Are certified supply chains *more* socially sustainable? A bargaining power analysis[1]

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Abstract: Food Quality Schemes (FQS: organic and geographical indication products) are often supposed to be more sustainable by their political advocates. We explore the social sustainability advantage of FQS through the lens of supply chains' bargaining power (BP) distribution. We propose an indicator synthesizing different sources underlying BP (competition-based, transactional, institutional) and counting two dimensions (fair BP distribution and adaptation capacity), that we apply to 18 FQS supply chains and corresponding reference. FQS perform better than their reference products on both dimensions. This better performance is due to a combination of sources.

Keywords: Bargaining power, market power, transaction costs, institutions, social sustainability indicator

Key results:

- FQS can globally be considered as socially more sustainable than conventional reference products regarding bargaining power distribution.
- But this higher sustainability only partly builds on their capacity to more evenly distribute bargaining power among levels. According to our results, another key determinant of their social sustainability lies in their adaptation capacity, ie. their capacity to resist and accommodate potential perturbations.
- The sustainability advantage of FQS over conventional counterparts is based on a combination of sources base their advantage over conventional products by combining sources of bargaining power instead of relying on a single one

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Introduction

A common argument put forward by advocates of FQS (Food Quality Schemes - covering organic, geographic indication, and short food supply chains[3]) supply chain is that they are more socially sustainable than their conventional counterparts. This sustainability premium notably manifests through higher survival rates of small agricultural firms (Bontemps, Bouamra-Mechemache, and Simioni 2013) and their contribution to rural territories development and recovery (Tregear et al. 2007). Existing literature has identified several factors explaining this sustainability premium. On the one hand, it stems from the collective development of specific assets at the supply chain level (see Barjolle and Sylvander 2002). In the specific case of geographic indications, they consist, for instance, of the development of particular organoleptic attributes contributing to the specificity of the end product (Mancini, Arfini, and Guareschi 2019). On the other hand, it is due to the existence of collectively negotiated and accepted specifications, contributing to even out bargaining power among stakeholders (Sonnino 2009). This evening out process is viewed as an essential determinant of their capacity to fairly distribute the value generated throughout the chain (Coff 1999; Bonnet and Bouamra-Mechemache 2016). However, past research that investigated the relationship between FQS sustainability and bargaining power has often conflated it with market power (see Bonnet and Bouamra-Mechemache 2016). But, the concept of bargaining power is multidimensional. Existing literature has identified, among others, its competition-based (Barney 1986; Porter 2008a), transactional (Filippi and Muller 2013), and institutional sources (Coff 1999; Torre 2002).

This paper intends to investigate whether FQS achieve more balanced bargaining power distributions, thus allowing them to be more socially sustainable than conventional supply chains. To this end, the paper takes on a more comprehensive understanding of bargaining power as rooted in different sources: competition-based, transactional, and institutional. We argue that the existence of a possible sustainability advantage of FQS related to bargaining power relies on a combination of its different sources. In so doing, we propose an original method for building up and testing a synthetic indicator accounting for the vertical distribution of bargaining power in supply chains, which incorporates competition, transactional and institutional variables. Another originality compared to existing literature that usually treats of only one type of food product (cheese, wine, etc.) is that the proposed indicator is tested on 18 European and Asian FQS supply chains for different types of food products (sea, animal, vegetal) and compared with conventional reference products[4]. To this end, we exploit data collected in the frame of the H2020 Strength2Food project[5].

An advantage of the proposed indicator is that it allows performing a first evaluation of a supply chain social sustainability by relying on simple and easy-to-obtain variables (eg. number of firms operating at each level, the existence of FQS management unions, contribution of the considered level to the specificity of the end product, etc.). Furthermore, it provides an overview of the dimensions (competition, institutional, resources) that are likely to be at the root of a supply chain level's bargaining power, thus paving the way (after, of

[3] Due to its scope, this paper only considers geographic indication (PDO – Protected Denomination of Origin -, PGI – Protected Geographical Indications) and organic food supply chains.

[4] A reference product is here defined as a product that may be considered as a substitute to the FQS product by non-specialist consumers and / or for producers, as FQS producer can choose to produce both reference or FQS product, being in the same country or region.

[5] Information about the project are available at https://www.strength2food.eu/.

course, the collection of deeper knowledge) for possible enhancements for its social sustainability.

Our paper is organized as follows. In the second section, we present and theoretically advocate for a broader conception of bargaining power which better accounts for social sustainability issues, which is multifactorial (including competition-based, transactional, and institutional factors) and collective. We propose in section three a set of variables aimed at operationalizing our theoretical discussion. They are at the root of the calculation of a social sustainability indicator based on bargaining power that will be presented in section four. Section five presents the results of this sustainability assessment, before concluding.

Constructing social sustainability indicators based on bargaining power

Bargaining power as a multidimensional phenomenon

As bargaining power determines the capacity of individual stakeholders to capture the value created along the supply chain (Coff 1999; 2010), our indicator is concerned with the repartition of bargaining power among individual actors. It is closely linked to several indicators proposed in the SAFA (Sustainability Assessment of Food and Agriculture systems) typology, such as those pertaining to fair trade practices (FAO 2013). It is defined as an actor's capacity to influence in its favor the definition of terms and conditions of a contract (Argyres and Liebeskind 1999). If standard microeconomics has essentially conflated bargaining power with market power, such an approach can hardly be applied to the analysis of actual supply chains. First, most supply chains are based upon coopetition relationships (Brandenburger and Nalebuff 1996; Bengtsson and Kock 2014), thus stretching beyond simple market relations. A consequence is that bargaining power also has to be considered as a collective attribute, several actors being able to weigh in on the bargaining process by coordinating against opposing parties. Second, players can root their bargaining power on other attributes than market position. For instance, they can take advantage of the possession of specific resources as bargaining inputs (Coff 1999). Finally, it ignores the role the institutional settings is likely to play for shaping its distribution, and, more particularly, the key role of collective rules (North 1994).

Ultimately, by taking a wider lens than only that of market mechanisms, we adopt a more global conception of bargaining power that is multifactoral and collective, because we ascertain the capacity of actors of different supply chain levels to weigh in on bargaining processes. In so doing, a central aim of the paper is to test the existence of a sustainability advantage of FQS supply chains which is due to the existence of more balanced bargaining power distribution. A subsequent objective is to check whether this sustainability advantage can be attributed to one dominant or different bargaining power sources: competition-based, transactional, institutional. In the next paragraph, we discuss main factors influencing supply chain levels' collective bargaining power.

Framing the sources of bargaining power

Market power and competitive advantage constitute a first source of bargaining power. Several papers used it as a basis for analyzing the economic efficiency of FQS supply chains (Mérel 2011), the capacity of actors to capture value (Richards, Acharya, and Molina 2011) or to manage vertical relationships (Wycherley 2002). On his side, Porter (1979) developed a comprehensive definition of competition-based bargaining power, inherited from the

strategic conception of competitive advantage. Also known as the five forces model, this competition-based model assesses actors' bargaining power at the supply chain level while considering at the same time the threat of possible substitutes (Porter 2008b). It was originally designed for assessing performance at the firm level through an explicit account of its environment (Porter 1979). The model has then been applied to industries and value-chains and used for assessing the bargaining power at each of their stages (Besanko et al. 2009; Porter 2008b). More precisely, it appraises a firm's bargaining power through the influence of five forces: industry rivalry, threat of new entrants, threat of substitute products and services, bargaining power of suppliers, and of customers. Those forces limit firms' bargaining power by constraining their strategies and behaviors. It is important to note that three forces (threat of new entrants, threat of substitute products, and industry rivalry) apply at the considered stage of the supply chain and may thus be qualified as "horizontal forces" while the two others (bargaining power of suppliers and of customers) are dealing with vertical relations which are, in turn, expected to be subject to the same types of horizontal forces (see Crook & Combs, 2007). However, those vertical forces may be offset in the case that a dominant firm can adopt a monopolistic behavior.

