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# To trust or to bid: an empirical analysis of social relationships on a fish market

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## Abstract

This article analyses the influence of trust on the functioning of a fish market, where agents can choose between bidding or exchanging through bilateral transactions. Even if it is well accepted in economy that trust plays an important role in transactions, its definition and its measurement stay, as far as we know, very elusive. Starting from the empirical analysis of the Boulogne-sur-Mer fish market, a market where people have the choice between trading through auctions or bilateral exchanges, we show how the social networks structure differ between the auction market and the bilateral one . We then propose a measurement of trust, based on the dynamics of agents encounters. We bring into the light that, when the transaction links on the auction market reflects the economic constraints of the partners, the relationships on the bilateral market depend on something more. Clearly, the bilateral transactions result from economics and non economics determinants.

**Keywords:** market design, trust, social networks.

**J.E.L. codes:** L14,D85, D47.

# 1 Introduction

It is actually largely accepted that markets need suitable institutions to be efficient and a huge literature has tried to design the "right" institutions. As well summarised by Milgrom (2004), the idea of auction markets more efficient than the decentralized ones has been largely developed at the end of the 20th century. Nevertheless, a more recent literature tends to suggest that the conditions of dominance depend on something more than simple price formation mechanisms. Clearly, the agents interactions, the structure of the social network and the consequence of the goods characteristics on agents' behavior influence the market outcomes.

Starting with the empirical analysis of a particular fish market (the Boulogne s/mer fish market), our study seeks to underline the role of social interactions on the dynamics of transactions. Because this market presents a particular organization (co-existence of an auction market and a bilateral one), it allows to evaluate the influence of social networks on the market outcomes. The idea that networks can influence the markets functioning is not new in economics. Kirman & Vignes (1990), Kranton & Minehart (2000) or Kranton & Minehart (2001) show how on certain markets, with a high level of uncertainty on the goods exchanged, linking is essential for transacting. The place occupied by an agent in the network (in terms of centrality for example) greatly influences its economic activity, as shown by Corominas-Bosch (2004), Vignes & Etienne (2011) or Fafchamps, Ductor, Goyal & Leij (2013).

This article yearns to look at the emergence and the stability of social links in a market: the fundamental hypothesis of our study is that trust between agents will influence the price of their transactions. In a former article, Milgrom, North & R.Weingast (1990) show that, in the case of repeatedly trading relationship, gains are possible when there is cooperation. The authors underline that by establishing a continuing relationship, individuals ensure one other's honest behaviour: agents benefit more by cooperating and then honesty becomes a necessary condition in trading relationship. Cooperating can be a dominant strategy, if there exists a credible threat and this threat could be the disappearance of trust (which corresponds to a come back to the non cooperative game).

In recent years, social scientists have claimed that trust plays an important role in transactions, as a keystone for cooperation. Trust mixed with trustworthy behaviours turn out to be crucial for reducing uncertainty (*cf.* Guiso, Sapienza & Zingales (2008)), risk (*cf.* McCabe, Rigdon & Smith (2007)) and costs (*cf.* Meidinger, Robin & Ruffieux (1999)). However, as Fehr (2009) remarks, the measurement and the definition of trust seem to be not fully settled, despite its proposed importance. Moreover, its emergence and the identification of its exact role in

economic interactions stay elusive. Does trust come from good institutions? Or does it help to reinforce the existing institutions? In what follows, we postulate that trust emerges in a repeated game (or market) when two agents trade continuously together in a competitive environment: we show that this phenomenon is particularly important on the negotiated market, where the information is not centralised and where there exists no signal of information concerning the quality of the goods.

The question we ask here is how to measure the influence of trust on the dynamic of a market exchanges. A fundamental hypothesis of our study is that trust between agents will influence the price of their transactions. We define the level of trust between two persons by the number of encounters (number of days two persons traded together), relative to the number of encounters the same persons would done at random. The more two persons exchange together, the higher the level of trust is. Considering the market through the graph of transactions, we propose an original trust index based on repeated encounters between buyers and sellers and empirically estimated from the Boulogne s/mer trade network: this allows us to distinguish between the random encounters and the ones coming from trust relations. We then compare the two "trust networks" (auction and bilateral ones) and bring into light that on the auctions, links between buyers and sellers are mostly random, when they correspond to strategic decisions on the bilateral part of the market. Proximities play a central role on the decentralised market when they are not significant on the centralised one. A fixed-effect GLM model, where the network statistics are used as variables show that centrality influences the transactions prices in the same way, on the auction market and the bilateral ones. However, two other GLM estimations show that trust differently influences the prices and quantities exchanged, according to the market design.

**A REVOIR** This article is organised as follows: section 2 outlines the main characteristics of the market and presents the database. The statistical framework is presented in section 3. Section 5 presents the econometric models and the results. The conclusion follows.

## 2 The main market features and the data

We study here the functioning of the Boulogne s/mer fish market, through the analysis of a detailed database, consisting of 300000 daily transactions on the period 2006-2007.

**The market:** The Boulogne-sur-Mer fish market is located in the North of France near Belgium and considered as the most important fish market in France in terms of quantity. Its structure changed over time and for a long period, this market operated as a decentralised one. In the beginning of the 90s and following E.U. instructions, the market moved to an auction system, soon rejected by both buyers and sellers, alla arguing that the new market design was

not in their favour. After collective bargaining between the different partners (institutions and unions of producers), a double mechanism has been introduced the 1st of April 2006, where both auction and bilateral sub-markets coexist.

