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Abstract

There is burgeoning discussion in the literature about trade intermediaries and more precisely about their specific role in trade. Using very original data, our article sheds light on the behavior of trade intermediaries when importing fresh fruits and vegetables in France. To do so, we distinguish the shares of direct and indirect imports of fresh produce respectively operated through French brokers and through French retailers. Accounting for the bounded nature of the share, we show that brokers are more likely than retailers to operate in small countries with high variable costs.

JEL codes: F23, Q17, Q18

Keywords: Importers, Intermediation, Fresh produce, International Trade

1 Introduction

The main functions of market intermediation are disseminating market information and/or connecting buyers with sellers. The Internet has dramatically reduced search costs by giving consumers the ability to compare between quality and price. However, while information is more available than it used to be, we can observe from the field that intermediaries maintain their activities in a lot of markets – which justifies the importance of considering their economic activity.

In Industrial Organization literature (at least), market intermediation is not a new topic. Much research has shown the advantages of using intermediaries over direct exchange in a number of activities whatever the sector (Spulber, 1999). Belleflamme and Peitz (2010) make a distinction between dealers and platforms depending on the product ownership. Dealers buy at a wholesale price and resell at a retail price to their customers. Platforms are matchmakers. They match sellers with buyers, and get a commission. From the Industrial Organization perspective, the underlying question is about the most profitable form of this intermediation (Belleflamme and Peitz, 2010).

Intermediation in international trade literature has been developed more recently because of the recent availability of data at firm level. There is a burgeoning discussion in international trade economics about trade intermediaries and more precisely about their specific role in trade flows. In these works, trade intermediaries import or export products in the name of domestic firms, which need them - or not - depending on their productivity level. In other words, the more productive the domestic firm the more she imports directly. Market intermediaries support the exchanges of less productive firms while the least productive ones remain in the domestic market (Ahn et al., 2011).

In this article, we follow the definitions of intermediaries used in Industrial Organization literature. Indeed, we are able to distinguish between flows operated by brokers and by retailers from an original dataset of in-

ternational trade transactions. Brokers, who operate indirect imports, do not buy any products; they only get a commission on the total value sold. They offer foreign products to buyers at a wholesale price (buyers can be retailers or wholesalers). Retailers, who operate direct imports, purchase foreign products at a wholesale price to sell them at a retail price in their own supply chain. Retailers sell to consumers products imported by brokers and/or directly by themselves. Are imports by brokers and retailers similar? And if not, how and why do they differ? Considering the activity of importing in an active way, we specifically address the importance of making a distinction between these two broad categories of intermediation. Brokers tend to specialize on less accessible markets whatever the product whereas retailers appear to specialize on more sensitive products from more accessible countries.

Our empirical analysis focuses on the shares of direct (retailers) /indirect (brokers) imports for specific country-product pairs imported to France and aims at understanding the specific role of those two agents in fresh produce imports. Our approach is original because we look at the flip side of the coin considering the activity of importing in an active way, through two identified channels, direct and indirect imports. To do so, we build our analysis on existing theoretical and empirical literature that has mostly focused on the decision of exporters to rely or not on trade intermediaries (assumed as a technology) (Ahn et al., 2011; Antràs and Costinot, 2010). However, whereas exporting behavior is well documented in research, only a few works are analyzing imports (see Bernard et al., 2005; Bernard et al., 2010). Second, our analysis is not constrained by the availability of data as some other research works could be, which would make comparison of results between studies difficult (Bernard et al., 2010). Last but not least, we account for the bounded nature of the imports share (our dependent variable) and provide unbiased estimator coefficients.

Our results first underline the importance to distinguish between trade

intermediaries and second to rely on an estimation method that takes into account the distribution of the shares at the extremes, that is, when there is a mass at 0 and at 1. The probability of a full share - i.e. that the agent is the only one to import a specific product from a specific country - increases for small size markets for both retailers and brokers. For retailers, the sensitivity of the product also has a positive impact. The probability of a null share - i.e. that the agent is absent from a country-product pair - decreases with distance from the origin country for brokers whereas it increases for retailers. Once again, the sensitivity of the product has a significant impact for retailers and reduces their probability of a null share. When the share is in-between, that is $0 < s < 1$, brokers have a higher share than retailers on small-size markets, far from France and with high tariffs on the product.

This article is organized as follows: the second section presents the related literature on the activity of trade intermediaries and the reading done by the New New International Economics literature. In the third section, we describe data and highlight empirical facts on French trade of fresh produce. The fourth section highlights the impact of a set of country and product variables on the retailers' (direct imports) and brokers' (indirect imports) imports shares accounting for the bounded nature of the shares. The last section concludes.

2 Intermediaries in trade: related literature

There are several strands of literature that have focused on the recourse of intermediaries or middlemen in transactions. The two terms have been used interchangeably by authors to define their activities, leading to a very broad and vague definition of what is an intermediary. For some scholars, middlemen are more present in markets where there is a lack of information between buyers and sellers. Rubinstein and Wolinsky (1987) underlined that intermediaries act as matchmakers and reduce transaction costs between buyers

and sellers. They also act as "guarantors of quality" or "experts" when it is difficult to judge of the quality of the product (Biglaiser, 1993; Biglaiser and Friedman, 1994). For Spulber (1996), the type of information imperfection in the markets will determine the activities of the intermediary: price setting and market clearing, providing liquidity and immediacy, matching and searching or guaranteeing and monitoring. More recently, Antràs and Costinot (2010) developed a theoretical model of trade with the presence of a technology of intermediation. They show that the presence of intermediaries facilitates the realization of the gains from trade. Moreover, intermediaries can gain advantages over direct exchanges by pooling and diversifying risk (Spulber, 1996). For Spulber (1996), an intermediary can be defined as "an economic agent who purchases from suppliers for resale or who helps sellers and buyers to meet and transact". Some authors, as Hackett (1992), clearly identify two types of intermediaries: on one hand, matchmakers who never own the product and work on a commission basis and, on the other hand, traders who are merchants and trade products for their own account. The definition provided by those authors converges and depends on the ownership of the product that intermediaries deal with. In transactions costs economics, some scholars have focused on the existence of brokers in transactions (Rindfleisch & Heide, 1997; Williamson, 1979). For instance, Weiss and Anderson (1992) analyze the decision of manufacturers whether to vertically integrate the selling function or to use an outside selling organization. The underlying question is about the profitability between the different forms of intermediation, the two extreme forms of intermediation being dealers and platforms (Belleflamme and Peitz, 2010). The former buys to sell and the latter only gets a commission when matching buyers with sellers. However, it is difficult to identify them in data as empirical evidence of differences between the two types is difficult to provide.

