IMPERFECTIONS IN ITALIAN TOMATO FOOD CHAIN

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MARKET IMPERFECTIONS IN ITALIAN TOMATO FOOD CHAIN

Abstract

The paper focuses on the analysis of market imperfections in the Italian tomato food chain. The identification of the degree of non-competitive behaviour is based on the derived mark-down and mark-up model and using the latest developments in stochastic frontier methodology. The estimated models reveal some degree of non-competitive behaviour in the input as well as in the output processing market. Since the distribution of estimated Lerner indices are relatively narrow and skewed to smaller values only small number of companies are characterized by considerably high degree of non-competitive behaviour. Moreover, relating the results to governance and evaluating the sustainability, integrity as well as resilience of the Italian tomato value chain we can conclude that there are fairly stable long-term food chain relationships despite the significant change in market power imbalances in favour of farmers in 2010.

Key words: Market imperfections, sustainability, tomato, food chain, SFA

1 Introduction

The retail and processing segments of food supply chains have witnessed an increasing concentration across at global level. As a result of this development, the bargaining power in trade relations between the actors in the supply chain will be affected, potentially leading to unfair trade practices (UTPs) (FALKOWSKI et al., 2017, ch1). The emergence of powerful food retailers, along with continued increases in concentration among food manufacturers, raises issues of bilateral oligopoly and countervailing power in whole sale market (SEXTON AND XIA, 2018). The concentration in the agri food chains is mainly fuelled by increasing consolidation and vertical coordination in the value chain and by worldwide food price inflation and volatility 2007-2008 (McCORRISON, 2014). The concern is that UTPs in the food supply chain due to increasing concentration and consolidation among market intermediaries will harm farmers and small-businesses in the food supply chain. This will cause market inefficiencies, curtail investment and, in the most severe cases, the exit of otherwise viable entrepreneurs. (FALKOWSKI et al., 2017, ch1). The common topic of concern regarding UTPs is farmer interactions with their downstream buyers. The increasing concentration and consolidation among food manufacturers and retailers has reduced potential trading partners for many farmers to only one or a few. (FALKOWSKI et al., 2017, ch1)

The above mentioned discussion make the measuring of the level of this concentration with available economic tools an important issue. Therefore, by focusing on tomato processing in Italy, we have decided to test this concentration changes in this value chain[1]. Italy, Spain and Portugal are the European countries with the highest production of processed tomato. Italy is the second largest producer of processed tomato worldwide after the USA (30% of global production), representing 13.6% of the global production and 49% of EU production, with a turnover of 3.15 billion Euros, from which 1.1 billion Euros derive from exports (ANICAV, 2018). Italy is the first exporting country of finished processed tomato products in the EU, showing increasing export numbers in the first semester 2018 of +11.2% in volume and of +7.69% in value (ANICAV, 2018).

In this paper we focus on the analysis of market imperfections in the Italian processed tomato food supply chain. In particular, we pay attention to the behaviour of tomato food processors on their input as well output market. Our aim is to identify the degree of market imperfections

[1] This selection is done in the framework of VALUMICS project.

in the input and output tomato processing market, conduct an analysis among the main groups of tomato processors and/or processing associations, and evaluate the managerial governance of the food value chain regarding the sustainability, integrity and resilience from a static as well as dynamic perspective. This study extends the research on the analysis of market imperfections. In particular, the paper addresses the following research questions: (1) which degree of non-competitive behaviour of the food processors with respect to farmers and/or retailers could be observed? (2) can we observe the links between market failures and chain governance, 3) does the tomato value chain meet the measures of sustainability?, and 4) is the value chain becoming increasingly competitive or an idiosyncratic development can be observed?.

The identification of the degree of non-competitive behaviour is based on the derived mark-down and mark-up model and using the latest developments in stochastic frontier methodology. The stochastic frontier approach for the detection of the degree of market power was first applied by KUMBHAKAR et al. (2012) – for mark-up model. The novelty of our study is the use of mark-down model and the decomposition of the one sided error term on transient and persistent part. Assuming that market power comes from the company strategy then only the persistent component can be associated with the bargaining power. The another novelty of the study is the use 4-step estimation procedure and two-step system GMM estimator to address the endogeneity problem.