This market is a daily one, open 6 days a week. Transactions begin early in the morning. Sellers are fishermen and buyers are restaurant owners, retail buyers and fish processors. Buyers form then an heterogeneous population, facing different budget and time constraints. They can freely buy on the two sub-markets. Each day, sellers have the possibility to choose how to sell their fish (centralised or decentralised mechanism). Once the sub-market chosen, sellers cannot change their strategy until the next day for practical reasons (costs of bring the merchandise from one part of the market to the other are very high). Mignot, Tedeschi & Vignes (2012) show the existence of two behaviours: some agents purchase most of the time on the same sub-market, when others switch regularly. Loyal sellers, the ones who change rarely, are mainly present on the bilateral market.

The auction market opens at 4 a.m. and always operates at the same place. During the studied period, the auction was an ascending one on 7 charts at the same time. It is a non cooperative game and the prices reflect the intensity of competition. Transactions on this sub-market are anonymous and the buyers are not supposed to interact with the auctioneer, apart from the prices formation mechanism. The time constraint is high, all transactions take place in 4 hours. Important volumes of fish are traded and transactions occur at a fast rate.

On the bilateral market, the prices are not displayed and emerge from a bargaining process. Buyers, who are retailers are looking for specific species, that correspond to their expected demand. Here agents have different source of private information, depending on their past history and their intensity to bargain and transact.

**The data:** 200 boats are registered in this market and are considered as sellers. 100 buyers purchase regularly, most of them on both sub-markets. The database we use covers a year and a half (2006-2007) where both sub-markets coexist. For each transaction, the date, the species, the characteristics of the traded fish (size, presentation, quality), buyer's and seller's identities, the type of trade mechanism (auction or negotiated), the quantity exchanged and the transaction price are known. In what follows, we focus on the post-reorganisation period, to evaluate the differences in the influence of trust on the outcomes of the two market designs. The analysis of the database tells a story of heterogeneity. First statistical results show that both buyers and sellers differ in terms of quality and quantities exchanged.

Moreover, the two submarkets (auctions and negotiated) have an equal importance: same agents transact on the two "submarkets" and the same types of fish are sold through both mechanisms (80 species of fish traded).

### 3 The framework

After the introduction of the double mechanism, traders can decide to play randomly between the two submarkets or to favour one. Auctions do not allow loyal strategies unlike the decentralised market where people can choose with whom they exchange.

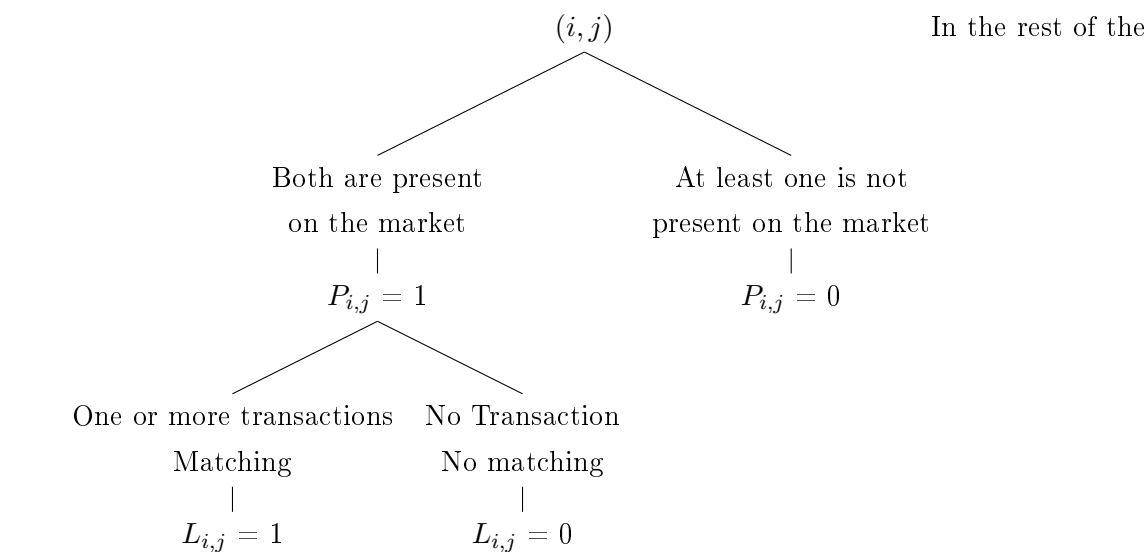
#### 3.1 The bilateral market

##### 3.1.1 Market

Consider a bilateral market, where there is no arbitrage, composed by  $N$  buyers  $i$ , with  $i = 1 \dots N$  and  $M$  sellers  $s$ , with  $s = 1 \dots M$  who buy and sell regularly during  $\tau$  periods,  $\tau = 1 \dots T$ . At each period  $\tau$ , a buyer (seller) can be present or not. When present, he can exchange with one or more sellers (buyers). In each bargaining bin, players trade with a partner they trust or with one randomly matched.