A second source of bargaining power comes from actors' capacity to develop and to exploit transaction costs. So far, Transaction Costs Theory (TCT) in the context of agricultural economics has been mainly used for discussing the most efficient supply chain governance model (market/hybrid / vertical integration) (Fernández-Olmos et al. 2009). In our case (and this is an originality of this paper), we apply Transaction Costs Economics for analyzing discrepancies in bargaining power (see Klein 1980) in agrifood supply chains.

Transaction costs are rooted in two phenomena: uncertainty and asset specificity. Uncertainty is related to the difficulty of observing behavior and performances (internal uncertainty) and to the environment's complexity and turbulence levels (external uncertainty) (Williamson 1981). A solution proposed by TCT for coping with uncertainty is to replace spot transactions by long term contracts. A consequence is that they limit actors' contractual flexibility by contributing to raising switching costs. In this sense, long-term contracts limit bargaining power because, once settled, it becomes more difficult to renegotiate the terms of the agreement. More globally, and this has been particularly highlighted for agri-food supply chains, the choice of long-term contracts is not necessarily aimed at minimizing transaction costs, but also reflects the bargaining power advantage of downstream actors (Barjolle and Chappuis 2000).

Specific assets correspond to investments dedicated to developing a relationship between two economic agents (Williamson 1981). Strictly speaking, specific assets should limit the bargaining power of their owners because they increase exit costs (Vukina and Leegomonchai 2006). However, a more extensive conception of asset specificity, which has been developed in the resource-based literature, posits that an actor's contribution to the relationship supports its bargaining power: partners contributing with specific resources that are key to the specificity of the end product develop higher bargaining power (Longfellow Blodgett 1991; Shervani, et al. 2007).

All in all, the relationship between bargaining power and transaction costs via asset specificity appears to be ambiguous. On the one hand, uncertainty induces long-term contracts, which contributes to lower bargaining power by raising switching costs. On the other hand, owned and developed specific assets and resources contribute to bargaining power precisely because they increase transaction costs. In the specific case of GI (geographical indication) products, specific assets are considered as key for establishing their

uniqueness and, therefore, their commercial success (Barjolle and Sylvander 2002). This is why we consider that asset specificity has a positive impact on bargaining power.

A third, collective, source of bargaining power is associated with the institutional framework. We take on the institutionalist view developed in the tradition of North, who defined institutions as "the rule of the game in a society or, more formally, are the humanly devised constraints that shape human interaction. In consequence, they structure incentives in human exchange, whether political, social, or economic" (North 1990 p.3). Out of this definition, it is assumed that institutions contribute to regulating bargaining power by constraining individual behavior. For FQS, this is notably done through the collective development of specifications, which set specific production practices and minimal standards of quality for the product, and control for production levels (Giraud-Héraud and Soler 2003). In turn, the management of those specifications may be operated by management consortia. Furthermore, several papers highlight the fact that agri-food supply chains organized around strong management consortia globally show higher cooperation levels than supply chains that are not (Ditter and Brouard 2014; Martin and Tanguy 2018; Loubaresse and Pestre 2014).

However, as North recalled: "institutions are not necessarily or even usually created to be socially efficient; rather they, or at least the formal rules, are created to serve the interests of those with the bargaining power to create new rules" (North 1994, pp. 360-361). It follows that institutions are designed for supporting the bargaining power of already dominant actors (Friedberg 1997). That said, at a collective level, institutions are key for supporting collective action and strategies because they provide safeguards against conflicts and opportunistic behaviors (Ring and Van de Ven 1994). As such, professional networks and unions have to be considered both as an output and as a factor underlying institutionally "thick" environments (Keeble et al. 1999). "Institutional thickness" therefore contributes to a higher collective bargaining power at the considered level of the supply chain.

Bargaining power is multifactorial and is influenced by competitive, transactional, and institutional factors. However, it should also be stressed that identified factors can, to some degree, interact with each other. For instance, institutional thickness may be related to the existence of strong market leaders, as they have a higher capacity to settle conventions and norms of behavior (see Muller 2006). Table 1 summarizes our discussion of the factors influencing the bargaining power of each level of a supply chain.

Factors		Expected impact on bargaining power
Competitive	Horizontal forces: degree of competition, threat of new competitors	Negative
	Vertical forces: bargaining power of suppliers and customers	Negative
	Existence of a market leader	Positive
Transactional	Contractual flexibility	Positive
	Asset specificity	Positive
Institutional	Institutional "thickness"	Positive

Table 1: Factors influencing supply chain level's collective bargaining power

Out of the preceding discussion, we can put forth two hypotheses that will be tested in the empirical part of the paper. 1) FQS supply chains achieve vertically more balanced bargaining power distribution than conventional productions. 2) This more balanced distribution is due to the complementary action of different sources of bargaining power

rather than that of one single source. The next section aims to operationalize previous discussions by describing the methodology for building up social sustainability indicators based on bargaining power.

Constructing variables for assessing collective bargaining power

In the objective of doing a comparative analysis of different supply chains, we start by constructing a synthetic indicator of bargaining power for each level of each supply chain. This indicator is in turn based on variables accounting to different sources (competition-based, transactional, and institutional), which we detail in this section. To the best of our knowledge, this paper is the first attempt to construct a synthetic indicator of bargaining power by aggregating variables from those different sources. Among them, some are dichotomous while others are quantitative. We have chosen to normalize or to dichotomize these variables to avoid undesirable overweighting effects.

Competition-based variables

In line with Porter (1979), a supply chain level's bargaining power is influenced by vertical and horizontal forces, which our model accounts for through two variables. A first variable (MarketLeader) captures vertical forces underlying bargaining power. To this aim, we assume that a level is considered more robust against vertical forces when it counts one or a few dominant actors who can enforce their bargaining power while negotiating with upstream and downstream levels. The impact of strong market leaders is particularly visible in private and, to a lesser extent, in public quality labels (Raynaud, Sauvee, and Valceschini 2005).

The identification of leaders is based on the market share of the main competitor. Although the literature does not make clear the threshold from which a firm can be qualified as a market leader, our data reveal two very different types of situations. Some levels of supply chains come close to a situation of pure competition, with very low market shares, whereas other supply chains include players whose market share systematically exceeds 25%. We retain this observation. Our MarketLeader variable, therefore, takes value 1 if at least one firm has a market share of at least 25% and 0 otherwise.

Horizontal forces are captured by a variable accounting synthetically for the relative number of competitors existing at each level of the supply chain[6]. Indeed, the collective bargaining power at one level is likely to depend on the relative number of actors at all levels, as oligopolies or oligopsonies occupy dominant positions. Therefore, this balance of power is captured through a discrete variable (Num_compet)[7]. A specific difficulty arises for computing this variable in a simple way. This is why we make the methodological choice of basing the Num_compet variable on a comparison of the number of firms at each level. We distinguish between three possibilities:

[6] An important aspect that has to be considered in our calculation is the existence of cooperatives and of organizations of producers. As they are usually designed for grouping the production of several farmers, we made the methodological choice of considering the number of coops instead of member farmers when calculating the Num_compet indicator at the producer level.

[7] Popular indicators such as Lerner index (Lerner 1934), Bresnahan's mark-up test (Bresnahan 1982), Panzar-Rosse H-statictics (Panzar and Rosse 1987) are concerned with calculated horizontal market power while we are interested in assessing its impact along supply chains. Besides their calculation necessitates data dealing with market (demand elasticity, etc.) and industrial characteristics (cost structure) that were not available.