In the New New International Economics, there is a burgeoning literature that explores the great role played by intermediaries in the trade process

using firm level data.[1] Scholars mostly focus on the determinants of the export mode that firms choose. Either firms would export directly or they would use an intermediary (Ahn et al., 2011; Blum et al., 2009). But, those settings consider the intermediary in a very passive way and, as suggested by Bernard et al. (2010), importing behavior has been mostly ignored.

In Bernard et al. (2010), intermediaries are non-producing or consuming firms and they are sales intermediaries. Their study compares manufacturers and intermediaries in all Italian sectors that are respectively assumed to directly/indirectly export. They show that firms have direct profit according to the export mode they choose. Low productivity firms will choose the intermediation technology whereas more productive ones will export directly. The respective share of indirect vs. direct export will depend on the export destination, as more productive firms will be able to overcome high trade costs. Ahn et al. (2011) modify a model of heterogeneous firm "à la Melitz" (Melitz, 2003) by introducing an intermediation technology. Firms' choice to export would depend on the characteristics of the destination country (size of the foreign country, cultural distance, etc) and on their own characteristics, namely their productivity. The least productive firms would export using intermediaries. The underlying hypothesis is that fixed costs to export using intermediation technology are lower than direct exporting fixed costs. In their empirical setting, they consider intermediary as all Chinese firms which have "trade" in their name and consider that exports passing through these firms are indirect exports. Based on this assumption, they show that exports via the intermediation technology will be larger in countries with small market size, higher variable costs and higher fixed costs of exporting. In other words, these studies considered that the activity of intermediaries was maintained because of firms that are less productive than firms that could export directly. However, results are difficult to compare because none of these papers use the same definition of trade intermediaries (Bernard et al., 2010) and they

[1] see Rauch, 2001; Feenstra & Hanson, 2004

consider trade intermediaries as a homogeneous type.

In the following, we distinguish indirect and direct imports using the definition provided by the Industrial Organization literature and the imports industry of fresh produce as an illustrative example. On one hand, we consider brokers[2] who do not buy any products and act as matchmakers. Brokers import as their main activity and develop a strategy to do so. They help the transaction between foreign producers and French buyers. Most of the time, buyers are retailers.[3] Thus, brokers' share of imports would represent the share of indirect imports. On the other hand, we consider direct imports by retailers (intermediaries that sell directly the products to consumers without any transformation). This distinction allows us to introduce heterogeneity in the wide definition of trade intermediaries at the product level. We combine different sources of data to provide valuable insights on French direct/indirect imports of fresh produce: original data at firm level, data on some characteristics of fresh fruits and vegetables and classical trade data on country characteristics.

3 Data

3.1 Firm Level Data

First, we restrict the French customs dataset to the imports of fruit and vegetables in 2005. The sub-dataset documents all transactions on fresh produce from foreign country to French firms. For each firm which imported fruits and/or vegetables, we know the annual value and volume of imports disaggregated by country of origin at the 6-digit product level. Second, we distinguish between trade operators (firms whose main activity is to trade)

[2]Brokers get a commission which is about (in average) 6 or 7% of the total value they import to the French market.

[3]According to the survey conducted in 2006 by one of the authors (see below in the data section).

and other firms importing fresh produce (for instance manufacturers who transform fresh produce)[4]. To do so, we merge this customs dataset, using the identification number of the firm (SIREN), with the "Trade" section of the "Enquete Annuelle d'Entreprises" (EAE annual survey) that records economical information on firms (total sales, employees, etc.) whose main activity is "trade" and of more than 20 employees.

The next step further is to identify brokers - who do not buy the product - and retailers - who buy and resale in their own supply chain - among the different types of importing and trading firms. In the French nomenclature, brokers do not have any specific activity code (APE) and, as a consequence, we are not able to isolate them in the main dataset. To get round it, we use data from a survey done during the summer 2006. Brokers were asked questions, face-to-face, about the firm situation in 2005, and particularly about characteristics such as total amount of sales, main produce, specialization. From this survey[5], we are able to identify 100 firms which operate as fresh produce brokers. It is important to note that, most of the time, those brokers are small firms with less than 20 employees and as a consequence are not present in the "EAE annual survey". In other words, isolated data for brokers of fresh produce is not available anywhere else. Then, we identify 90 firms concerned with "retailer supply chain".[6] Our final dataset is built on 190 French firms (100 brokers and 90 retailers) which import and trade fresh fruits and vegetables in France. For all of those 190 firms, we know the total volume and value of imported fresh produce and the economic characteristics (total sales, number of employees and value added) for the year 2005.

[4]We rule out of our sample all manufacturers since they are not at the core of our analysis.

[5]The survey gathers data on all brokers located in the Perpignan and Rungis markets which are the main imports markets of fresh fruits and vegetables in France.

[6]We compiled data from firms with the French APE code (main activity code) 511P, 521D, 521F.