##### 3.1.2 Matching

- The diagram below represents the different possibilities for each couple (seller, buyer) present at time  $\tau$  on the market:



paper, we use the following notations:

- $m_{i,j}^T = \sum_{\tau=1}^T L_{i,j,\tau}$ : Number of days a couple meets and transacts (we will refer to it as number of encounters)
- $M_{i,j}^T = \sum_{\tau=1}^T P_{i,j,\tau}$  : Number of days a couple is present on the market
- $t_{i,j}$ : Number of transactions between a buyer  $i$  and a seller  $j$
- $T_k$ : Number of total transactions for a trader  $k$
- $D_{i,\tau}$ : Degree of buyer  $i$  at time  $\tau$  (number of sellers linked to  $i$  at time  $\tau$ )
- $n_{i,\tau}$ : Number of buyers present on the market at time  $\tau$
- $n_{j,\tau}$ : Number of sellers present on the market at time  $\tau$
- $D_{j,\tau}$ : Degree of seller  $j$  at time  $\tau$  (number of buyers linked to  $j$  at time  $\tau$ )

### 3.1.3 The trust

Trust is defined as a stock and strongly depends on the number of encounters between different people. The more a couple exchanges, the higher is their level of trust. The ratio below  $R_{i,j}$  allows to associate a level of trust to each potential couple  $(i, j)$  of the market.

$$R_{i,j}^T = \frac{m_{i,j}^T}{M_{i,j}^T} - \frac{\sum_{\tau=1}^T \left[ \frac{D_{j,\tau}}{n_{i,\tau}} + \frac{D_{i,\tau}}{n_{j,\tau}} - \frac{D_{j,\tau} * D_{i,\tau}}{n_{j,\tau} * n_{i,\tau}} \right]}{M_{i,j}^T} \quad (1)$$

This ratio can be explained by dividing it to two expressions. The first quotient explains the strategic decision for linking and the second one represents the random choice.

The first term  $\frac{m_{i,j}^T}{M_{i,j}^T}$  shows the probability for a buyer  $i$  to transact with a chosen seller  $j$ . The second one  $\frac{\sum_{\tau=1}^T \left[ \frac{D_{j,\tau}}{n_{i,\tau}} + \frac{D_{i,\tau}}{n_{j,\tau}} - \frac{D_{j,\tau} * D_{i,\tau}}{n_{j,\tau} * n_{i,\tau}} \right]}{M_{i,j}^T}$  shows the probability for the buyer  $i$  to transact with the seller  $j$  if the seller  $j$  is chosen randomly. As Granovetter (1973) said, mutual confiding matters. Hence, the second term of equation 1 considers both agents degrees on a market where buyers and sellers can both choose between trusting behaviour or not.

## 3.2 Stylised facts

Equation 1 proposed in this article is used to verify that agents behaviours are not similar on both submarkets. Its purpose is not only to illustrate the agents behaviour but also to pinpoint that trust level is not the same and agents are more strategic and make more choices on the negotiated market.

The trust index can take negative values as well as positive ones. A negative ratio shows that a buyer chooses in a random way his seller. He thinks less in choosing from whom to buy. The probability for a buyer  $i$  to choose randomly his seller  $j$  is more important than the probability of making choices. Whereas for a positive ratio, the probability for making choices is greater than the probability of choosing randomly. Thus, the buyer decides about his seller. He makes more choices, he distinguishes and prefers between the sellers on the market.

Figure 1 displays the distribution of the random vs trust ratio (equation 1) on the negotiated and on the auction market.

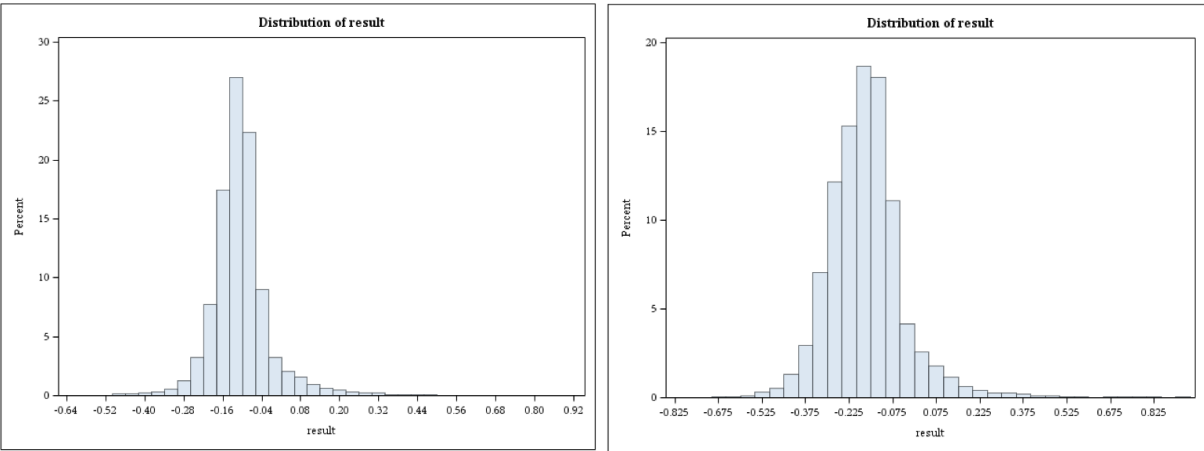


Figure 1: The distribution of the trust ratio on the negotiated (left) and the auction (right) submarkets

Figure 1 shows the distribution of the random vs trust ratio on both submarkets: the negotiated and the auction submarkets (Table 1). We observe that on the auction submarket, the negative values are more important. Technically speaking, a negative value corresponds to the fact that some people are matched randomly.

Looking at the random vs trust ratio (equation 1), we remark that on auction submarket, agents choose more randomly from whom to buy and they do not make much choices. Oppositely, agents on negotiated submarket make more choice. Figure 1 highlights more negative ratios on the auction market and more positive ratios on the negotiated market.



	auction	negotiated
Mean	-0.17	-0.10
Std Dev	0.14	0.10
Kurtosis	8.19	17.76
Skewness	1.5	2.48

Table 1: Main statistics of the distribution of the trust vs random ratio on the negotiated and the auction market

As both variances on the auction and the negotiated markets are not the same (table 2), we test the equality of means on both submarket using the Satterthwaite method for unequal variances.