In section 2, we will analyse the processed tomato industry in Italy. The literature review on market concentration is presented in section 3. Data and methodology are described in section 4. Section 5 presents main results. We provide discussion and draw conclusions in the last section.

2 Tomato industry in Italy

Italian production of processed tomato amounted to 4.65 million tons in 2018 (-11.5% compared with 2017), with a reduction of -12.7% in the Southern production region and of -10.2% in the Northern production area (ANICAV 2018). Production of tomatoes for processing in Italy, as well as in Spain and Portugal, is locally concentrated. Italy is the second most important supplier of tomato paste to the 26 main importing regions with a market share of 22% right after China (28%) and before the USA (13%) (TOMATO NEWS, 2017). Italy is the leading exporter of canned tomatoes in the world, accounting for an 80% global market share of the main 8 exporting countries to the 26 main importing regions for the season 2017/2016 (TOMATO NEWS, 2017). In Italy, processing tomato production is divided between a Northern production area (mainly Emilia-Romagna region) and a Southern production area (mainly Campania and Puglia). The production of tomatoes for processing is entirely separate from the fresh tomato market. One reason for this is that the two industries use completely different tomato varieties and production methods (EUROPEAN COMMISSION, 2017). In Italy in 2018, a total of 60.500 ha (-6% compared to 2017) were dedicated to the production of tomatoes for processing. 2.45 million tons (53%) of processed tomato was produced in the Northern production area, and 2.20 million tons (47%) in the Centre-south production area (ANICAV, 2018). The Italian tomato processing industry produces mainly four different types of processed tomato products: tomato puree (passata), pulp/chopped tomato (polpa), tomato paste (concentrato), and whole tomato (pelati) (ANICAV, 2018). Regarding the production method, 93.4% of tomato cultivation is conventional, 6.6% is organic production (IBO, 2018, July 18).

North Italy represents around 50% of the Italian processed tomato production and 25% of processed tomato production in Europe. Around 22 tomato-processing companies process 98.9% of the tomato produced in the area of the IBO North Italy Processing Tomato (IBO, 2018, July 18). Tomato processing is concentrated in Parma province, with more than half of the private processing companies, and half of the processing producers' cooperatives located there (MANTINO & FORCINA, 2018). Tomato processing is partly done in private companies and partly in producers' cooperatives. Producers' cooperatives processing their own tomato account for 34% of processing activity. 66% are processed in private processing companies. The largest private processing companies are located in Parma and Piacenza, such as Mutti, Rodolfi, Greci Alimentari, and Emiliana Conserve. A characteristic of these private companies is that they still belong to the founder families (MANTINO & FORCINA, 2018). On the distribution side, more than half of the processed tomato goes to food industry (52.5%), 30.9% goes to retail distribution, and 16,7% to HORECA (IBO, 2017). The processing tomato value chain of IBO North Italy Processing Tomato the is particularly structured, locally concentrated and characterized by a specific governance system guaranteeing both vertical and horizontal cooperation, coordination within the value chain, and production and processing adaptation to environmental and economic sustainability requirements (MANTINO & FORCINA, 2018). According to the interviews with selected producers, processed tomato is produced on a contractual basis. Tomato production and commercial relationships within the IBO North Italy Processing Tomato are regulated by general rules of a Framework Contract and specific contractual conditions set in detailed supply contracts between producers and processors, and between producers and self-processing cooperatives (e.g. no pesticide residues or chemical ingredients, brix level, consistency, flaws, etc.). In the framework that is proposed by contract, the approximate price will be ratified in the single delivery contracts that will be set up between the single POs and processing industries. As the integration between actors in this supply chain and the way that the price formation happens is particular, it is a special candidate to do the market power analysis on that.