3.2 Product Level Data

Product characteristics are expected to play a great role in determining the share of direct or indirect imports since products are at the core of the transactions. In the fresh produce industry, an important characteristic of fresh fruits and vegetables, at least in Europe, is that these products are very sensitive to pesticides. In France, the definition of food safety for fresh fruits and vegetables is regulated by the Maximum Residue Limits for pesticides (MRLs) set by the European authorities (Regulation (EC) No 396/2005) or French law (Decree 04/08/1992, as amended). In French law, importers of fresh produce are considered as producers, because they are the very first to introduce foreign produce into the national market.[7] As producers, first importers of fresh produce are thus liable under criminal law if the imported products do not comply with the regulations in force (Rouvière et al., 2010). In order to take into account this sensitivity of fresh produce, we refer to the list of products most sensitive to pesticides published by the Environmental Working Group (http://www.ewg.org/). According to this list, we are able to classify fruits and vegetables according to their sensitivity to pesticides. (*Sensitivity*) is a two-class variable that allows identifying the first 12 most sensitive products,[8] all others being considered as sensitive.

Moreover, fresh fruits and vegetables are perishable and fragile products which need to be handled with special care when they are imported. As Emlinger et al. (2008) point out, we must take into account the degree of perishability of the product which could impact transport costs. We use the index of perishability provided by Emlinger et al. (2008) to build two groups of perishability from the least perishable ($Perishability = 0$) to the most perishable ($Perishability = 1$), perishability being a combination of conservation time, respiratory intensity and fragility of the goods.

[7] Art. L 221-1 ; Art. L 212 -1, French Consumption Law.

[8] i.e. tomatoes, strawberries, citrus, grape, cantaloupe, sweet pepper, green salads, peaches, celery, carrot, cauliflower, pears.

3.3 Country Level Data

To characterize the country from which firms import products, we use the classical trade variables. Growth Domestic Product - (GDP) - is used to approximate market size and comes from the World Bank's World Development Indicators Database. We complement the information given by the variable GDP with the domestic production in 2005 at the HS6 level provided by the Food and Agriculture Organization[9].

We also proxy variable and fixed trading costs with distance (*Distance*), the number of Documents (*Adm doc*) required to export from the country of origin and tariffs (*Tariffs*). Geographical distance approximates transportation costs between the country of origin and France. As suggested by Ahn et al. (2011) and Bernard et al. (2010), we also approximate the country-level fixed costs using the number of documents requested for exporting from a country of origin - this information is available from the World Bank's Doing Business dataset. We use product-level tariffs as applied by France to the country of origin. This data is available from the TARIC database (DG Taxation and Customs Union).

4 Retailers and brokers in the fresh produce trade

During the year 2005, brokers and retailers - i.e. 190 identified firms in our sample - represented 64% of the value made by trade intermediaries and 37% of the whole French imports (in value).[10] In the fresh produce imports industry in France, brokers and retailers are the two main agents but they are very different. The main activity of brokers is to import whereas the

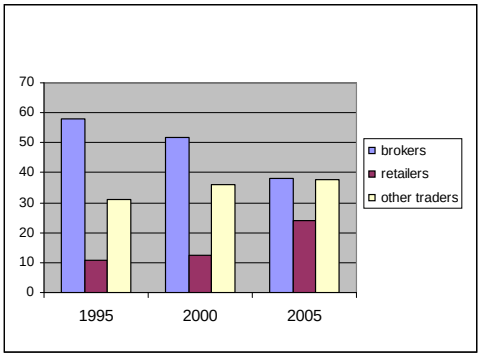
[9] Estimations using FAO data are provided in the Appendix B.

[10] It is worth noting that the trading firms, not counting brokers and retailers, represent 21 % of French imports of fresh produce. In other words, we focus in this article on the main operators of the fresh produce imports industry.

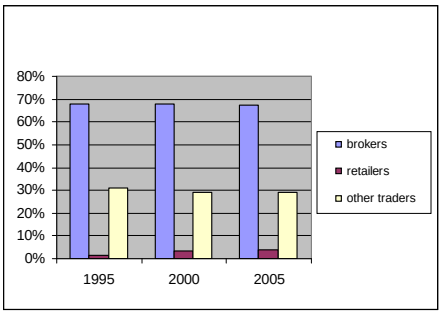
first aim of retailers is selling food items to consumers. Regarding firms size, brokers are smaller than retailers. As noted, brokers have an average number of 18 employees with a median at 10 whereas for retailers the mean is 3072 with a median at 344 employees. We can observe the same trend with the magnitude of sales. In 2005, importers made 22 133 thousand Euros whereas the 90 retailers made 1 176 073 thousand Euros. In total, brokers and retailers import 107 products coming from 100 different countries of origin, which represents a possible combination of 1118 product-country pairs.

4.1 The persistency of brokers in imports flows

We look at data about our 190 firms from 1995, 2000 and 2005. First, we provide evidence that brokers are still present in trade flows. Second, we can observe that flows from brokers and retailers are not identical regarding size and type of countries of origin of their imports. From Graph 1 and Graph 2, we can observe that brokers are more likely to import products from countries outside the EU whereas retailers would rather tend to import product directly from the EU countries. We can also observe that the brokers' share in the EU decreased between 1995 and 2005 whereas their activity outside the EU - where retailers are mostly absent – remained steady. To further this observation, we considered the share of total French imports operated by retailers and brokers in 2005 from the 10 major countries in terms of fresh produce exports, in value (Table 1).



Graph 1: Imports from EU by trade intermediaries



Graph 2: Imports from non-EU countries by trade intermediaries.

Table 1 provides the total value imported by brokers (indirect) and retailers (direct) in 2005 and their respective share. We can observe that brokers mostly import products from less developed and more distant countries (Morocco, Israel, Argentina) than retailers (Spain, Belgium, the Netherlands). Moreover, brokers are significant in flows of fresh produce imported from South Africa (66%), Israel (98%) or Ivory Coast (91%). As suggested on Graph 1, retailers are dominant in flows of produce coming from Europe (Belgium 23%, the Netherlands 22% and Germany 33%).