1) a level is considered as highly competitive if the number of competing firms is much higher than the aggregate number of actors at all other levels. The Num_compet variable takes value 0 in this case.
2) a level is considered as fairly competitive if the number of competitors is commensurate with the aggregate number of actors in all other levels. The Num_compet variable takes value 0,5 in this case.
3) a level is considered as not concurrential if the number of competitors is lower than the aggregate number of actors in all other levels. The Num_compet variable takes value 1 in this case.

The construction of the Num_compet is illustrated in figure 1.

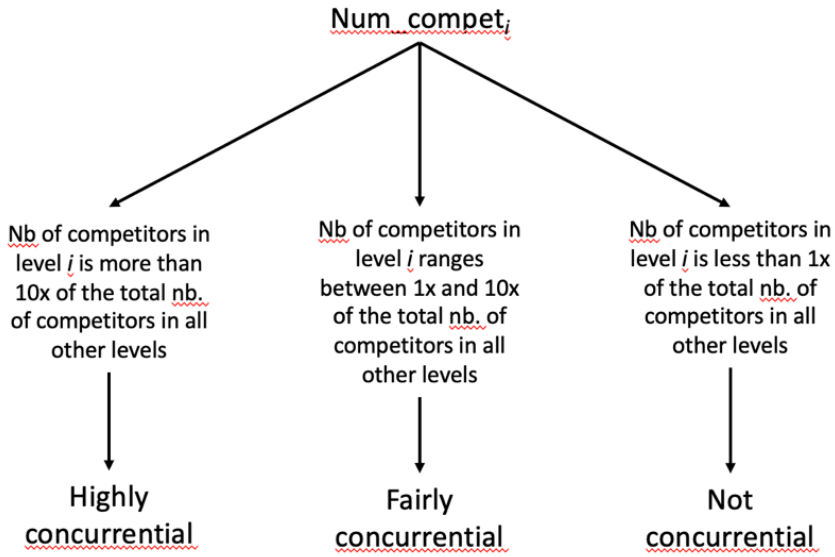

Figure 1: Algorithm for setting the value of the num_compet variable

Transactional variables

Transactional variables capture two effects. The first one is dealing with contractual flexibility. As argued in the theoretical section, high levels of uncertainty lead to a greater propensity to adopt long-term contracts, thus contributing to decreasing relational flexibility. This is why we proxy flexibility by introducing a variable (prop_contract) estimating the share of volumes that is subject to pluriannual contracting with the downstream level. The lower the share of pluriannual contracting, the more flexible the relationship is supposed to be, the higher the associated score.

The second effect is dealing with the collective capacity of developing specific assets and exploiting them in such a way that they are considered as key for the specificity of the end product. This effect is captured in two ways. First, through an evaluation of the global degree of specificity of mobilized assets at the considered level (spec_res); second, through an estimation of the contribution of the considered level to the specificity of the end product (prod_proc). For instance, by mobilizing specific assets, knowledge, and competencies, FQS farmers are expected to possess higher bargaining power than conventional farmers (Morgan and Murdoch 2000). In the same way, PDO products are proved to raise higher loyalty levels on the consumer side (Fandos and Flavián 2006), which contributes to raising switching costs for retailers.

Both variables are coded on a four-point Likert scale, after assessment made by key informants of each supply chain. The variable spec_res takes value zero when the resources mobilized at the considered level are generic and it takes value three when the resources are considered as highly specific and cannot be technically replaced by substitutes. In the same way, the variable prod_proc takes value zero when the contribution of the product of the considered level is considered as negligible to the specificity of the end product and takes value three when its contribution is considered as fundamental to the specificity of the end product.

Institutional variables

Institutional variables grasp the ability of supply chains to build up a complex set of procedural rules for regulating individual behaviors. However, even though some of them are formal (eg. specifications), most are informal by nature, as they pertain to locally embedded cultural traits and routines (see eg. Gertler 2001, 2003). This makes it difficult to directly appraise a supply chain's "institutional thickness". This is why we assess institutional thickness indirectly, through the existence of professional unions. This proxy can be considered as quite reliable because, as previously discussed, consortia evidence the capacity of actors to form collectives and to establish collective strategies (Raynaud, Sauvee, and Valceschini 2005; Raynaud, Fernández-Barcala, and Gonzalez-Diaz 2013; Martin and Tanguy 2018). We, therefore, assume the existence of a positive relationship between "institutional thickness" and supply chain actors' capacity to form and to belong to diverse professional unions. In so doing, we identify two relevant variables. The first one (Union_FSC) refers to the existence of unions and consortia specifically related to the supply chain. This variable is relevant because this type of union/consortium indicates the existence of spaces of collective discussion and coordination among supply chain actors. Besides, they act as lobbying bodies aimed at promoting the interest of their members. The second variable (union_others) relates to the existence of any other sectoral union related to the product (eg. professional union of meat or of cereal producers…). They also have to be considered because they not only achieve collective coordination and lobbying tasks (see Mérel 2011), but they also tie up local supply chains with a wider, national, productive context. Both variables are dichotomous because they only aim at accounting for the existence of professional unions/consortia. Table 2 summarizes variables used for building up the bargaining power scores for each level and associated possible values.

Variable		Description	Value and associated score	FQS		Ref.	
				Mean	Std. dev	Mean	Std. dev
competition-based	Num_compet	Number of entities producing similar/substitutable products at level *l* of the supply chain (cf. algorithm in annex 1)	Highly competitive: 0 Fairly competitive: 0,5 Not competitive: 1	0,595	0,383	0,582	0,417
	MarketLeader	Existence of a market leader at level *i* of the supply chain	1 if the leading firm's market share exceeds 25% 0 else	0,382	0,421	0,471	0,425
Transactional	prop_contract	Proportion of transacted volumes that are subject to long-term contracts between supply chain level *l* and its clients (level l+1)	[0% ; 25%[: 3/3 = 1 [25% ; 50%[: 2/3 = 0,67 [50% ; 75%[: 1/3 = 0,33 [75% ; 100%]: 0/3	0,744	0,437	0,361	0,480
	spec_res	Does the level *l* in the supply chain require the possession of specific resources (natural, physical, knowledge/skills…) not accounted for in the specifications?	Resources are generic: 0/3 Resources are specific but could easily / at low cost be technically replaced by substitutes: 1/3 = 0,33 Resources are specific and could hardly / at high cost be technically replaced by substitutes: 2/3 = 0,67 Resources are specific and cannot be technically replaced by substitutes: 3/3 = 1	0,754	0,331	0,276	0,258
	prod_proc	Does the level *l* of the supply chain contribute to the differentiation of the end product with potential substitutes	Contribution is negligible: 0/3 Contribution is moderate: 1/3 = 0,33 Contribution is important: 2/3 = 0,67 Contribution is fundamental: 3/3 = 1	0,364	0,481	0,244	0,421
Institutional	unionFSC	Are firms at level *l* of the supply chain involved in a product management consortium?	Yes: 1 No: 0	0,643	0,479	0,567	0,496
	union_others	Are firms at level *l* of the supply chain involved in other professional unions linked to the product?	Yes: 1 No: 0	0,559	0,332	0,320	0,275

Table 2: Description of variables, values, and associated scores, and descriptive statistics

Data and method for constructing a social sustainability indicator based on bargaining power

Computing bargaining power scores and the social sustainability indicator

The method proceeds into two steps. In a first step, a bargaining power index value (BP_i) is computed for each level *i* of the supply chain. The bargaining power index value of level *i* is obtained as the weighted sum of all scores obtained for each variable. As the literature doesn't allow to state a priori weights of each variable, we used a Monte Carlo method for estimating bargaining power at each level:

$$BP_i = \alpha_1 * Num\_compet_i + \alpha_2 * MarketLeader_i + \alpha_3 * prop\_contract_i + \alpha_4 * spec\_res_i + \alpha_5 * prod\_proc_i + \alpha_6 * unionFSC_i + \alpha_7 * union\_others_i$$

Where BP_i is the bargaining power value of level *i*; α_j (*j* = 1,…,6) are randomly drawn coefficients ($\alpha_j \in [0;1]$ and $\sum_{j=1}^{7} \alpha_j = 1$). We then use obtained bargaining power values at each level for assessing the social sustainability of supply chains along two dimensions: the equity of bargaining power distribution and the capacity of supply chains to maintain bargaining power positions against potential shocks or their adaptation capacity.

