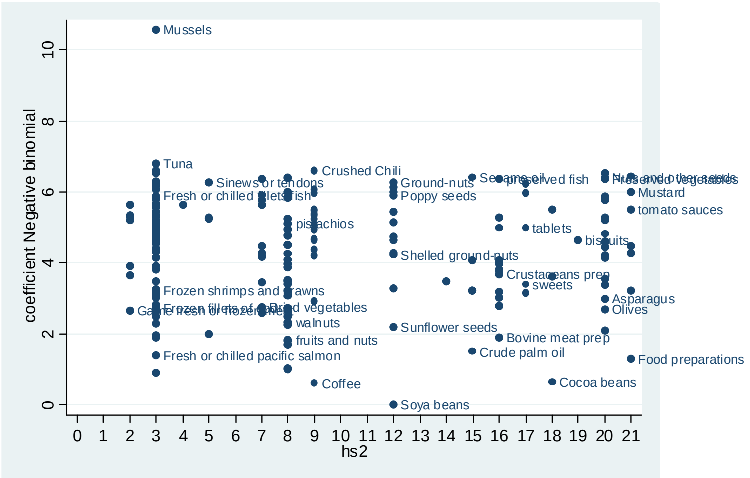
$$C_{kt} = \beta_0 + \beta_1 \tau_k + \beta_2 Q_k + \beta_3 D_k + \beta_4 \hat{\delta}_k + \beta_5 \delta_t + \beta_6 \hat{\delta}_k \delta_t + v_{kt} \quad (18)$$

where C_{kt} is a measure of concentration (within- and between-groups components of Theil's index, or simple number of suppliers) for good k in year t and other variables are as before, except for time effects δ_t which enter the equation both linearly and interacted with product-risk estimates from Step 1.

4.2.3 Results

First-step regression results yielded over two thousand estimated product coefficients. The distribution of significant point estimates is shown in Figure 8.

Figure 8
Distribution of significant point estimates on product dummies



It can be seen that no chapter stands out as having particularly high risk levels, except for fisheries products, with mussels as an unsurprising outlier. It is also remarkable to see that traditional tropical products such as coffee and cocoa, whose share in EU foodstuff imports is, as noted, declining, are among the safest.

Second-step regression results are shown in Table 8.

Table 8
Regression results, second stage

	(1)	(2)	(3)
	Theil Within	Theil Between	Nber Suppliers
Product risk a/	0.044***	-0.128***	1.638***
	(6.427)	(-12.033)	(13.224)
risk*Time b/	0.088***	-0.044**	0.796***
	(7.345)	(-2.340)	(3.645)
Tarrif_2005 c/	0	0	-0.010*
	(1.091)	(-0.550)	(-1.779)
Quota_2005 d/	-0.212***	0.357***	-2.220***
	(-9.853)	(10.580)	(-5.672)
Ban e/	-0.350***	0.562***	-5.308***
	(-24.094)	(24.676)	(-20.073)
Dispute f/	-0.093	0.142	-0.901
	(-1.369)	(1.340)	(-0.731)
Imports g/	6.15e-10***	-9.57e-10***	1.87e-08***
	(13.903)	(-13.826)	(23.289)
Constant	1.076***	2.070***	12.765***
	(102.057)	(125.346)	(66.551)
Observations	7051	7051	7051
R-squared	0.219	0.232	0.263
Time fixed effects	yes	yes	yes

t-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

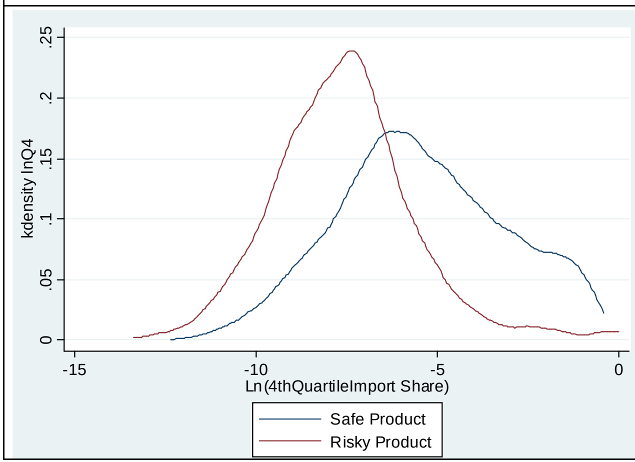
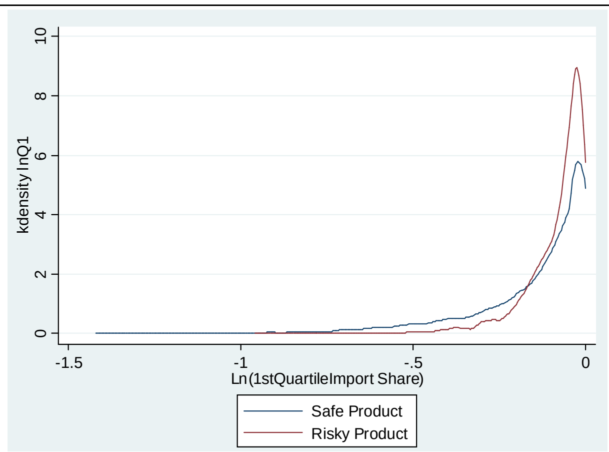
Note:
a/Product risk coefficient estimated in step1
b/Interaction term between time variable and a risk dummy variable, that takes the value 1 if for the product risk coefficient is positive
c/Ad-valorem equivalent of protection measures for product *k* in 2005
d/Dummy variable that takes the value 1 if the product was imposed a quota measure in 2005
e/Dummy variable that takes the value 1 if the product was imposed a ban between 2001 and 2005
f/Dummy variable that takes the value 1 if a trade concern was reported for the product between 2001 and 2005
g/ EU imports of product *k* , in thousand euros