Country	Total	Retailer (%)	Broker (%)
Spain	1642837	17,4%	35,4%
Morocco	441552,2	1,8%	54,5%
Belgium	361464,8	12,3%	1,6%
Italy	302102,2	6,4%	14,4%
Netherlands	269452,4	17,9%	3,7%
Israel	223405,1	0,0%	91,4%
United States	184070,5	0,0%	4,7%
Ivory Coast	168858,8	0,7%	64,1%
Turkey	105385,8	0,5%	6,6%
South Africa	98551,3	2,8%	45,8%
Germany	88859,77	18,0%	5,5%
Argentina	67010,5	10,0%	42,5%
Chile	67691,09	2,4%	29,9%

Table 1: Imports from trade intermediairies by country of origin 2005 (Sources: French Customs data)

The imports from Spain and Morocco are mostly dominated by brokers. Retailers control 17.4% of produce flows from Spain but they do not import produce directly from Morocco. It is worth noting that these two countries export more or less similar produce and are not far from France (Rouvière et al., 2010). In 2005, flows from Morocco are mostly captured by brokers who represent 54.5% of the total value

Brokers work, for a non negligible part of their transactions, with retailers (Rouvière et al., 2010). Descriptive statistics show us a persistence of some agricultural imports through French brokers when we could actually have expected them to disappear because of the development of private standards which led them to integrate part of the supply chain (Fulponi, 2006). Taking note of this allows us to hypothesize a specific role for brokers: they act as a filter for produce entering the French market and would support some kind of "responsibility" directly linked to the product imported or/and the country of origin.

4.2 Imports flows from brokers and retailers: Customs data & descriptive statistics

Using imports transactions across products and countries for both brokers and retailers, we provide summary statistics in Table 2 to describe the distinct flows of imports (in thousand Euros) from brokers and retailers. We can observe that the average value of imports by brokers is three times larger than the average value of imports made by retailers whose main activity is trading (see 3.1). In the same trend, brokers work in average with more products, import from more countries and deal with more product-country pairs.

	Brokers	Retailers
# Firms	100	90
Total Imports Value (Thousands €)	1 459 810	456 946
	Mean (Median)	Mean (Median)
Products	23.8 (25.5)	17 (9.5)
Countries	7.6 (4)	5.7 (2)
Prod_Country	39 (34.5)	33.6 (9.5)

Table 2: Firm-level summary statistics for imports firms

Going through the 1123 product-country pairs operated by retailers and brokers, we can observe that, among those pairs, 283 are exclusive to brokers and 413 are exclusive to retailers. As for countries, retailers and brokers share 62 countries of origin while they respectively have 16 and 22 exclusive ones. As for products, we notice that retailers and brokers share 86 products and exclusively deal with 19 and 2 products respectively. In 2005, brokers worked with 88 products for a mean value of 16 587 thousand Euros by product whereas retailers worked 105 products for a mean value by product nearly 4 times lower (4 290 thousand Euros). In other words, while brokers seem to work with more countries of origin, retailers work with a greater number of products. Concerning the mean value imported by country, it was three times larger (17 377 thousand Euros) for brokers than for retailers (5 775 thousand Euros).

5 Importing behavior: Brokers vs. Retailers

5.1 Brokers' and Retailers' share of imports

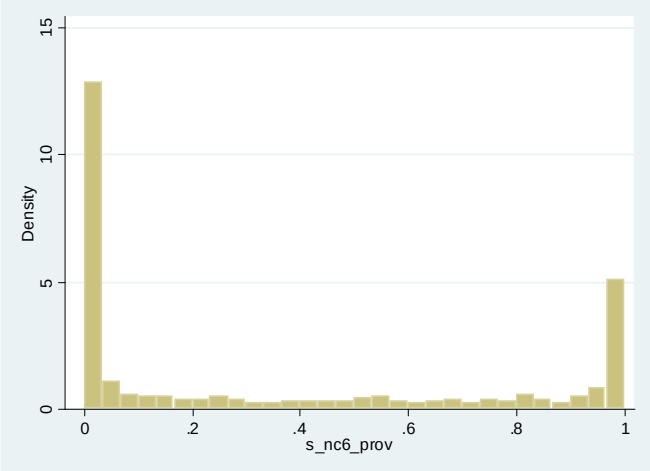
The share of imports to France by agent i is given by:

$$s_{ik}^{Fj} = \frac{\text{Value of product } k \text{ imported from country } j \text{ by agent } i \text{ to France } (F)}{\text{Total value of product } k \text{ imported from country } j \text{ to France } (F)}$$

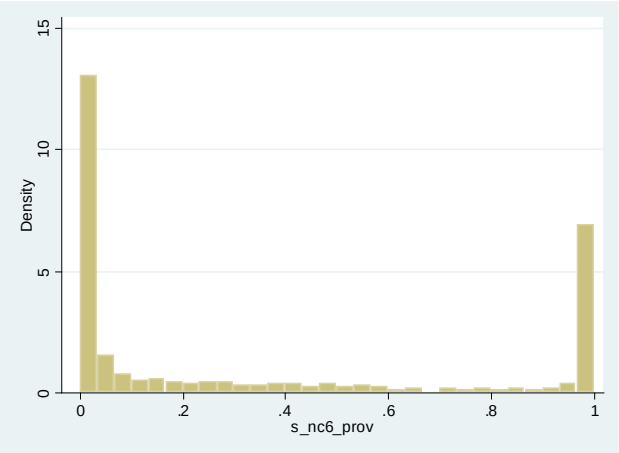
where j is the country of origin of product k (6 digit level). By definition, $s_{ik}^{Fj} \in [0,1]$ and $\sum_i s_{ik}^{Fj} = 1$.

In this article, we are only interested in the importing behavior of brokers ($i = 1$) and retailers ($i = 2$). So, we have only kept in the dataset product-country pairs operated at least by either retailers or brokers, that is $\sum s_{ik}^{Fj} > 0$ but not necessarily equals to one. We have created all the $s_{ik}^{Fj} = 0$ for $i = \{1; 2\}$ to obtain a squared matrix. For instance, $s_{1k}^{Fj} = 0.5$ and $s_{2k}^{Fj} = 0$ means that brokers import 50% of the product k from country j and retailers do not import this product k from this country j.