The first dimension corresponds to the ability to even out bargaining power along with the different levels of the supply chain (our indicator does not consider horizontal bargaining power distribution among competitors at the same level of the supply chain). To this end, we compute a bargaining power distribution indicator which corresponds to a normalized Herfindahl-Hirschmann index based on bargaining power values obtained at each level:

$$HHI = \frac{\sum_{i=1}^{L} \left(\frac{BP_i}{\sum_{j=1}^{L} BP_j} \right)^2 - \frac{1}{L}}{1 - \frac{1}{L}}$$

Where L is the total number of levels in the supply chain. By construction, HHI is bounded in a [0,1] interval where the level of inequality increases with the value of the normalized Herfindahl-Hirschmann index. Our choice for this statistics is justified by its simplicity, both for computing and for interpreting its value. However, its final value, especially at extremes, may be impacted by the number of observations used for its computation (ie. the number of supply chain levels taken into account in our analysis) (Owen, Ryan, and Weatherston 2007). This is why we opt for its normalized version.

A limitation of the bargaining power distribution indicator is that it only provides indications of the ability to fairly redistribute bargaining power under current conditions in the supply chain. From this point of view, the bargaining power distribution indicator can be considered as a static indicator of social sustainability. This is why we complement it with an indicator accounting for supply chain actors' capacity to adapt and maintain their bargaining power after the occurrence of external (significant change in competition, market or production conditions…) or internal (entry of new competitors, exit of a significant player) shake-outs. This second indicator adds a dynamic dimension to our results, by assessing the capacity of supply chain actors to accommodate perturbations without significantly modifying the existing vertical bargaining power distribution. We refer to this second dimension, and associated indicator, to the adaptation capacity of the supply chain.

Adaptation capacity is also rooted in bargaining power as past research has shown that bargaining power has to be considered as an important component of actors' capacity to adapt against changes or, put differently, of actors' dynamic capability (see Blyler and Coff 2003; Skilton 2009). Moreover, our bargaining power indicator, which is calculated for each level, is based on variables that the literature identified as important for a supply chains' adaptation capacity: specific resources ownership (Brandon-Jones et al. 2014), institutional thickness (Roundy, Brockman, and Bradshaw 2017), or the existence of strong market leaders (Gnutzmann, Kowalewski, and Śpiewanowski 2020).

Thus value chains whose actors collectively show "strong" bargaining power can better accommodate disruptive change while keeping their bargaining power positions. In supply chains counting several levels, a straightforward way of proxying such an "adaptation capacity" consists of identifying and evaluating the bargaining power of the weakest level.

For all supply chains (FQS and reference), we computed results for each of both indicators (bargaining power distribution and bargaining power of the weakest level) for each set of coefficients. We run Monte Carlo simulation 10,000 times, corresponding to as many sets of coefficients. The following results are obtained as averages of all simulation runs for each supply chain.

Data

The empirical part of the paper consists of a transversal study based on the cross-comparison of several FQS and their "reference" supply chains, which correspond to similar products produced according to conventional practices. In the case that no similar product is available, we base our comparison on national averages. A list of FQS and corresponding "reference" supply chains is provided in annex 1.

Our sample includes supply chains from different countries, representing different types of FQS (PDO, PGI, organic), corresponding to different crops (dairy, fruit/vegetable, meat, seafood, cereal/bakery). FQS and reference supply chains are chosen as part of the Strength2Food H2020 project (see Barczak et al. (2016) for more details on the selection methodology). This selection methodology prevents several possible biases:

- The choice of different countries controls for possible effects arising from country-specific institutional settings. In particular, although unified quality signs exist at the European level, some aspects of FQS regulations are still country-specific. For instance, FQS management consortia are compulsory in France, while this is not the case in other European countries.
- The choice of different sectors controls for possible biases related to technical specificities of the product that may explain some aspects of bargaining power distribution along the supply chain.
- Last but not least, each FQS supply chain is compared with a reference product from the same country. This cancels out country- and sector-specific features when the difference is computed, thus highlighting the possible advantage of FQS certification.

For each supply chain (FQS and reference), data were collected by a local team led by one of the coauthors. Data sources are of two main types, depending on the variable. For variables of "quantitative origin" (Num_compet, MarketLeader, prop_contract), most data were retrieved from official sectoral statistics. If not available, data were based on key informant estimates. For all other variables, data were based on key informant appraisal (see annex 1).

Results and discussion

Bargaining power and the social sustainability advantage of FQS supply chains

Mean values and standard deviations of the results obtained for each FQS and corresponding reference supply chains are provided in annex 2. Figure 1 shows average positions after 10,000 simulation runs of FQS (blue dots) and reference (orange dots) supply chains along both the bargaining power distribution (horizontal) and the "adaptation capacity" – ie. bargaining power value of the weakest level – (vertical) axes. Figure 1 shows that the distribution of FQS and reference supply chains is not homogeneous along the two dimensions. FQS supply chains are mostly concentrated in the upper and left-hand parts of the graph, which is associated with a fairer bargaining power distribution and a higher "adaptation capacity". On their side, reference supply chains are spread in the lower part of the graph, which indicates a lower "adaptation capacity". This is a first indication of the fact that FQS supply chains show a more equal distribution of bargaining power, as well as a higher "adaptation capacity".