Satterthwaite test shows that the mean values for the trust versus random ratio on both submarkets are significantly different. The mean on the negotiated submarket is more important than on the auction submarket.

Equality of Variances			Methode		
Method	F Value	Pr>F	t value	Pr> t	
Folded F	1.82	<.0001	Satterthwaite	-46.81	<.0001

Table 2: Equality of variances and Satterthwaite test

## 4 Network analysis

### 4.1 Bipartite network

This section analyses, in a bipartite approach, the set of links between people as a social network (heterogenous individuals).

The purpose here is to compare the differences in terms of relations between buyers and sellers between both submarkets. To do so, we build for each submarket a bipartite network formed of two types of nodes, buyers and sellers, on the total period.

We describe a graph as a set of nodes where buyers (the grey nodes) and sellers (the back nodes) interact and we track the intensity of the relation among people<sup>1</sup>.

We measure the link between two nodes using the trust index (equation 1) defined in the upper section.

We consider in what follows all the link that are created between agents when making choices (we

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<sup>1</sup>the grey nodes are represented by green nodes, and the back nodes by red color

do not consider the links created by random matching). Hence a link is formed between a buyer and a seller for a ratio higher than 0,1, otherwise there is no link. This threshold is chosen because it allows us to distinguish between a random matching (the set of these matchings describe a quasi-complete network) and a strategic one.

$$Link_{i,j} = \begin{cases} 1 & \text{if } R_{j,i} \geq 0.1 \\ 0 & \text{else} \end{cases} \quad (2)$$

At first sight, both graphs in figure 2 are not similar. On the negotiated submarket, some buyers have a set of "preferred" sellers, unlike the auction submarket where all the sellers and buyers are centralised.

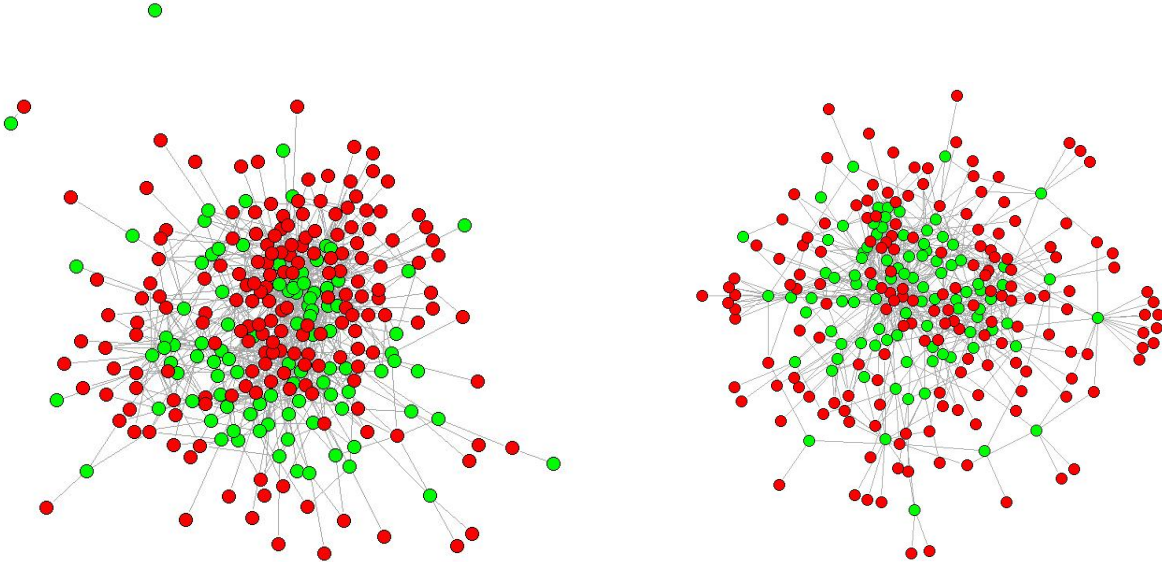


Figure 2: A bipartite graph for auction (right) and negotiated (left) submarkets: sellers are in black, buyers in grey

	auction	negotiated
Nodes	272	278
Links	592	629
Density	0.016	0.015
Assortativity	-0.0023	0.0165

Table 3: Networks statistics

The density of a network is the fraction between the number of created links and the number of total possible links. The density value is between 0 and 1. A density close to 1 reflects a very

dense network with an important number of links and when it is closed to 0, the network has very few links. Both submarkets have a similar density equal to 0.015.

Do high degree nodes tend to connect with other high degree nodes, or do they prefer to establish a link with low degree ones? A different measure used in the literature is the assortativity. Therefore, this coefficient explains the capacity of a node to create a link with a node that is similar. It measures the correlation between two nodes giving a value between -1 and +1. Our assortativity ratio is not the same for both submarkets. It is negative for the auction market (-0.023) and that could be explained by important buyers who transact with many small sellers or important sellers (rational ones) who sell to many small buyers what explain figure 2. The assortativity ratio is positive on the negotiated submarket that could suggest that links are based on something other than pure economics relationships; and that could be clarified by important buyers who transact with many important sellers (rational ones) or small sellers who sell to many small buyers.

## **4.2 Projected network**

To better estimate the role of centrality, we project now the bipartite network on homogenous one.

A buyer is linked to another buyer if both of them transact with at least the same seller (one or more). As well, sellers are linked if they transact with at least the same buyer (one or more).

Figure 3 and 4 picture buyers and sellers projected network.