Graph 3 and Graph 4 give the distribution of the share of imports made in 2005 by both brokers (Graph 3) and retailers (Graph 4).



Graph 3: Brokers' share of imports - country-product level (HS6 level)



Graph 4: Retailers' share of imports - country-product level (HS6 level)

For each product-country pair[11], we can easily observe the importance of null ($s = 0$) and full share ($s = 1$) for both types of agents. Brokers only import products from 63% of the available product-country pairs whereas retailers import from 74.53% of them. Brokers import exclusively (share of imports = 1) from 12.11% of the product-country pairs. Retailers import exclusively from 20.66% of them.

5.2 Alternative approaches to model proportions

To our knowledge, the few existing studies examining how classical trade variables (countries variables) influence the share of firms exports model the share of exports as a linear function of the explanatory variables (see Ahn et al, 2011; Bernard et al, 2010). However, linear models may be inappropriate since assuming a linear function between shares (that are restricted to the interval $[0, 1]$) and explanatory variables may yield that fitted values for the variable of interest would exceed its lower and upper bounds. Moreover, the closer the mean to one of the extremes the lower the variance. When modeling proportions, normality and homoskedasticity are more often

[11] 1123 country-product pairs in total at the nc6 level.

violated and make OLS biased (Paolino, 2001). As a consequence, the inconsistency of the estimates of the regression coefficients then raises issues about the conclusions of such analysis.[12] Ramalho et al. (2011) and Ramalho and Silva (2008) review the technical solutions provided by scholars to deal with this methodological issue. Some scholars use logistic transformation through linearization of the estimation equation to model proportions and infer that $0 < E(Y \mid X) < 1$.Papke and Wooldridge (1996) and Cox (1996), in their seminal papers, propose to use fractional regression model to deal with bounded variables. However, implementing fractional regression requires practitioners to assume that ones and zeros occur through the same process than other proportions. Ramalho et al. (2011) suggest to take into account the specific distribution at the extremes using a three-part model, i.e. two Logistic Models to consider the full and the null shares and a fractional regression model to consider the distribution in between, $s \in [0, 1]$.

A less known alternative has been suggested by Ospina and Ferrari (2010; 2011). They proposed to consider mixed continuous-discrete distributions when modeling proportions observed on $[0, 1), (0, 1]$ *or* $[0, 1]$. Ospina and Ferrari (2011) use the beta law to define the continuous component of the distribution and a degenerate distribution or a Bernoulli distribution at zero or at one. When the distributions combined are a Beta and a Bernoulli distribution, Ospina and Ferrari (2010; 2011) refer to Zero-One Inflated Beta distributions. When the mixed distributions are a Beta and a degenerate distribution, they refer to Zero- or One- Inflated Beta distribution, respectively when only zeros or ones appear in the dataset.
The Beta distribution with parameters μ and ϕ ($0 < \mu < 1$ and $\phi > 0$) , denoted by $B(\mu, \phi)$ has the density function such as:

[12] This methodological issue widely occurs in empirical works (see Cook et al. (2008) for a discussion in the corporate finance literature.).

$$f(y;\mu,\phi) = \frac{\Gamma(\phi)}{\Gamma(\mu\phi)\Gamma((1-\mu)\phi)} y^{\mu\phi-1}(1-y)^{(1-\mu)\phi-1}, \qquad y \in (0,1) \quad (1)$$

where $\Gamma(.)$ is the Gamma function, μ and ϕ being respectively a location parameter and a scale parameter which correspond to the Generalized Linear Models convention (Ospina and Ferrari, 2011). This allows us to write the distribution mean such as, $E(y) = \mu$ and the variance of y ,

$$Var(y) = \frac{\mu(1-\mu)}{(\phi+1)}.$$

The larger ϕ , the dispersion parameter, the smaller $Var(y)$. As Ospina and Ferrari (2011) suggest, we assume that the probability density function of y is given by

$$bi_1(y;\alpha,\mu,\phi) = \begin{cases} \alpha, & if \quad y = c \\ (1-\alpha)f(y;\mu,\phi), & if \quad y \in (0,1) \end{cases} \qquad (2)$$

where $f(y;\mu,\phi)$ is a Beta density (see Eq(1)) and α the probability mass at c that represents the probability of observing zero $(c = 0)$ or one $(c = 1)$, with

$$E(Y) = \alpha c + (1-\alpha)\mu$$

and

$$Var(Y) = (1-\alpha)\frac{\mu(1-\mu)}{\phi+1} + \alpha(1-\alpha)(c-\mu)^2.$$

5.2.1 Estimation

Let y_t be an independant variable such as for each y_t, $t = 1, 2, ..., n$ has a probability function (2) with parameters α_t, μ_t, ϕ_t and α_t, μ_t, ϕ_t are defined

as

$$\begin{aligned} h_1(\alpha_t) &= v_t^T \rho = \eta_1 \\ h_2(\mu_t) &= x_t^T \beta = \eta_2 \\ h_3(\phi_t) &= z_t^T \gamma = \eta_3 \end{aligned} \tag{3}$$

where $\rho = (\rho_{1,}..., \rho_p)^T$, $\beta = (\beta_{1,}..., \beta_k)^T$, $\gamma = (\gamma_{1,}..., \gamma_k)^T$ are vectors of unknown regression parameters, v_t, x_t, z_t are observations on explanatory variables. $\eta_{1,}\eta_{2,}$ η_3 are predictor parameters. $h_1(.), h_2(.), h_3(.)$ being strictly increasing and twice differentiable link functions. Our task, then, is to form a regression model or use three link functions, linking the linear predictor and the observations. The estimation of model parameters is done by the maximum likelihood technique.