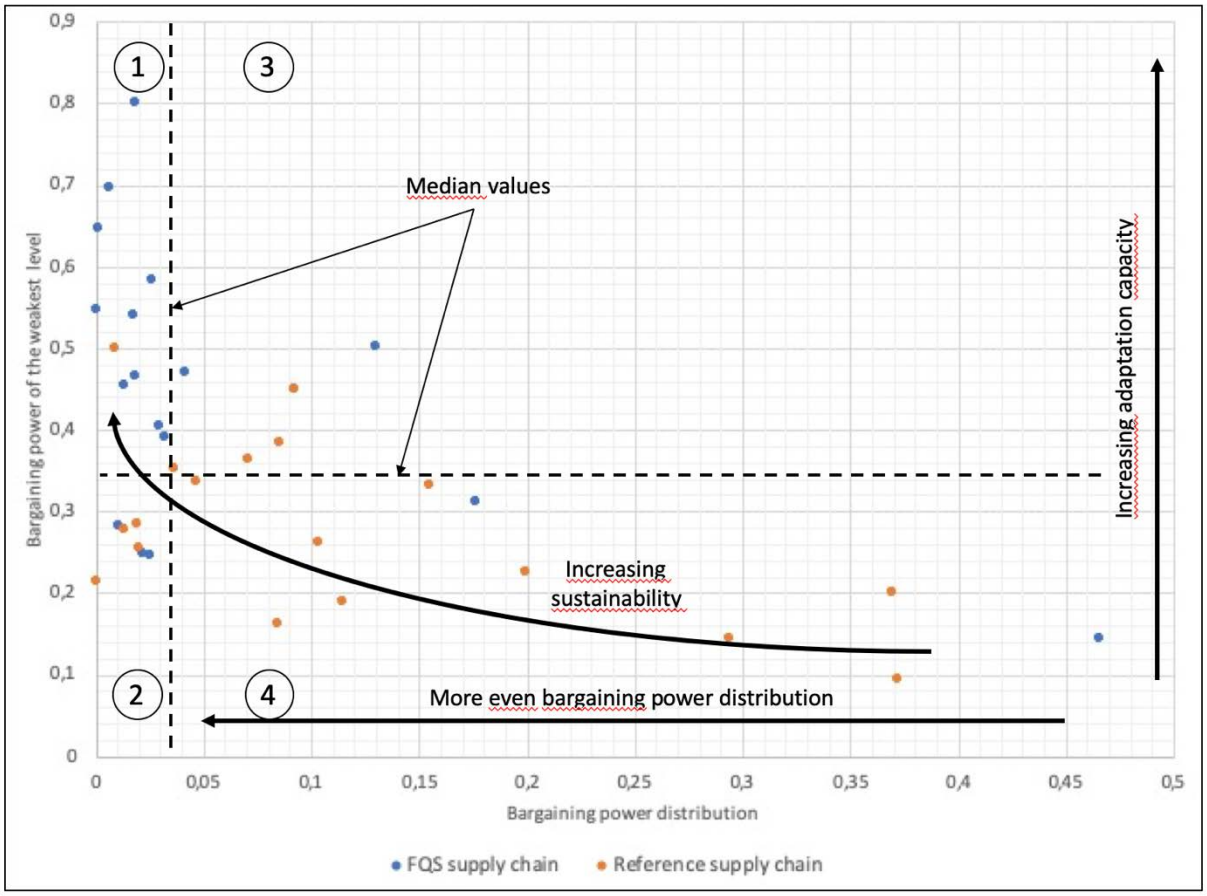

Figure 1: Bargaining power profiles of FQS (blue dots) & of reference (orange dots) supply chains. Median values shown on this graph correspond to the averages calculated over 10,000 Monte Carlo runs.

We give in figure 2 a comparison of average bargaining power distribution and average bargaining power value of the weakest level for FQS and reference supply chains after 10,000 Monte Carlo runs. Boxplots show the four quartiles of each distribution: statistically significant minimums and maximums correspond to the extreme ends of the whiskers. First and third

quartiles correspond to the edges of central boxes and medians correspond to the horizontal lines inside the boxes. Mean values correspond to crosses.

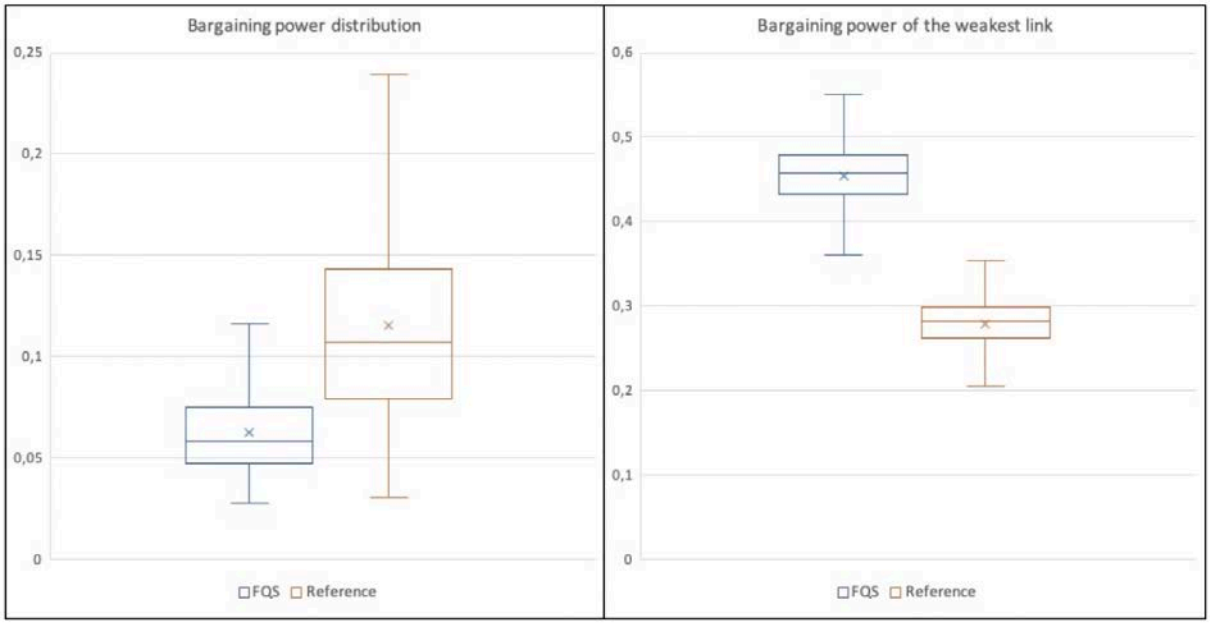

Figure 2: comparison of bargaining power distribution (left) and bargaining power of weakest link (right) between FQS and reference supply chains

Figure 2, left panel, shows that the distribution of calculated values of the normalized Herfindahl-Hirschmann index for bargaining power is more concentrated towards 0 than for FQS supply chains than for references. This evidences that bargaining power is more fairly distributed in the former than in the latter. T-tests further confirm this finding at a 1% significance level (see table 4).

Figure 2, right panel, compares, for both types of supply chains, bargaining power of the weakest level, which accounts for their "adaptation capacity". In the same way as for bargaining power distribution, FQS supply chains show a significant advantage over references in this dimension. This result is statistically confirmed in table 4.

Out of those first results, one can conclude that, on average for all coefficient sets, FQS supply chains significantly outperform references in both dimensions of a fair distribution of bargaining power and the bargaining power of the weakest level. This supports the argument that FQS supply chains are more sustainable than conventional ones, not only because they offer fairer bargaining conditions among stakeholders, but also because they can be more adaptable against shakeouts. Besides, we run comparison tests on the average values on both dimensions for FQS and corresponding references. T-tests conclude to a significant advantage on both dimensions for most FQS supply chains over corresponding references at a 1% significance level (cf. annex 2). Only exceptions are for organic tomatoes from Emilia Romagna and for organic flour, for which no significant advantage of the FQS, or, even a significant advantage of the reference over the FQS was observed. However, those exceptions only concern FQS sharing the particularity of being "offshoots" of corresponding references. Indeed, in both cases, FQS products are produced and processed by the same firms and they considered them more as "premium" side activities.

Those first results globally confirm the social sustainability advantage of FQS supply chains over conventional products. However, as our analysis covers a wide array of agri-food sectors, one question arising is whether those conclusions depend on the sector or the type

of quality sign. To put it differently, one can wonder whether, in some agri-food sectors or for specific signs, there is a substantial sustainability advantage of FQS over conventional productions, while in some others this sustainability advantage might be less clear. To investigate this, we split our supply chain sample into four parts defined along median values obtained for both dimensions, and each run. Those sections group supply chains that perform relatively better or worse along both dimensions compared to the rest of our sample. We then cross this cut-off with the sectoral classification of supply chains. In the absence of any sectoral of quality sign effect, one would expect similar patterns of distribution among sectors. Figures 3 and 4 suggest the existence of different sectoral patterns in the distribution between FQS and references, which depends on the type of quality sign, and of culture. Globally, the results of this splitting confirm previous findings (figures 1, 3, and 4). On average, about 50% of all FQS supply chains belong to section 1, which groups supply chains that perform relatively better on both dimensions. Then, about 20% of FQS supply chains belong to section 3, which group supply chains that perform relatively better on the adaptation capacity but relatively worse on a fair bargaining power distribution. This suggests that, that the specificity of FQS compared to conventional supply chains not only lies in their capacity of distributing bargaining power more evenly but also, and more importantly, in their higher adaptation capacity. Thus, supply chain levels can show stronger collective bargaining power when it comes to renegotiating existing relations with other actors after a significant shakeout. This result adds to previous contributions observing a fairer distribution of bargaining power (see Bonnet and Bouamra-Mechemache 2016) in FQS supply chains by stating that their premium compared to conventional supply chains also lies in their higher adaptation capacity.