### **Buyers projected network**

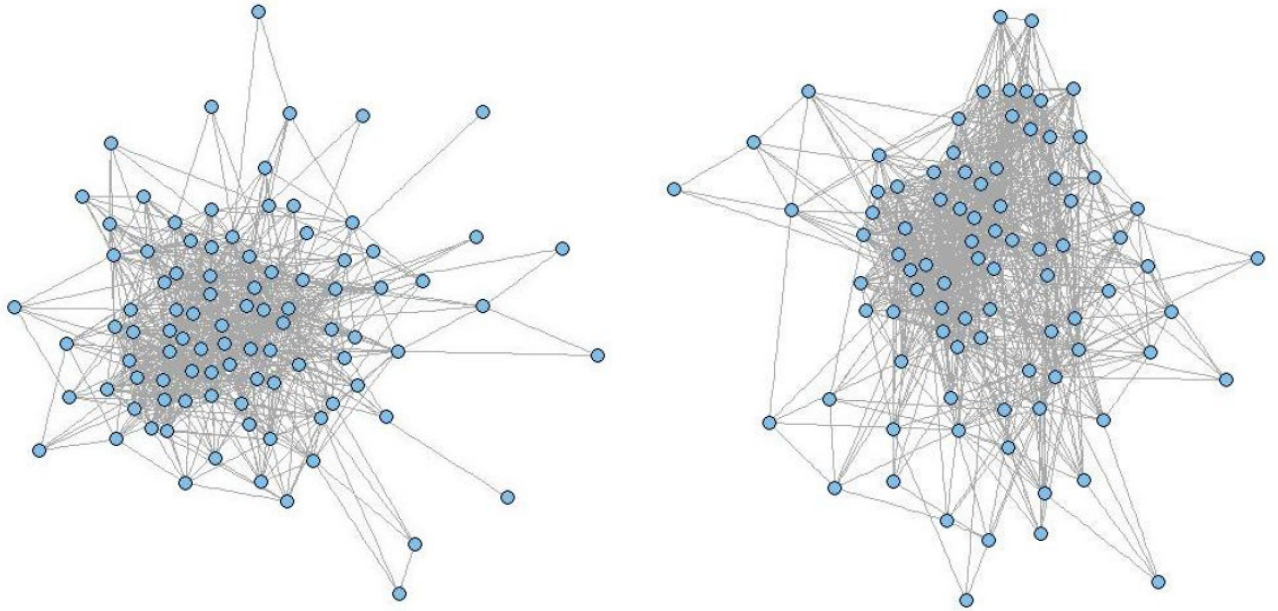


Figure 3: Buyers projected network (auction (left) negotiated (right))

	auction	negotiated
Nodes	95	88
Links	866	998
Density	0.1939	0.2607
Assortativity	0.205	0.0501

Table 4: Buyers projected graph statistics

Even though there is no remarkable difference between both submarkets for numbers of nodes, a difference can be noted for the number of links as for the density. Buyers on the negotiated submarket are more linked, hence they have more common sellers. One interpretation is that buyers visit more sellers on the decentralised market. The assortativity is slightly higher on the auction market. To explain the higher density on the negotiated market, we calculate for each buyer and seller how many days they take to return to the market. In other words, we determine for each buyer and seller the time period between two presence on each submarket. In average a buyer returns to the auction market each 19 days and each 5 days to the negotiated one. As for the seller, they sell in average each 14 days on the auction market and each 6 days on the negotiated one (Table 5) .

	Buyer		Seller	
	Auction	Negotiated	Auction	Negotiated
Mean	13.78	6.26	18.59	4.87
Std Dev	34.08	15.59	17.19	3.67
Kurtosis	17.53	40.29	6.12	20.97
Skewness	4.08	5.90	2.01	3.91