3 Literature review

The tomato industry (fresh or processed) is suspected for appearance of concentration since many years. The market power studies which are focused on domestic supply chain market imperfection are few. HUANG & SEXTON (1996) is one of the primary study with this concern. They have used the cost-reducing innovation approach to analyse the components of welfare changes of tomato harvesters and processors in Taiwan by used the time series data between 1980-90. The results revealed that mechanical harvesting of processing tomatoes has the potential for significant benefits to adoption of mechanical harvesting in Taiwan. However, farmers' incentives to adopt the harvester was weak as the total benefits are reduced by oligopsony power in tomato procurement, and imperfectly competitive processors will capture a large share of the benefits that remain. The dynamics in European process tomato in producing countries also studied. In one research attempt, the market imperfection in the Portuguese tomato processing industry was studied. By using the 1990-2005 data, the result indicated that the market concentration in tomato processing industry was moderate but the concentration level had increased over the years up to 2005. No linkage was found between the market share and R&D expenses. Marketing costs were concentrated in the four biggest companies but the concentration increase did not change the evolution of marketing costs and profits (DE OLIVIERA, 2008). It must be mentioned that the competitiveness of major processed tomato producers (CAPOBIANCO-URIARTE, APARICIO, & DE PABLO-VALENCIANO, 2017; DE OLIVEIRA, DE CEPEDA, & BERNABÉU, 2019) or trade policies between US and Mexico on processed tomato (PEREZ, RIBERA, & PALMA, 2017) are other issues which are not focused directly on market imperfection. However, market power in trade issues is another aspect of imperfection in processed tomato.

4 Data and methodology

4.1 Data

The data we use in the analysis is drawn from the Amadeus database, created and produced by Bureau van Dijk. The database contains financial information for private companies across Europe.[2] The database provides detailed information about (standardised) annual accounts, financial ratios, sectoral activities and ownership information.[3] The panel data set that we use in our analysis contains companies whose main activity is tomato food processing according to the NACE classification and desk investigation of each company website. It is a panel data set which represents the period from 2006 to 2018 and contains 97 companies, processing only tomato or processing mainly tomato.

The following variables were used in the analysis:

Mark-down model: Cost share = Material costs/Revenue, Material, Capital and Labour. Material costs were used in the form of the total costs of materials and energy consumption per company. Revenue is represented by operating revenue (Turnover) of the company. Material is the total costs of materials and energy deflated by the index of producer prices in the industry (2010 = 100). Labour is represented by the costs of employees deflated by consumer price index (2010 = 100). Capital is the book value of fixed assets deflated by the index of producer prices in the industry (2010 = 100).

Mark-up model: Revenue share = Revenue/Costs, Output, normalized Material and Labour. Revenue is represented by operating revenue (Turnover) of the company. Costs are the sum of Labour costs, Material costs and Capital costs. Labour costs are represented by the costs of employees, Material costs are the total costs of materials and energy consumption per company, and Capital costs are calculated as the book value of fixed assets multiplied by the interest rate according to convergence criteria. Output is represented by operating revenue (Turnover) of the company and is deflated by the sectoral index of tomato processing prices (2010 = 100). Material and Labour are normalized by Capital. As in the case of the mark-down model, Material is the total costs of materials and energy deflated by the index of producer prices in the industry (2010 = 100). Labour is represented by the costs of employees deflated by consumer price index (2010 = 100). Capital is the book value of fixed assets deflated by the index of producer prices in the industry (2010 = 100).

We rejected producers with fewer than four observations (on average) to comply with the requirements of applied system GMM estimator. Moreover, we decrease the problem with the use of unbalanced panel data this way. Finally, GMM model estimates used input variables as instruments lagged up to two periods for the equation in levels and up to three periods for the equation in differences. Then, we used year dummies and the size variable for mark-down model and year dummies for mark-up model as additional instruments.

4.2 Theoretical models

The mark-down and mark-up model are derived using the conjectural variation approach (e.g. BRESNAHAN, 1982 and 1989; MUTH & WOHLGENANT, 1999). We follow the standard behavioural assumption about the profit maximisation. In this case, the optimisation problem (OP) can be approached either as input or output market oriented.
Input market oriented OP – mark down model

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2 The dataset consists of the companies who are obliged to publish a balance sheet and a profit loss account (cooperatives, joint stock companies, etc.). That is, the dataset contains mainly large (and often successful) companies that might be able to exercise market power. In other words, the sample of companies is biased with respect to the companies that might be able to exploit their bargaining power.