However, our analysis also tempers this global finding when distinguishing between the type of quality sign (figure 3). For the most part, PDO supply chains belong to profile 1, of fairly distributed and strong bargaining power. On their side, PGI supply chains are also, for the most part, populated by supply chains belonging to the profile 1. However, our results also show that the distribution among the other profiles is slightly more even than for PGI. By way of contrast, organic supply chains appear to be relatively well distributed among the different profiles, thus meaning that, on average, they are less socially sustainable than other FQS.

Contrasting with organic labels, PDO and PGI labels share the characteristic of being at least partially anchored in a territory. This obligation even applies to all production and processing operations for PDOs. This territorial anchoring would at least partly explain their overall better overall performance, which is, once more, more visible for PDO. Indeed, those constraints put on production localization would act as barriers for supply chain actors against external competitors, thus contributing to strengthen and to balance their respective bargaining powers.

In the case of animal products (dairy, meat, and seafood), FQS supply chains are all classified in sections 1 and 3, accounting for supply chains that perform better on the bargaining power strength indicator (figure 4). This gives evidence of relatively higher adaptation capacities. By way of contrast, the picture for vegetal productions (fruit/vegetable and cereal/bakery) is less clear. Fruit and vegetable supply chains are mostly characterized, on the one hand, as belonging to section 3, ie. witnessing fair bargaining power distribution but low bargaining power strength. On the other hand, they are only scarcely represented in section 1, representing supply chains with fairly distributed bargaining power and high bargaining power strength. By way of contrast, cereal/bakery supply chains are mostly distributed between sections 1 and 3.

Globally, our findings suggest the importance of distinguishing between animal and vegetal supply chains as both types of supply chains show different behaviors in terms of bargaining power distribution. One explanation for this intersectoral heterogeneity could lie in differences in the influence exerted by different types of factors, whether they relate to the competitive and institutional context or be transactional. This result raises the question of the sources of the sustainability advantage of FQS over reference. Next developments will try and identify factors underlying the social sustainability advantage of FQS by distinguishing competition-based, transactional, and institutional factors.

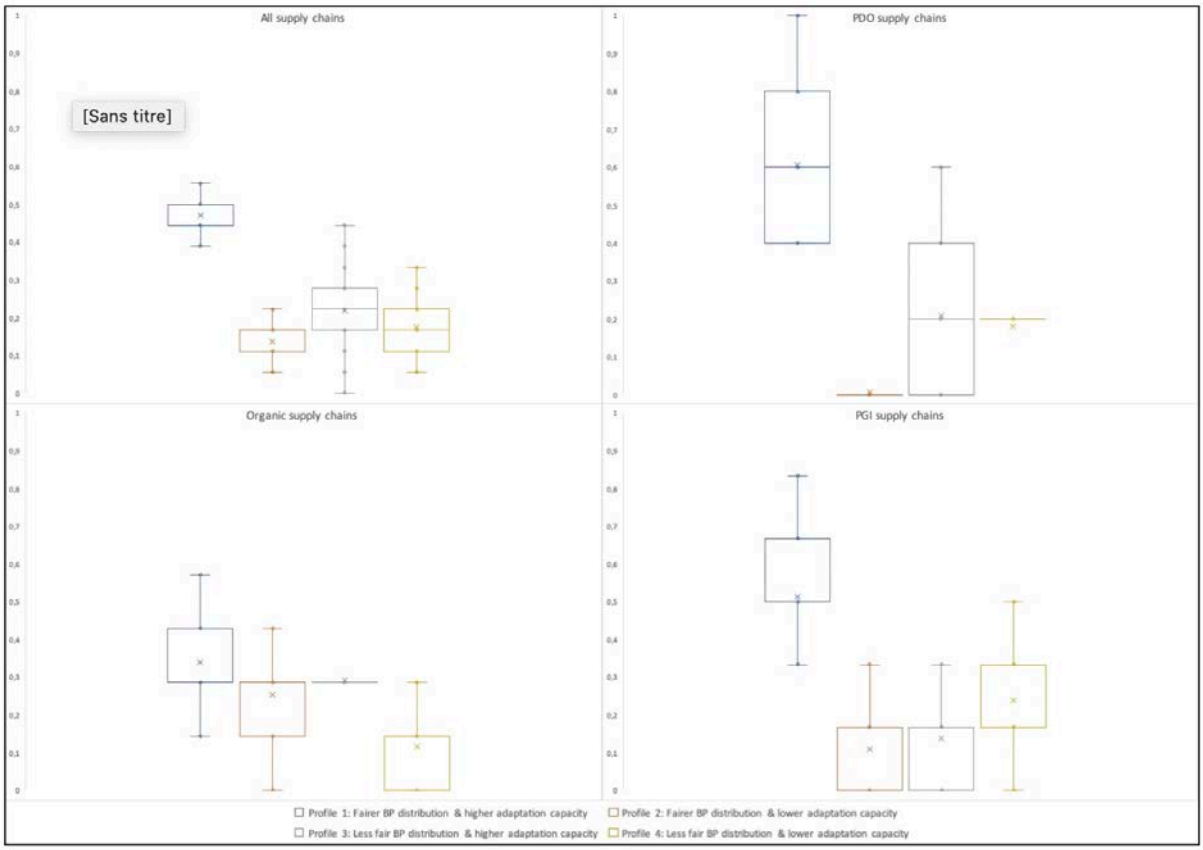

Figure 3: proportion of FQS supply chains in each profile – upper left-hand-side panel: distribution in each sustainability profile of all FQS supply chains, upper right-hand-side panel: distribution in each sustainability profile of PDO supply chains – lower left-hand-side panel distribution in each sustainability profile of organic supply chains - lower right-hand-side panel distribution in each sustainability profile of PGI supply chains - average results obtained after 10 000 Monte Carlo runs