Table 5: Descriptive statistics buyer and seller sides

### Sellers projected network

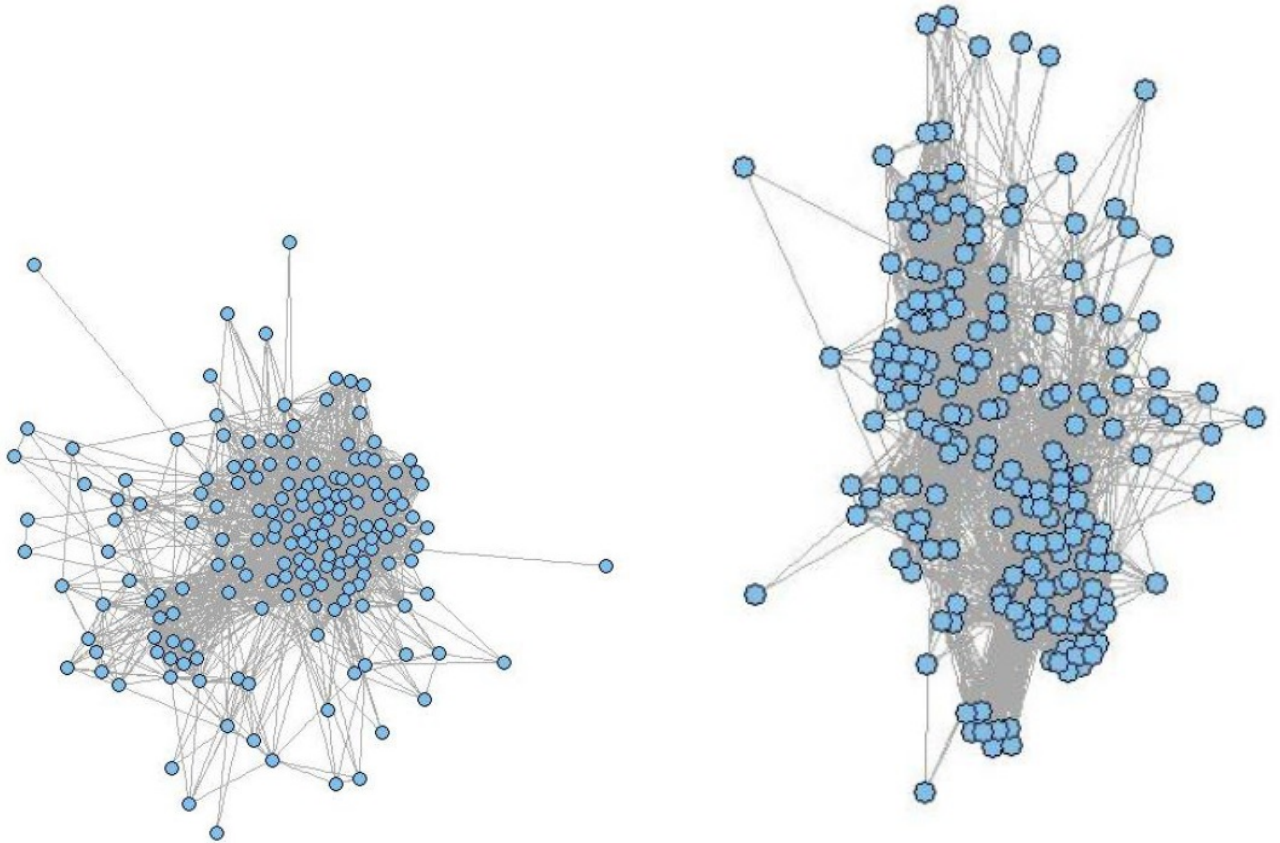


Figure 4: Sellers projected network (auction (left) negotiated (right))

Sellers projected graph shows the number of links created on auction and negotiated submarkets is the same which explains the same density. The assortativity on the auction market is twice the one on the negotiated market (see table 6) and on both submarkets they are positive.

This is in line with the assortativity level on the bipartite network (table 3) for the negotiated

submarket; the positive assortativity close to zero suggests that links are based on something other than pure economics relationships. Linked sellers have similar characteristics and therefore are connected to similar buyers.

	auction	negotiated
Nodes	173	189
Links	2710	3321
Density	0.1821	0.1869
Assortativity	0.1	0.04

Table 6: Sellers projected graph statistics

## 5 The Econometric Models

We now explore how the trust propensity and the individual position in the social network influences the outcome of the market. A first model evaluates the influence of Bonacich (1987) centrality and betweenness on transactions prices. Models two, three and four evaluates the influence of the trust ratio as defined section 3 on the quantities and prices exchanged by pairs of buyers and sellers. In this section, we will see if our ratio affects in a different way the prices and the quantity on both submarkets, and the influence of centrality on prices.

### 5.1 Model 1: Centrality analysis

We begin by analysing the effects of centralities on prices. The objective is to see if the position of the agents in the networks influences the prices they will pay (or get). Because of seasonality (see Mignot et al. (2012)), we know that the price of a transaction also depends on the day of the week ( $Weekday_k$ ). We control for the global significance of the 80 species ( $Species_k$ ) exchanged. The explained variable is the price of a transaction  $k$ . Each transaction  $k$  involves a buyer, a seller and a species. We also control for the identity of the seller ( $boat_k$ ) and the buyer ( $buyer_k$ ). The centrality used are the Bonacich centrality ( $bon_k$ ) and the betweenness centrality ( $bet_k$ )

$$P_k = \beta_1 + \beta_2 \cdot Bon_k + \beta_3 \cdot Bet_k + \beta_4 \cdot Species_k + \beta_5 \cdot Weekday_k + \beta_6 \cdot boat_k + \beta_7 \cdot buyer_k + \beta_8 \cdot mois_k + v_{i,t} \quad (3)$$

$$v_{it} = \mu_i + \delta_{it}, \quad \mu_i \sim i.i.d.(0, \sigma_{\mu_i}^2), \quad \delta_{it} \sim i.i.d.(0, \sigma_{\delta}^2) \quad (4)$$

#### *The results*

We use this model with the centrality coefficient of the four homogenous graphs, 3 and 4. At first glance, the results are quite paradoxical. concerning the sellers homogenous network (the

one where two sellers are linked when they share one or more buyers), the different centralities negatively and significantly influence the prices. The more central a seller is (the more buyers he shares with competitors), the lower the prices are (See table 7). If these results correspond to some economic evidence, they remain paradoxical in the fact that they are identical on both submarkets. Despite different information structures, the place where people are affects their outcomes. Concerning the buyers homogenous network (where buyers are linked when they share at least one seller), there is non significant effect of their position neither on the auction market nor on the bilateral one (See table 8). This suggests that personal relationships, which are strong enough to design two different networks (corresponding to the two different submarkets) play an other role than a pure economic one.