Ospina and Ferrari (2011) give the likelihood function for $\theta = (\rho^T, \beta^T, \gamma^T)^T$ in a sample of n independant observations

$$L(\theta) = \Pi_{t=1}^n bi_1(y; \alpha_t, \mu_t, \phi_t) = L_1(\rho) L_2(\beta, \gamma),$$

The log-likelihood function is then given by

$$l(\theta) = l_1(\rho) + l_2(\beta, \gamma) = \sum_{t=1}^{n} l_t(\alpha_t) + \sum_{t:y\in(0,1)}^{n} l_t(\mu_t, \phi_t) \tag{4}$$

Ospina and Ferrari (2011) propose to use a logistic link for μ and α because they must be positive and a log function for ϕ. From those hypotheses we can write our estimation equations as

$$\begin{aligned} \text{logit}(\alpha) &= \rho_0 + \rho_1 X + \rho_2 Z \\ \text{logit}(\mu) &= \beta_0 + \beta_1 X + \beta_2 Z \\ \log(\phi) &= \gamma_0 + \gamma_1 X + \gamma_2 Z \end{aligned} \tag{5}$$

5.3 Comparing approaches: results

We now illustrate the methodological issue we have just raised in order to position our results to what has been done in the literature. First, following Ahn et al. (2011) we estimate the share of imports through the classical OLS estimation with classical trade variables.

Share of imports	OLS regressions	
	Brokers	Retailers
	Coefficient	Coefficient
Constant	0.06 (0.22)	1.68*** (0.23)
Ln GDP	-0.008 (0.007)	-0.03*** (0.007)
Ln Tariffs	0.05*** (0.015)	0.01 (0.016)
Ln distance	0.05*** (0.011)	-0.06*** (0.01)
Subsector fixed effects	YES	YES
No. Observations	1100	1100
Adjusted R2	0.11	0.04

*** significant at 1%level; ** significant at 5% level; * significant at 10 % level.

Table 3: Brokers' & Retailers shares of imports estimated by OLS at the HS6 level

We can observe in Table 3 that the influence of country characteristics is not the same for brokers and retailers: (*GDP)* is not significant for brokers whereas it is negative and significant for retailers. (*Distance*) is significant for both but with opposite sign. Regarding brokers, our results are in line with Anh et al. (2011) for (*Distance)* and (*Tariffs*) but not for (*GDP*). Our results[13], though qualitative, confirm our intuition that we must make a distinction between trade intermediaries and consider them as heterogeneous agents and not as a homogenous type.

Since observations at the boundaries are a natural consequence of individual choices and not of any type of censoring, we can assume that when

[13]If the OLS estimation gives us a qualitative result on the sign of significant variables, as noted, the estimator is biased since the share of imports is bounded.

$s_{ik}^{Fj} = 1$ or $s_{ik}^{Fj} = 0$ the share is not governed by the same process as for other proportions, i.e. when $0 < s_{ik}^{Fj} < 1$ (see Graph 3 and Graph 4 specific to our data). Table 4 and Table 5 present results of the zero and one inflated beta (ZOIB)[14] regression model. In this part, we still use classical country variables to explain the share of imports by brokers and retailers.

	Zero and One inflated Beta model		
	Proportion between 0 and 1	Probability to be 0	Probability to be 1
Share of Brokers	Marginal effects at mean point	Marginal effects at mean point	Marginal effects at mean point
Ln GDP	-0.02*** (0.01)	-0.05*** (0.01)	-0.03*** (0.01)
Ln Tariffs	0.06*** (0.02)	0.04* (0.02)	0.07*** (0.02)
Ln distance	0.06*** (0.01)	-0.06*** (0.02)	-0.004 (0.02)
Subsector fixed effects	YES		
No. Observations	1100		
R2	-		
Lplikelihood	-800.72		
R2 mc Fadden	0.13		
Pseudo R2	-		

*** significant at 1%level; ** significant at 5% level; * significant at 10 % level.

Table 4: ZOIB regression results accounting for zeros and ones to explain the share of brokers in imports at the HS6 level

[14] We use the new routine -zoib- provided by Buis (http://www.maartenbuis.nl/software/zoib.html) in order to consider that ones and zeros are governed by different processes from the other proportions. ZOIB runs a beta model for proportions between zero and one and a logistic regression model for proportions that are zero and one.

Share of Retailers	Zero and One inflated Beta model		
	Proportion between 0 and 1	Probability to be 0	Probability to be 1
	Marginal effects at mean point	Marginal effects at mean point	Marginal effects at mean point
Ln GDP	0.02*** (0.006)	-0.05*** (0.01)	-0.12*** (0.01)
Ln Tariffs	0.004 (0.01)	0.07*** (0.02)	0.05* (0.02)
Ln distance	-0.05*** (0.01)	0.04*** (0.02)	-0.008 (0.02)
Subsector fixed effects	YES		
No. Observations	1100		
R2	-		
Lplikelihood	-411.91		
R2 mc Fadden	0.32		
Pseudo R2	-		

*** significant at 1%level; ** significant at 5% level; * significant at 10 % level.

Table 5: ZOIB regression results accounting for zeros and ones to explain the share of retailers in imports at the HS6 level

From Table 4 and Table 5, we can argue that it is important to consider "null","full" and "in-between" shares as independent and different processes. For instance, if we consider the effect of (GDP) on the share imported by retailers (Table 5), we can observe a positive and significant impact on the continuous part ($s \in (0,1)$) but we observe a negative and significant effect on the full and null shares. Similarly, we notice that the impact of ($Distance$) is negative and significant for null shares of imports by brokers but ($Distance$) is not significant for full shares[15]. Using Table 4 and Table 5, we can deepen our understanding of the differences between brokers and retailers.