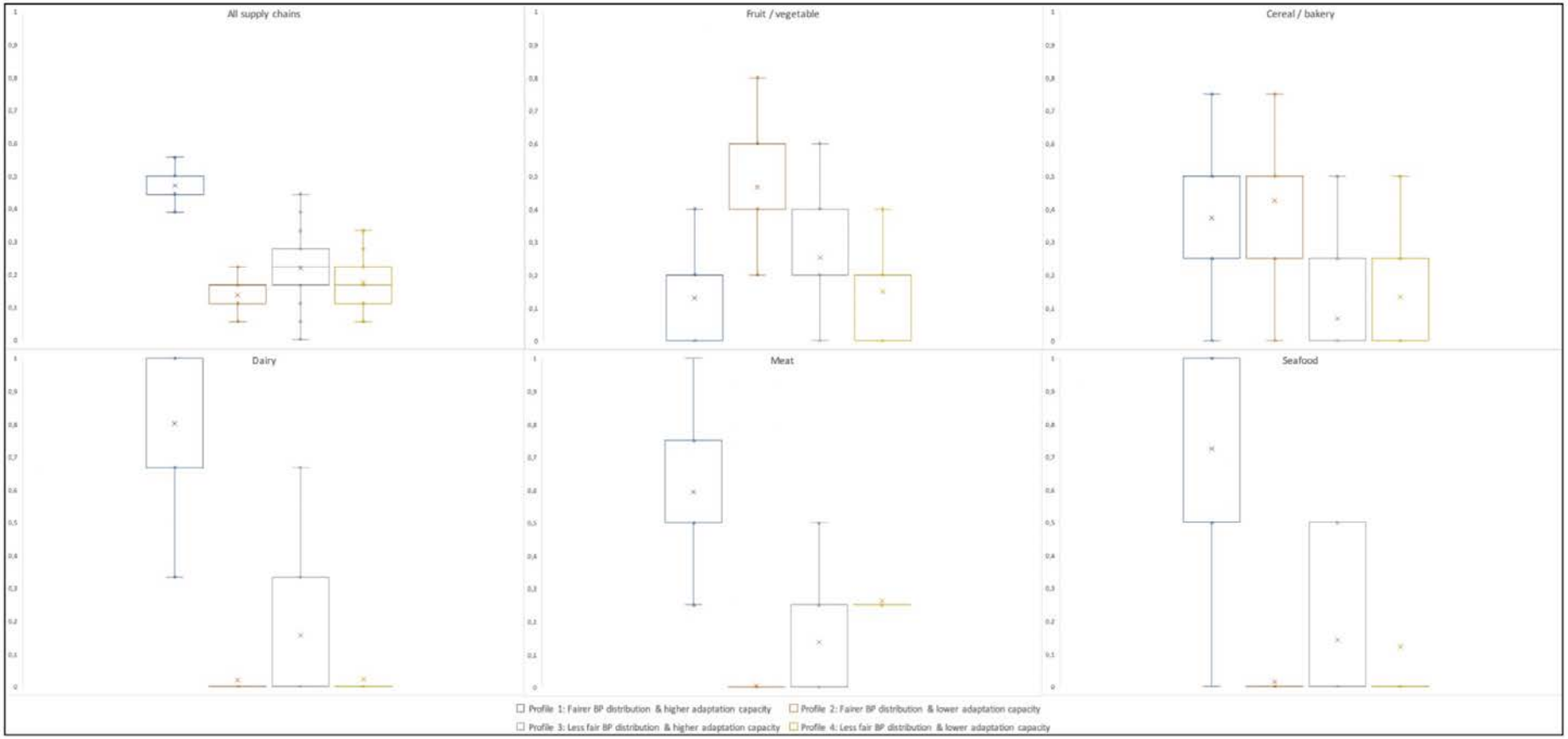

Figure 4: proportion of FQS supply chains in each profile – upper left-hand-side panel: distribution in each sustainability profile of all FQS supply chains - upper middle panel: distribution in each sustainability profile of fruit-vegetable supply chains - upper right-hand-side panel: distribution in each sustainability profile of cereal/bakery supply chains – lower left-hand-side panel: distribution in each sustainability profile of dairy supply chains – lower middle panel: distribution in each sustainability profile of meat supply chains – lower right-hand-side panel: distribution in each sustainability profile of seafood supply chains - average results obtained after 10 000 Monte Carlo runs

Identifying factors underlying FQS' social sustainability

		With all variables	Without Competition variables	Without Transactional variables	Without institutional variables
Bargaining power distribution	Nb. of advantaged FQS	13	11	10	11
	No difference	1	1	5	2
	Nb. of disadvantaged FQS	4	6	3	5
	Nb of SC with a key contribution of variable categories	/	3	3	2
Bargaining power of weakest level / adaptation capacity	Nb. of advantaged FQS	15	16	12	14
	No difference	1	2	6	1
	Nb. of disadvantaged FQS	2	0	0	3
	Nb of SC with a key contribution of variable categories	/	1	4	2

Table 3: Comparison of FQS and corresponding references supply chains along bargaining power dimensions – results based on T-tests for p < 0.01 after 10 000 Monte Carlo runs.

This section aims at identifying the factors underlying FQS's social sustainability advantage over references. It is based on two-by-two comparisons. In so doing, we drew in the theoretical discussion a distinction between different types of factors, each corresponding to different categories of variables (cf. table 1): competition-based, transactional, and institutional. Table 4 presents results of Monte Carlo simulation runs performed on each supply chain under several configurations: 1) when all variable categories were included (column "with all variables"), 2) when only transactional and institutional variables were included (column "without competition variables"), 3) when only competition and institutional variables were included (column "without transactional variables"), 4) when only competition and transactional variables were included (column "without institutional variables"). For each dimension (bargaining power distribution and bargaining power of the weakest level) we then counted the number of FQS supply chains that significantly performed better / equally / worse than corresponding reference supply chains at a $p < 0,01$ significance level. Finally, we counted the number of FQS supply chains for which any of the variable categories had a key impact on the sustainability advantage of FQS over corresponding references: those correspond to the situation where FQS performed statistically better when all variables categories were included and this advantage vanished when variables of the category were removed (lines "Nb of SC with a key contribution of variable categories").

Table 4 further confirms our previous finding that, for the most part, FQS have a significant sustainability advantage over corresponding references over both dimensions (bargaining power distribution as well as bargaining power of the weakest level). This finding however complements previous results because we base here our results on two-by-two comparisons between FQS and reference supply chains.

Another interesting finding also lies in the relative stability of FQS' performance premium on both dimensions (see lines "nb of advantaged FQS"). Indeed, most FQS still significantly outperformed corresponding references after the removal of any of the variable

categories. For instance, concerning bargaining power distribution, 13 FQS significantly outperform references when all variables were considered and this figure only drops to 11 after removing competition or institutional variables and to 10 after removing transactional variables.

This finding is confirmed by an inspection of the lines "Nb of SC with a key contribution of variable categories". Competition, institutional, and transactional variables can be considered as a key determinant for the bargaining power distribution of only three and two FQS supply chains respectively. A similar pattern of findings can be observed for the dimension of bargaining power of the weakest level / adaptation capacity. Those results evidence that competitive, transactional, and institutional variables only have a limited individual impact on FQS sustainability premium. Rather, their premium depends, for the most part, on the complementary effect of all variable categories.

Those findings, therefore, confirm our previous hypothesis that the FQS' sustainability advantage, as measured from the bargaining power standing point, comes from the interaction between different effects, pertaining to supply chains' competitive, transactional and institutional characteristics. Besides, our contribution points to the importance of adopting a comprehensive analysis of bargaining power in supply chains, which has not to be conflated with market power but also has to include other dimensions, such as institutional characteristics or transaction costs patterns.

Conclusion

This paper evaluates the social sustainability advantage of FQS supply chains through the lens of bargaining power distribution. We base our development on a more comprehensive conception of bargaining power, rooted in different categories of factors: competition-based, transactional, and institutional. to this end, we propose a synthetic indicator mixing inputs from those three theoretical arguments. Our indicator highlights two dimensions of social sustainability: 1) the capacity of supply chain actors to reach a fair distribution of bargaining power, and 2) the ability of all supply chain levels to show strong bargaining power at all level, what is conducive to increased adaptation against potential shakeouts.

Our results show that, globally, FQS have significantly higher scores in both dimensions than reference supply chains, thus grounding evidence of their social sustainability advantage. This conclusion is further verified by statistical tests comparing FQS and related "reference" supply chains. But, at the same time, this performance might also depend on the type of quality sign at stake, as well as on the type of agricultural production. Finally, our study has found evidence that their sustainability advantage comes from a combination of various sources, pertaining to the competitive and institutional characteristics of the supply chain, as well as on transaction costs.