Parameter	Auction			Negotiated		
	coefficients	Std err	$Pr >  t $	coefficient	Std err	$Pr >  t $
Intercept	1.36	1779	0.999	1.14	2338	0.999
Bonacich	-0.56	1196	0.999	-0.24	0.098	0.013
Betweenness	-0.20	496	0.999	0.058	0.021	0.007

Table 7: Sellers on auction and bilateral submarkets

Parameter	Auction			Negotiated		
	coefficients	Std err	$Pr >  t $	coefficient	Std err	$Pr >  t $
Intercept	-1.02	0.298	0.0006	2.13	1032	0.999
Bonacich	-0.29	0.057	<.0001	0.44	183	0.999
Betweenness	0.197	0.045	<.0001	0.077	141.42	0.999

Table 8: Buyers on auction and bilateral submarkets

## 5.2 Model 2: Influence of trust index on prices

$$P_{i,j,\tau,t} = \beta_1 + \beta_2 \cdot R_{i,j} + \beta_3 \cdot i + \beta_4 \cdot j + \beta_5 \cdot Weekday_\tau + \beta_6 \cdot year_k + \beta_7 \cdot mois_k + \beta_8 \cdot Specie_k + v_{i,t} \quad (5)$$

Price	Negotiated			Auction		
	Coef	Std Dev	Pr > t	Coef	Std Dev	Pr > t
Intercept	4.94	0.43	<.0001	2.80	0.52	<.0001
$R_{i,j}$	0.22	0.034	<.0001	0.075	0.045	0.09

Table 9: Estimation results for the negotiated and auction submarkets

This section seeks to explain how the trust index (equation 1) influences prices on auction and negotiated submarkets throughout time. To do so, we estimate the price transactions in a GLM model. We control the global significant of the 80 species, the weekdays, the years, the months, the buyers and the sellers. The explained variable is the price of a transaction per couple and day.

The results are given in table 9. As it can be observed, significant coefficient are on the negotiated submarket and not on the auction one. We verify a positive relation between the prices and the trust index on the negotiated submarket. Hence trust has no effect on the auction submarket but it increase price on the negotiated one. When people trusts each other, they get higher prices with time.

### 5.3 Model 3: Influence of the number of encounters on quantity

To explain if the numbers of encounters influences quantity, we compute the relation between the quantities exchanged  $Q_{i,j}$  and the number of encounters between a buyer and a seller  $m_{i,j}$  on the auction and the negotiated submarkets.

An econometric model is used to evaluate if trust affects differently the outcomes of the transactions for both submarkets. In this model we use:

- The quantity exchanged between each couple:  $Q_{j,i}$
- The number of encounters between  $(j, i)$  on both submarkets :  $m_{j,i}$

We estimate the following equation:

$$Q_{j,i} = \beta_1 + \beta_2 m_{j,i} + \beta_3 m_{j,i}^2 + u_{j,i} \quad (6)$$

where  $Q_{j,i} = \sum_{t=1}^T q_{(j,i),t}$

for  $(j, i) = 1, \dots, C$  (where C is the number of all the created couples). We explore here the influence of the different components of trust ratio on the quantity.

Log quantity	Negotiated			Auction		
	Coef	Standard Error	Pr> t	Coef	Standard Error	Pr> t
Intercept	3.502	0.0022	0.000	3.66	0.022	0.000
Log encounters	1.35	0.025	0.000	1.33	0.027	0.000
$Log^2$ Encounters	-0.013	0.006	0.02	-0.000	0.006	0.9104

Table 10: Estimation results for the negotiated and auction submarkets



We remark that, on the auction and the negotiated submarket, the quantity exchanged increases with the number of encounters. It grows with an increasing rate at the auction market and a decreasing one on the negotiated market. So when a couple meet more frequently, it is obvious that they exchange more quantity on the auction market, when it is not the case on the negotiated market. The results of the estimation are given in table 10 . We observe significant coefficients for all the explaining variables. We verify a negative relation between the quantity and the *encounters*<sup>2</sup> on the negotiated submarket and a positive one on the auction submarket.

To better understand trust results, we analyse in what follows, how the prices are affected by our ratio.

#### 5.4 Model 4: Influence of the number of encounters on price

This model explains the relation between the price and the trust ratio. where

$$P_{j,i} = \frac{\sum p_{j,i} * q_{j,i}}{\sum q_{j,i}} \quad (7)$$

is the price index for the different species exchanged.

$$P_{j,i} = \alpha_1 + \alpha_2 m_{j,i} + \alpha_3 m_{j,i}^2 + u_{j,i} \quad (8)$$

Log Price	Negotiated			Auction		
	Coef	Standard Error	Pr> t	Coef	Standard Error	Pr> t
Intercept	1.059	0.015	0.000	1.118	0.016	0.000
Log Encounters	0.227	0.017	0.000	0.11	0.019	0.000
Log <i>Encounters</i> <sup>2</sup>	-0.037	0.004	0.000	-0.217	0.005	0.000

Table 11: Estimation results for the negotiated and the auction submarkets

As we can see, there is no significant difference between both submarket at a price level. When agents meet more, prices get higher.

#### 5.5 Model 5: Influence of the number of encounters on price and quantity for the different categories

In order to understand why a difference exists at a quantity level and not at a price level, we estimate both regressions for the different categories of the species. We differentiate three categories: the first one, "category auction" includes the species that are more expensive on

auction submarket, while category two, "category negotiated" is composed of fish that are more expensive on negotiated submarket and the third category "category neutral" combines fish that have no significant difference in terms of prices between both submarkets.