The dependent variable is the within-groups component of the Theil index (the intensive margin) in column (1), its between-groups component (the extensive margin) in column (2), and the number of suppliers in column (3). Coefficients of our constructed measure of product risk are all highly significant (at the 1% level), confirming that product riskiness seems indeed to affect sourcing concentration.

Thus, again, the evidence points in conflicting directions. On one hand, column (1) suggests that concentration is higher at the intensive margin for riskier products. On the other hand, column (2) suggests that concentration is lower at the extensive margin for those products, and column (3), that the number of suppliers is higher. We already observed, in Section 2, that the distribution of EU suppliers was evolving precisely in that direction—concentration at the intensive margin and diversification at the extensive margin. Thus, combining our results in Section 2 with those of the present section, it seems that the distribution of EU suppliers is converging toward the pattern that we observe for the riskiest products—increasingly dominant suppliers with a growing fringe of small-scale ones.

Figure 9 shows the first and last quartile import share distribution in 2005 for risky versus safe products. Risky products are products with a positive risk coefficient. For the smallest partners (last quartile of the import share distribution), the risky products distribution is shifted to the compared safe products. While for the biggest exporters (first quartile of the import share distribution) the curves are very similar and no shift in either direction is observed. Thus, there is a rising polarization between the bottom and the top of the distribution for risky products.

Figure 9
Import share distribution for risky and safe products, 2005

Smallest exporters, last quartile	Biggest exporters, first quartile
	

5 Concluding remarks

This paper establishes a stylized fact on EU import concentration in agro-food products and a correlation with the degree of product safety. We have shown that EU imports of agro-food products over 1988-2005 show a pattern of concentration at the intensive margin and diversification at the extensive margin, the more so for products that EU deemed risky, as demonstrated by the number of food alerts that occurred on that product between 2001 and 2005.

While previous empirical work have focused on the ex-ante impact of standards on trade flows, this paper is, to our knowledge, the first to assess the impact of standards on trade flows ex-post. Using a new dataset - that has never been exploited before- on food alerts that can provide information on the effective (ex-post) implementation of SPS norms by EU importing countries, this paper contributes to the empirical debate about the evolution of geographical concentration of agrofood imports across time. The empirical results are clear. European importers tend to procure their agrofood products from an increasingly large portfolio of suppliers but large orders are concentrated on few among this pool of suppliers.

The policy implications of these results are of significant interest. Indeed as EU foodstuff distributors show growing concerns for food safety, the access to EU markets developing countries enjoy may be constrained by increasingly stringent sanitary requirements. While almost all papers address the issue of developing countries exports opportunities from the exporting country viewpoint, we consider it from the importer point of view. Developing countries export opportunities especially for high-value food products -fresh and processed fruits and vegetables, fish, meat, nuts, and spices- are shaped by importers requirements. Therefore understanding how the implementation of sanitary standards may affect importers suppliers selection is of critical importance for developing countries to maximise the magnitude of these opportunities.

References

Amurgo-Pacheco, Alberto, and M. D. Pierola (2008), "Patterns of Export Diversification in Developing Countries: Intensive and Extensive Margins", Policy Research Working Paper No. 4473, The World Bank.

Besedes, T. and T. Prusa (2006a), “Surviving the U.S. Import Market: The Role of Product Differentiation”, Journal of International Economics 70, 339-358.

– and – (2006b), “Ins, Outs, and the Duration of Trade”, Canadian Journal of Economics 39, 266-95.

Brenton, Paul, J. Sheehy, and M. Vancauteren (2001), “Technical Barriers to Trade in the European Union: Importance for Accession Countries”, Journal of Common Market Studies, 39(2), 265-284.