To the best of our knowledge, this paper is the first transversal study evaluating the social sustainability of FQS through bargaining power. It provides valuable insights, not only by proposing a quite simple and easy-to-use synthetic indicator but also by highlighting the existence of different social sustainability profiles. However, as we adopted a quantitative, transversal stance, some key aspects of studied supply chains may have been overlooked. First, our indicator is based on the comparison of bargaining power scores between different levels. To this end, our analysis relies on the key assumption that each level is independent of the other. This is not necessarily observed, as actors in agricultural supply chains often have a

strategy of vertically integrating different levels. Similarly, some supply chains may be partly or entirely controlled by single actors, such as agricultural cooperatives or producer organizations. Even though one cannot strictly speak of vertically integrated supply chains because farms are legally independent of the cooperative, this type of cases raises a specific issue in the sense that the vertical distribution of bargaining power would be dramatically influenced by cooperatives' strategy (Filippi, Frey, and Mauget 2008), what is not accounted for in our analysis. Agricultural cooperatives raise another specific issue in the analysis of the vertical distribution of bargaining power. Indeed, even though they are legally independent of the farms they serve, their existence precisely lies in the fact that they aim at aggregating the individual production of their members, and farmers are considered as involved in setting the cooperative's strategy (Filippi 2014). Farmers' investment in cooperatives is therefore aimed at restoring a balance in bargaining power with downstream levels, an objective that is also at stake in producer organizations. To account for this distortion with the supply chain model, we were led to count farmers members belonging to cooperatives or producer organizations as one single actor. Finally, further developments of our proposed bargaining model indicator should better account for the fact that coops 'influence can stretch beyond the cooperative perimeter and spread to strategies or dominant practices at the supply chain level (see Amisse, Leroux, and Muller 2012; Filippi and Muller 2013).

Finally, our analysis falls short for "short food supply chains", which are based on the assumption of the existence of, at most, one intermediary between farmers and end-consumers (Aubry and Chiffoleau 2009). But at the same time, some studies point to the fact that this type of supply chain is more socially sustainable than longer ones (see eg. Canfora 2016).

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Annex 1: list of supply chains (FQS and references) and key data sources

Sector	FQS product	Type of FQS	Country	Main data sources for the FQS	Reference product	Main data sources for the reference
Cereal / bakery	Camargue rice	Organic	France	Key informant (PGI consortium)	Non-organic rice (mostly PGI)	Key informant (PGI consortium)
	Thung Kula Rong-Hai (TKR) Hom Mali rice	PGI	Thailand	Key informant, Napasintuwong (2017)	National average	Key informants, Rice Mills Association
	Organic flour	Organic	France	*Avise* and *Agence Bio* websites	National average	*Agence Nationale de la Meunerie Française* website
	Organic pasta	Organic	Poland	Key informant (producer)	National average	Key informant
Dairy	Comte cheese	PDO	France	Key informant (PDO consortium)	National average (cow cheese)	France Agrimer (2010; 2011)
	Parmigiano Reggiano cheese	PDO	Italy	Key informant, PDO consortium	Biraghi cheese (similar non-PDO cheese)	Key informant, ISTAT
	Organic yoghurt	Organic	Germany	AMI (2017)	National average	*MIV*, Fakten Milch Sept-2017
Meat	Gyulai sausage	PGI	Hungary	PGI producers	National average	Key informant (Hungarian Meat Industry Federation), non PGI producers
	Organic pork	Organic	Germany	Key informant (*Naturland*), *EcoZept*	National average	*EcoZept*
	Sobrasada of Mallorca	PGI	Spain	Key informant	National average	Key informant
	Ternasco de Aragon	PGI	Spain	PGI consortium manager	Non-PGI lamb in the same region (Aragon)	Key informant, Sierra (2016)
Seafood	Saint-Michel Bay bouchot mussels	PDO	France	Key informant (PDO consortium)	National average (TSG Bouchot mussels)	Oyster general survey
	Phu Quoc Fish Sauce	PDO	Vietnam	Key informants (local expert and PDO consortium)	Non-PDO fish sauce from same region	Key informants (local expert and PDO consortium)
Fruit / vegetable	Buon Ma Thuot coffee	PGI	Vietnam	Key informant	Non-PGI coffee from Dak Lak province in Vietnam	Key informant
	Kalocsai paprika powder	PDO	Hungary	Key informants (PDO consortium)	Imported pepper milled in Hungary	Key informants (PDO consortium)
	Kastoria apple	PGI	Greece	Key informant	Kissavos apples (non-GI apples from another region)	Key informant
	Organic raspberries	Organic	Serbia	Organic farms registry	National average	Official farm registry
	Organic tomato from Emilia Romagna	Organic	Italy	Key informant, OI Pomodoro da Industria del Nord Italia	National average	Key informant, OI Pomodoro da Industria del Nord Italia

Annex 2: Average bargaining power distribution and bargaining power of the weakest level values for each FQS and corresponding reference supply chains: mean values (standard deviation) after 10,000 runs.

Sector	Case studied	Bargaining power distribution			BP of weakest level		
		FQS	Reference	Most performant SC (1% significance level)	FQS	Reference	Most performant SC (1% significance level)
		Average (std. Dev.)	Average (std. Dev.)		Average (std. Dev.)	Average (std. Dev.)	
Cereal / bakery	Camargue Rice	0,011 (0,012)	0,014 (0,015)	FQS	0,281 (0,030)	0,277 (0,034)	FQS
	TKR Hom Mali Rice	0,007 (0,011)	0,000 (0,000)	Reference	0,697 (0,080)	0,215 (0,085)	FQS
	Organic Flour	0,022 (0,019)	0,020 (0,018)	Reference	0,249 (0,040)	0,255 (0,039)	Reference
	Organic pasta	0,032 (0,048)	0,372 (0,191)	FQS	0,391 (0,086)	0,095 (0,035)	FQS
Dairy	Comté cheese	0,026 (0,023)	0,155 (0,144)	FQS	0,583 (0,114)	0,331 (0,131)	FQS
	Parmiggiano Reggiano cheese	0,002 (0,005)	0,047 (0,068)	FQS	0,646 (0,111)	0,337 (0,069)	FQS
	Organic yoghourt	0,013 (0,024)	0,115 (0,128)	FQS	0,455 (0,096)	0,189 (0,082)	FQS
Meat	Gyulai sausage	0,466 (0,222)	0,294 (0,246)	Reference	0,144 (0,083)	0,144 (0,082)	FQS
	Organic pork	0,018 (0,027)	0,037 (0,046)	FQS	0,466 (0,090)	0,352 (0,083)	FQS
	Sobrasada de Porc Negre	0,017 (0,029)	0,071 (0,097)	FQS	0,541 (0,107)	0,364 (0,099)	FQS
	Ternasco de Aragon	0,019 (0,023)	0,200 (0,235)	FQS	0,800 (0,113)	0,227 (0,121)	FQS
Seafood	Saint Michel Bay bouchot Mussels	0 (0)	0,009 (0,010)	FQS	0,546 (0,092)	0,499 (0,092)	FQS
	Phu Quoc Fish Sauce	0,030 (0,026)	0,103 (0,082)	FQS	0,405 (0,098)	0,262 (0,083)	FQS
Fruit / vegetable	Buon Ma Thuot coffee	0,025 (0,030)	0,085 (0,124)	FQS	0,246 (0,056)	0,385 (0,089)	Reference
	Kolocsai Paprika powder	0,176 (0,106)	0,019 (0,025)	Reference	0,311 (0,089)	0,285 (0,108)	FQS
	Kastoria apple	0,041 (0,064)	0,084 (0,093)	FQS	0,470 (0,107)	0,162 (0,063)	FQS
	Organic raspberries	0,130 (0,089)	0,369 (0,177)	FQS	0,501 (0,126)	0,200 (0,074)	FQS
	Organic tomato from Emilia Romagna	0,092 (0,064)	0,092 (0,064)	None	0,451 (0,092)	0,451 (0,092)	None