Log quantity	Negotiated			Auction		
<b>Category Auction</b>	<b>Coef</b>	<b>Std Dev</b>	<b>Pr &gt;  t </b>	<b>Coef</b>	<b>Std dev</b>	<b>Pr &gt;  t </b>
Intercept	3.217	0.025	<.0001	3.36	0.026	<.0001
Log Encounters	1.414	0.034	<.0001	1.304	0.035	<.0001
<i>Log<sup>2</sup></i> encounters	<b>-0.012</b>	<b>0.009</b>	<b>0.1905</b>	0.0244	0.009	0.0068
<b>Category Negotiated</b>	<b>Coef</b>	<b>Std Dev</b>	<b>Pr &gt;  t </b>	<b>Coef</b>	<b>Std dev</b>	<b>Pr &gt;  t </b>
Intercept	3.01	0.173	<.0001	3.10	0.02	<.0001
Log Encounters	1.313	0.024	<.0001	1.244	0.034	<.0001
<i>Log<sup>2</sup></i> encounters	-0.23	0.006	0.0003	<b>-0.01</b>	<b>0.011</b>	<b>0.3643</b>
<b>Category Neutral</b>	<b>Coef</b>	<b>Std Dev</b>	<b>Pr &gt;  t </b>	<b>Coef</b>	<b>Std dev</b>	<b>Pr &gt;  t </b>
Intercept	3.41	0.026	<.0001	3.67	0.027	<.0001
Log encounters	1.44	0.036	<.0001	1.39	0.037	<.0001
<i>Log<sup>2</sup></i> encounters	<b>-0.016</b>	<b>0.001</b>	<b>0.0996</b>	-0.022	0.009	0.0198

Table 12: Estimation results for the negotiated and the auction submarkets

Log Price	Negotiated			Auction		
<b>Category Auction</b>	<b>Coef</b>	<b>Std Dev</b>	<b>Pr &gt;  t </b>	<b>Coef</b>	<b>Std dev</b>	<b>Pr &gt;  t </b>
Intercept	0.925	0.016	<.0001	0.864	0.018	<.0001
Log Encounters	0.194	0.022	<.0001	0.222	0.024	<.0001
<i>Log<sup>2</sup></i> encounters	-.049	0.006	<.0001	-0.434	0.006	<.0001
<b>Category Negotiated</b>	<b>Coef</b>	<b>Std Dev</b>	<b>Pr &gt;  t </b>	<b>Coef</b>	<b>Std dev</b>	<b>Pr &gt;  t </b>
Intercept	1.374	0.016	<.0001	1.432	0.0176	<.0001
Log Encounters	0.127	0.022	<.0001	0.0835	0.03	0.0058
<i>Log<sup>2</sup></i> encounters	<b>0.016</b>	<b>0.0058</b>	<b>0.7775</b>	-0.05	0.01	<.0001
<b>Category Neutral</b>	<b>Coef</b>	<b>Std Dev</b>	<b>Pr &gt;  t </b>	<b>Coef</b>	<b>Std dev</b>	<b>Pr &gt;  t </b>
Intercept	0.752	0.017	<.0001	0.766	0.019	<.0001
Log encounters	0.298	0.023	<.0001	0.187	0.026	<.0001
<i>Log<sup>2</sup></i> encounters	-.057	0.006	<.0001	-.016	0.007	0.0198

Table 13: Estimation results for the negotiated and the auction submarkets

Tables 12 and 13 give the results for price and quantity regression for the three categories of fishes for both submarkets. The difference that should be noted between the submarkets, is marked in bold. What we observe is that for all the categories for both submarkets, prices increase at an decreasing rate with the number of encounters. But only one category should be noticed: the species that are more expensive and sold on the negotiated submarket increase but not with the same rate as all the other categories (there is no significant relation between  $Log^2$  encounters and the price).

As for the quantity, it increases at a decreasing rate for all the categories for both submarkets, but it increases at a increasing rate for the species that are more expensive and sold on the auction submarket. We note no significant relation between the  $Log^2$  encounters and the quantity for the species that are more expensive on auction submarket but sold on the negotiated one, for the species that are more expensive on the negotiated submarket but sold on the auction one and finally for the species that have no difference in terms of prices between submarkets but sold on the negotiated one.

## 6 Conclusion

This article shows how on a particular market where the level of uncertainty is quite high and where people meet regularly, trust can affect the way the transactions are accomplished. Even with a very simple measure of trust propensity, we obtain quite interesting results. In all our empirical work, we refer to the level of trust between two persons by the number of encounters (number of day two persons traded together), relative to the number of days these two persons were present on the market. When two people exchange more together, they significantly reach higher levels of trust.

We bring into the light the fact that links between people depend on something else than pure economic determinants. Network statistics on a bipartite graph, show that assortativity on auction market clearly depends on some economic strategies (highly connected buyers trade with poorly connected sellers). When we project the bipartite network on two different homogenous networks (a buyer one and a seller one), we observe that the density on the negotiated market is higher than on the auction one. This is due to the fact that people are more present on the negotiated market than on the auction one. Driving an econometric analysis, we observe quite paradoxical results. Concerning the sellers homogenous network (the one where two sellers are linked when they share one or more buyers), the different centralities influence negatively and significantly prices. The more central a seller is (the more buyers he shares with competitors), the lower the prices are. If these results correspond to some economic evidence, they remain paradoxical in the fact that they are identical on both markets. Despite different information structures, the place where people are affects their outcomes. Concerning the buyers homogenous

network (where buyers are linked when they share at least one seller), there is non significant effect of their position neither on the auction market nor on the bilateral one. This suggests that personal relationships, which are strong enough to design two different networks (corresponding to the two different submarkets) play an other role than a pure economic one.

Looking at the influence of encounters on the quantities exchanged by pairs of agents (buyer/seller), a GL model shows that this effect is different between the two markets. When we observe a concave effect on the negotiated market, we see an increasing effect on the auction market. It seems that encounters on the negotiated market have not the same consequences than on the auction market. Concerning the prices, we find a no significant differences between the submarket. But for the rust versus random ratio, we remark that it had no significant effect on price on the auction submarket, but a positive effect on the negotiated submarket. Can we relate this difference to the quality of fishes exchanged or to overconfidence on the negotiated submarket. This work is a very preliminary one but let the door open to more sophisticated estimations on the role of trust and the understanding of the emergence of trustworthy relationships.

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