3 More information on the Amadeus database is provided at: http://www.bvdinfo.com.

(1) $\pi_i = R(\mathbf{p}, \cdot x_i, \mathbf{z}_i, t) - w_X \cdot x_i - \mathbf{w_Z}'\mathbf{z}_i$

where π_i is the profit of a processor (*i*), **p** is a vector of product prices, R(**p**, x_i, $\mathbf{z_i}$, t) represents the revenue function depending in addition on the agricultural raw materials (x), other inputs (**z**) and a time trend (t) as an indicator of technical change. The symbol *w* is used for the corresponding factor prices. The supply function of raw materials is:

(2) $x = g(w_x, \mathbf{s})$ or $w_x = g^{-1}(x, \mathbf{s})$

where **s** is a vector of supply shifters and x is the total supply of raw material, or in terms of the inverse supply function $w_x = g^{-1}(x, \mathbf{s})$. Then, the first order condition for profit maximisation is:

(3) $$\frac{\partial R(\mathbf{p}, x_i, \mathbf{z})}{\partial x_i} - w_X - \frac{\partial g^{-1}(x, \mathbf{s})}{\partial x}\frac{\partial x}{\partial x_i}x_i = 0,$$

and after rearrangement:

(3a) $w_X\left(1 + \frac{\Theta}{\varepsilon}\right) = \frac{\partial R(\mathbf{p}, x, \mathbf{z}, t)}{\partial x}$, where $\varepsilon_x = \frac{\partial x}{\partial g^{-1}(x, \mathbf{s})}\frac{g^{-1}(x, \mathbf{s})}{x} = \frac{\partial \ln x}{\partial \ln w_x} < 0$ denotes the price elasticity of the raw tomato supply and $\Theta = \frac{\partial x}{\partial x_i}\frac{x_i}{x}$ is an elasticity capturing the degree of oligopsonistic market power (BRESNAHAN, 1989). The parameter range is $0 < \Theta < 1$. $\Theta = 0$ corresponds to perfect competition, while $\Theta = 1$ characterizes a monopsonistic market.[4]

From (3a) it follows that:

$w_x < MRP_x = \frac{\partial R}{\partial x}$, which can further be expressed as:

(4) $$w_x \frac{x}{R} < MRP_x \frac{x}{R} = \frac{\partial \mathrm{R}}{\partial \mathrm{x}}\frac{x}{R} = \frac{\partial \ln R}{\partial \ln x} = \frac{\partial \ln D^o}{\partial \ln x} ,$$

where the last equality comes from the duality of the revenue (*R*) and output distance (D^o) functions (SHEPHARD, 1970).

Output market oriented OP – mark up model

The optimisation problem can be introduced for the output market in the analogical way. In this case, the profit function of processor (i) is given by:

(5) $\pi_i = p \cdot y_i - C(\mathbf{w}, y_i, t)$

where p is a price of output, y_i is the output of processor (i), **w** is a vector of input prices, and C(w,y_i,t) is a cost function of processor (i) and time trend (t) for capturing technical change. The corresponding first-order condition for profit maximisation is:

(6a) $\frac{\partial f^{-1}(y, \mathbf{d})}{\partial y} \cdot \frac{\partial y}{\partial y_i} \cdot y_i + p - \frac{\partial C(\mathbf{w}, y_i, t)}{\partial y_i} = 0$ or (6b) $p \cdot \left(1 + \frac{\Omega}{\varepsilon_p}\right) = \frac{\partial C(\mathbf{w}, y_i, t)}{\partial y_i}$,

where $\varepsilon_p = \frac{\partial y}{\partial f^{-1}(y, \mathbf{d})} \cdot \frac{p}{y} < 0$ is a demand elasticity of the final product and $\Omega = \frac{\partial y}{\partial y_i} \cdot \frac{y_i}{y}$ is a conjectural elasticity capturing the degree of oligopolistic market power. The parameter is in the interval $\Omega \in [0;1]$, with $\Omega = 0$ indicating competitive behaviour and $\Omega = 1$ characterizing monopolistic power. It follows from (6b) that:

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4 Since prices of other inputs are assumed to be constant, their optimal level is given when the factor price is equal to the value of marginal revenue product (MRP): $w_Z = \frac{\partial R(\mathbf{p}, x, \mathbf{z}, t)}{\partial z}$.