Full Share: When $s = 1$, brokers and retailers are the only ones to import a specific product-country pair. In this part of the estimations, brokers and retailers have the same behavior pattern: GDP has a negative impact on the probability to be the only ones on a specific product-country pair. The lower the GDP, the higher the probability to be exclusive. Moreover, tariffs

[15] Zero-one inflated beta regression and Fractional regression give the same patterns and validate our assumption on the importance to distinguish full, null and in between shares. Results obtained estimating a three-part model (fractional regression on values between zero and one, and two probit models for null and full shares) are provided in appendix A.

have also a positive impact on this probability. This suggests that brokers and retailers adopt the same strategy if they can benefit from a market opportunity, i.e. importing a new product-country pair to France.

In-between Share: We consider the continuous part of the distribution of the share, i.e. when $s \in (0, 1)$. Brokers are more present in countries with a low GDP level, high tariffs and located far away from France. In other words, brokers' share of imports is higher in small countries with high variable trade costs. Conversely, retailers' share of imports increases with GDP and decreases with distance from France, (*Tariffs*) has no impact. The closer and the larger the country, the higher the retailers' share of imports.

From this result, we highlight the great difference between direct and indirect imports, brokers having a specificity regarding country characteristics.

Null Share: We now analyze null share for both agents. For brokers and retailers, the size of a country's export market (*GDP*) increases the probability to import from this particular country. The higher the level of GDP, the higher the probability to import this product-country pair. However, for retailers, (*Tariffs*) and (*Distance*) reduce this probability whereas for brokers only distance is significant and has negative effect. In other words, for a given GDP level, brokers are more likely to import from a more distant country than retailers.

5.4 Augmented regressions

In this section, we add to the estimations some product characteristics, and more specifically indexes of perishability and of sensitivity (see section 2 about data) and we consider the impact of the magnitude of French imports of product k (*ln total value*). Doing so, we take into account the interest of France for this product-country pair. Moreover, we consider the effect of the number of Administrative documents (*AdmDoc*) required to import from the country j to France. The results of the Augmented Zero and One

Inflated Beta regressions[16] are provided in Table 6 for brokers and Table 7 for retailers[17].

Share of brokers	Zero and One inflated model		
	Proportion between 0 and 1	Probability to be 0	Probability to be 1
	Marginal effects at mean point	Marginal effects at mean point	Marginal effects at mean point
Ln GDP	-0.023*** (0.009)	-0.06*** (0.01)	-0.032***(0,01)
Ln Tariffs	0.06***(0.02)	0.07*** (0.02)	0.09***(0.02)
Ln distance	0.03**(0.01)	-0.06***(0.02)	0.005 (0.02)
Ln total value	0.006 (0.009)	-0.07***(0.01)	-0.034***(0.01)
Sensibility	0.02 (0.03)	-0.005 (0.04)	-0.08***(0.03)
Perishability	0.007 (0,02)	-0.05 (0.03)	-0.016 (0.03)
Adm Doc	0.02**(0,01)	0.012 (0.151)	-0.02**(0,02)
Subsector fixed effects	YES		
No. Observations	1074		
LPlikelihood	-733.22		

(1) : dummy variable: marginal effect is for change from 0 to 1;

*** significant at 1%level; ** significant at 5% level; * significant at 10 % level.

Table 6: Augmented ZOIB regression for the Share of brokers.

[16]Results are the same if we run a three-part fractional regression model as suggested by Ramalho et al. (2011).

[17]The results obtained are confirmed when adding as explanatory variable the value of the production of the product traded (at the 6 digit level) in the origin country, as shown in appendix B.

Share of retailers	Zero and One inflated model		
	Proportion between 0 and 1	Probability to be 0	Probability to be 1
	Marginal effects at mean point	Marginal effects at mean point	Marginal effects at mean point
Ln GDP	0.03***(0.007)	-0.07***(0.01)	-0.122***(0.012)
Ln Tariffs	0.004 (0.01)	0.09***(0.02)	0.046**(0.02)
Ln distance	-0.06***(0.01)	0.1***(0.02)	-0.008 (0.02)
Ln total value	0.004 (0.006)	-0.03***(0.01)	-0.04***(0.01)
Sensibility	-0.02 (0.02)	-0.09**(0.04)	0.07**(0.03)
Perishability	-0.02 (0.02)	-0.02 (0.04)	-0.017 (0.03)
Adm Doc	0.02** (0.006)	-0.074***(0.15)	0.016 (0.145)
Subsector fixed effects	YES		
No. Observations	1074		
LPlikelihood	-387.38		

(1) : dummy variable: marginal effect is for change from 0 to 1;

*** significant at 1%level; ** significant at 5% level; * significant at 10 % level.

Table 7: Augmented ZOIB regression for the Share of retailers.

First, we must mention that models with product characteristics do not change our previous results on classical trade variables. (see Table 4 and Table 5). We observe that (*ln total value*) is always significant and negative, showing that the higher the demand from France, the lower the interest of intermediaries for full or null shares. For in-between share of brokers and retailers, (*ln total value*) has no impact. This is not a surprising result, the higher the demand from France, the higher the number of firms on a given country-product pair and the lower the market opportunity.

The product sensitivity (*sensitivity*) has a negative effect on the probability for brokers to be exclusive on a specific product-country pair whereas it has a positive effect on the full share of retailers. In the case of market opportunity (see previous results), the behavior of brokers and retailers only differ on the sensitivity of the product. Sensitivity has a negative effect on the probability for retailers to have null shares. The opposite effect of sensitivity on full and null shares could highlight the strategy of retailers to be involved in the import of sensitive products. These direct imports may be done in order to better ensure the product quality. This result is consistent

with the massive development of private standards. The perishability index is never significant.

The number of documents (*AdmDoc*) required to export products from country j to France has a negative and significant effect on the probability for retailers to be exclusive in the market. Administrative costs are fixed costs that retailers might want to mitigate. That could also explain the positive and significant effect of the number of documents on the in-between shares of brokers. For retailers, the number of documents increases the probability to import a specific product-market pair. This result is in line with the willingness of retailers to control the whole imports process, when importing from a specific country proves difficult.