Carrère, Céline, V. Strauss-Kahn and O. Cadot (2007), “Export Diversification: What’s Behind the Hump?”; mimeo, University of Lausanne.

Campa, Jose Manuel and L. Goldberg (1997), “The Evolving External Orientation of Manufacturing Industries: Evidence from Four Countries”; NBER Working Paper #5919.

Disdier, Anne-Célia, L. Fontagné, and M. Mimouni (2007), “The Impact of Regulations on Agricultural Trade: Evidence from SPS and TBT Agreements”, Working Paper No. 2007-04, CEPII.

Ethier, Wilfred (1982), “National and International Returns to Scale in the Modern Theory of International Trade”; American Economic Review 72, 389-405.

– (1998), “Regionalism in a Multilateral World” ; Journal of Political Economy 106, 1214-1245.

European Commission (2005), “Guidance Document on certain key questions related to import requirements and the new rules on food hygiene and on official food controls.”

European Commission (2000), “Guide to the Implementation of Directives Based on the New Approach and the Global Approach”, http://europa.eu.int/comm/enterprise/newapproach/newapproach.htm.

Fontagné, L., Mimouni, M., Pasteels, J.M., 2005, "Estimating the Impact of Environmentally –Related Non-Tariff Measures." World Economy, 28(10): 1417-1439.

Fujita, Masahiro; P. Krugman and A. Venables (1999), The Spatial Economy; MIT Press.

Garcia-Martinez, Marian, and N. Poole (2004), The development of private fresh produce safety standards: implications for developing Mediterranean exporting countries; Food Policy 29, 229-255.

Hausmann, R. and D. Rodrik (2003), "Economic Development as Self-Discovery"; Journal of Development Economics 72, 603-633.

–, J. Hwang and D. Rodrik (2005), "What You Export Matters"; NBER working paper 11905.

Imbs, Jean, and R. Wacziarg, 2003, "The Stages of Diversification", American Economic Review, 93(1), 63-86.

Jaffee, Steven (2003), "From Challenge to Opportunity: Transforming Kenya's Fresh Vegetable Trade in the Context of Emerging Food Safety and Other Standards in Europe," Agriculture and Rural Development Discussion Paper 1, World Bank.

Jaffee, Steven, and S. Henson (2004), "Standards and Agro-Food Exports from Developing Countries: Rebalancing the Debate," World Bank Policy Research Paper No. 3348. World Bank.

Jaffee, Steven, and al. (2005), "Food Safety and Agricultural Health Standards: Challenges and Opportunities for Developing Country Exports," Report no. 31207, Poverty Reduction & Economic Management Trade Unit and Agriculture and Rural Development Department, World Bank.

Klinger, Bailey and D. Lederman (2004), "Discovery and Development: An Empirical Exploration of 'New' Products; mimeo.

– and – (2005), "Diversification, Innovation, and Imitation off the Global Technology Frontier"; mimeo.

Lorenzo Cappellari & Stephen P. Jenkins, 2004. "Modelling Low Pay Transition Probabilities, Accounting for Panel Attrition, Non-Response, and Initial

Conditions," CESifo Working Paper Series CESifo Working Paper No. , CESifo GmbH

Maskus, K.E., Wilson, J.S., Otsuki, T. (2000), “Quantifying the Impact of Technical Barriers to Trade. A framework for Analysis.” Mimeo, World Bank.

Maskus, K.E., Otsuki, T., Wilson, J.S. (2005), "The cost of compliance with product standards for firms in developing countries: an econometric study." Policy Research Working Paper Series 3590, The World Bank.

Moenius, Johannes (2006), “The Good, the Bad, and the Ambiguous: Standards and Trade in Agricultural Products”, Paper presented at the IATRC Summer Symposium, Bonn, May 2006, http://www.agp.uni-bonn.de/iatrc/iatrc_program/Session%203/Moenius.pdf.

Otsuki, T., Wilson, J.S., Sewadeh, M., (2001), “Saving Two in a Billion: Quantifying the Trade Effect of European Food Safety Standards on African exports.” Food Policy, v-26, pp.495-514.

Plaggenhoef, W. van ,M. Batterink and J. H. Trienelkens (2002), “International Trade and Food Safety: Overview of Legislation and Standards,” Global Food Network

Rauch, James, and J. Watson (2003), “Starting Small in an Unfamiliar Environment,” International Journal of Industrial Organization, 21, pp. 1021-1042.

World Bank (2005), “Food Safety and Agricultural Health Standards: Challenges and Opportunities for Developing Country Exports”; Poverty Reduction & Economic Management Trade Unit and Agriculture and Rural Development Department Report 31207.