$$p \geq \frac{\partial C(\mathbf{w}, y_i, t)}{\partial y_i} \quad \text{for} \quad \Omega \in [0;1]$$, which can be expressed as:

$$(7) \quad \frac{p \cdot y}{C} \geq \frac{\partial C(\mathbf{w}, y_i, t)}{\partial y_i} \cdot \frac{y}{C} = \frac{\partial \ln C}{\partial \ln y} = \frac{\partial \ln D^I}{\partial \ln y} \quad ,$$

where the last equality comes from the duality of the cost (C) and input distance (D^I) functions (SHEPHARD, 1970).

4.3 Estimation strategy

The inequalities in (4) and (7) can be transformed to the equalities adding a non-negative one-sided error term (see KUMBHAKAR et al. (2012) for mark-up model):

$$(8) \quad \frac{w_x x}{R} = \frac{\partial \ln D^o}{\partial \ln x} - u,\ u \geq 0 \ \text{ and } \ \frac{p \cdot y}{C} = \frac{\partial \ln D^I}{\partial \ln y} + u \ ,\quad u \geq 0.$$

Assuming that both output and input distance functions have translog form the resulting mark-down (9) and mark-up (10) model, respectively, for one output are as follows:

$$(9) \quad \frac{w_x x}{R} = \beta_x + \beta_{xt} t + \beta_{xx} lnx + \beta_{zx}{}' lnz - u \quad \text{and}$$

$$(10) \quad \frac{py}{C} = \alpha_y + \alpha_{yt} t + \alpha_{yy} lny + \boldsymbol{\alpha}_{xy}{}' ln\tilde{\mathbf{x}} + \mathrm{u}$$, where $\tilde{x}_j = x_j / x_J$ for j = 1,…,J.

KUMBHAKAR, BAARDSEN & LIEN (2012) first applied stochastic frontier approach in the estimation of the degree of market power in (7). The novelty of our study is the use of GMM estimator to address the endogeneity problem and the decomposition of non-negative one-sided error term to transient (μ) and persistent (η) part, i.e. $u = \mu + \eta$. Moreover, intercept terms will be treated as heterogeneity component to respect the different firm's technologies. This conceptual distinction of the four components[5] allows getting unbiased estimate of one-sided error terms. In particular, since the market power is a product of firm strategy, our primal interest is to get unbiased estimates of the persistent part of the one-sided error term.
That is, the models to be estimated are:

$$(11a) \quad \frac{w_x x_{it}}{R_{it}} = \beta_{x_i} + \beta_{xt} t + \beta_{xx} lnx_{it} + \boldsymbol{\beta}_{zx}{}' ln\mathbf{z} - \mu_{it} - \eta_i + v_{it}$$

$$(11b) \quad \frac{py_{it}}{C_{it}} = \alpha_{y_i} + \alpha_{yt} t + \alpha_{yy} lny_{it} + \boldsymbol{\alpha}_{xy}{}' ln\tilde{\mathbf{x}} - \mu_{it} - \eta_i + v_{it}\ ,$$

where subscript i = 1, …, I, refers to the processors (i) and t = 1, …, T denotes time. The distributional assumptions are as follows: $v_{it} \sim N(0, \sigma_v^2)$, $\mu_{it} \sim N^+(0, \sigma_\mu^2)$, $\eta_i \sim N^+(0, \sigma_\eta^2)$ and $\beta_{x_i} \sim N^+(0, \sigma_\beta^2)$. Moreover, the components are assumed to be independent of each other and of regressors.
The endogeneity problem resulting from the firms' decision process is addressed by the instrumental variable estimator. In particular, we use the two-step system GMM estimator (BLUNDELL & BOND, 1998) to get unbiased parameters of (11a) and (11b) in the first step. In the second step, the GMM residuals are employed in the estimate of the random effects model. The next steps provides the estimates of transient, persistent and heterogeneity component (BOKUSHEVA & ČECHURA, 2017).
Finally, defining the relative mark-down (12a) and relative mark-up (12b):