6 Conclusion

Using very original data, we consider the activity of trade intermediaries in an active way. To stick to the recent development of the new new international economics literature and using the definitions provided by the Industrial Organization literature, we assume that brokers would be considered as a channel of indirect imports. They are matchmakers importing products in the name of a customer and they get a commission to do so. As for retailers, they represent the direct imports channel highlighted in the literature. We show that direct and indirect imports do not follow the same pattern and that each type of agents develops its own strategy.

Accounting for the heterogeneity among trade intermediaries, the bounded nature of the share and its distribution at the extremes, we propose alternative approaches to model shares of imports by retailers and brokers. We then establish that brokers and retailers do not play the same role in trade.

Brokers act as a filter for some product-country pairs entering the market, especially for fruits and vegetables coming from small and distant countries. Retailers, who massively use private standards of their own, do not follow

the same pattern. They are more likely to be involved in the import of more sensitive products from neighboring and large countries.

Further work must be done to better understand specificities in the behavior of brokers as economic agents, especially the link between brokers' characteristics and the product-country pair imported. A classical variable analyzed in such models is productivity which remains difficult to define for agents as brokers. Moreover, it would be worth to go a step further to the understanding of the impact of private standards on the food supply chain in developed countries. When we could have expected brokers to disappear from the supply chain because of the development of private standards, we actually show that brokers maintain and position their activity in specific markets. Therefore, private standards would not be tools allowing retailers to integrate all the procurement of all products.

Appendix A

Share of brokers	Three part model		
	Probability to be 0	Logistic reg.	Probability to be 1
	Marginal effects at mean point	Marginal effects at mean point	Marginal effects at mean point
Ln GDP	-0.03*** (0.01)	-0.03*** (0.01)	-0.01** (0.005)
Ln Tariffs	0.06*** (0.02)	0.06*** (0.02)	0.04*** (0.01)
Ln distance	-0.05*** (0.01)	0.07*** (0.02)	0.005 (0.009)
Subsector fixed effects	YES	YES	YES
No. Observations	1100	564	1100
R2	-	-	-
LPlikelihood ou LLikelihood	-701.29	-292.37	-379.70
R2 mc Fadden	-	0.10	-
Pseudo R2	0.03	0.03	0.06

(1) : dummy variable: marginal effect is for change from 0 to 1;

*** significant at 1%level; ** significant at 5% level; * significant at 10 % level.

Table A1: Three parts model with fractionnal model (on shares between zeros and ones) and probit models on zeros and ones to explain the share of brokers in

imports at the HS6 level

A Appendix B

This appendix proposes an augmented regression with the quantity of product domestically produced at the HS6 level on the basis of the FAO data.

Accounting for zero production[18], the introduction of quantity produced in the country of origin does not modify our results and improves the quality of the model (higher loglikelihood).

We see that for both retailers and brokers, the quantity produced in the country of origin has a negative impact on the probability to be exclusively operating on a given country-product pair. This variable also has a negative impact on the probability for brokers not to operate on a given product country pair (and no impact for retailers) and it significantly decreases the proportion between zero and one for retailers.

[18] A non negligible part of product-country pairs have a zero in production whereas we do observe imports of those products. Two sources might lead to these zeros in dataset: i) availability of data. ii) countries are re-exportation platform.

Share of brokers	Zero and One inflated model		
	Proportion between 0 and 1	Probability to be 0	Probability to be 1
	Marginal effects at mean point	Marginal effects at mean point	Marginal effects at mean point
Ln GDP	-0.02*** (0.008)	-0.05*** (0.01)	-0.030***(0.01)
Ln production	0.003 (0.003)	-0.04*** (0.004)	-0.02*** (0.004)
Ln Tariffs	0.06*** (0.02)	0.07*** (0.03)	0.1*** (0.02)
Ln distance	0.03** (0.02)	-0.003 (0.02)	0.03 (0.02)
Ln total value	-0.01 (0.01)	-0.05*** (0.01)	-0.02** (0.01)
Sensibility	0.01 (0.03)	0.09** (0.05)	-0.07**(0.03)
Perishability	0.004 (0.03)	-0.02 (0.04)	-0.004 (0.03)
Adm Doc	0.02* (0.01)	0.007 (0.02)	-0.02* (0.01)
Subsector fixed effects	YES		
No. Observations	1074		
LPlikelihood	-649.37		

(1) : dummy variable: marginal effect is for change from 0 to 1;

*** significant at 1%level; ** significant at 5% level; * significant at 10 % level.

Table B1: ZOIB model with FAO production data as explanatory variable of the share of brokers in imports

Share of retailers	Zero and One inflated model		
	Proportion between 0 and 1	Probability to be 0	Probability to be 1
	Marginal effects at mean point	Marginal effects at mean point	Marginal effects at mean point
Ln GDP	0.04***(0.007)	-0.07***(0.01)	-0.11***(0.01)
Ln production	-0.01*** (0.002)	-0.0002 (0.004)	-0.03*** (0.004)
Ln Tariffs	0.002 (0.01)	0.09***(0.02)	0.05*(0.02)
Ln distance	-0.05***(0.01)	0.1***(0.02)	0.02 (0.02)
Ln total value	0.013** (0.007)	-0.03*** (0.01)	-0.018* (0.01)
Sensibility	-0.001 (0.02)	-0.09**(0.04)	0.12***(0.04)
Perishability	-0.008 (0.02)	-0.016 (0.03)	-0.002 (0.03)
Adm Doc	0.019*** (0.007)	-0.07***(0.02)	0.01 (0.01)
Subsector fixed effects	YES		
No. Observations	1074		
LPlikelihood	-341.92		

(1) : dummy variable: marginal effect is for change from 0 to 1;

*** significant at 1%level; ** significant at 5% level; * significant at 10 % level.

Table B2: ZOIB model with FAO production data as explanatory variable of the share of retailers in imports

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