$$(12a) \quad \sigma = \frac{MRP_x - \mathrm{w}_x}{\mathrm{MRP}_x} \quad \text{and (12b)} \quad \varphi = \frac{p - MC}{MC} \quad ,$$

they can be estimated as:

$$(13a) \quad \hat{\sigma}_i = \frac{\hat{\eta}_i}{\beta_{x_i} + \beta_{xt} t + \beta_{xx} lnx_{it} + \boldsymbol{\beta}_{zx}{}' ln\mathbf{z}} \quad \text{and (13b)} \quad \hat{\varphi}_i = \frac{\hat{\eta}_i}{\alpha_{y_i} + \alpha_{yt} t + \alpha_{yy} lny_{it} + \boldsymbol{\alpha}_{xy}{}' ln\tilde{\mathbf{x}}}$$

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[5] The model specification is an analogy to the 4-component stochastic frontier model (TSIONAS & KUMBHAKAR, 2014).

or in terms of Lerner index (1934)[6] as:

(14a) $"L" = \frac{MRP_x - w_x}{MRP_x} = \frac{\sigma}{1+\sigma}$ (14b) $L = \frac{P-MC}{P} = \frac{\varphi}{1+\varphi}$.

5 Results

Table 1 and 2 provide the parameter estimates of the mark-down and mark-up model for Italian tomato food processing industry. All the fitted parameters are statistically significant at a 5 % significance level, except for time in the mark-down model and normalized labour in the mark-up model that is, however, statistically significant at a 10 % significance level. Moreover, Arellano-Bond test for AR(2) in first differences as well as Hansen test of overidentified restrictions show the validity of the models and the correct selections of the employed instruments, respectively.

In the case of mark-down model, the fitted parameters show that labour (ln_L) and capital (ln_C) have a negative impact on the material cost share and material inputs (ln_M) contribute positively. The material cost share does not change significantly over time (t). The negative impacts of capital and labour inputs together with the positive contribution of the material inputs correspond with our expectations and suggest that larger companies may produce with higher relative value added.

As far as the mark-up model is concerned, the fitted parameters show that the output (ln_y) and normalized material inputs (ln_nM) have a negative impact on the revenue share. On the other hand, normalized labour inputs (ln_nL) determine positively the revenue share. This result corresponds with the estimates of the mark-down model and suggest that large companies operate with decreasing returns to scale. Moreover, some companies may overuse the material costs and produce with lower value added. The significant positive coefficient on time variable (t) indicates that the revenue share increases over time. In the light of the previous conclusion, this implies that economies of scale has been improving over time and/or the material costs have been getting closer to their shadow price in the study period.

Table 1: Mark down model

Variable	Coefficient	St.Dev.	p-value
t	0.000	0.001	0.682
ln_M	0.083	0.013	0.000
ln_L	-0.043	0.012	0.001
ln_C	-0.023	0.009	0.009
constant	0.368	0.037	0.000
			p-value
AR(2)		0.02	0.982
Hansen test of overid. restrictions: chi2(78)		84.83	0.876

Source: own calculations

Finally, the parameter estimates in the second, third as well as fourth steps are highly significant and provide very good overall statistical and econometric quality for both models. In particular, the random effects models show that the variation of one-sided component are more pronounced than the variation in the random component. Moreover, the estimates of persistent part of one-sided component indicate that differences in non-competitive behaviour among Italian tomato processors are important characteristics of this industry.

[6] Lerner index was originally defined only for the output market (LERNER, 1934). We redefined it for the input market.

Table 2: Mark up model

Variable	Coefficient	St.Dev.	p-value
t	0.004	0.002	0.041
ln_y	-0.045	0.015	0.003
ln_nL	0.061	0.031	0.050
ln_nM	-0.085	0.036	0.019
constant	-1.919	0.125	0.000
			p-value
AR(2)		0.18	0.854
Hansen test of overid. restrictions: chi2(78)		92.96	0.540

Source: own calculations

Table 3 provides statistical characteristics of the relative mark-down, "Lerner" index for the mark-down model, relative mark-up and the Lerner index. The relative mark-down (MD) as well as the "Lerner" index are in the interval zero to one. Zero indicates no market imperfections or generally competitive behaviour, as the case may be, i.e. the situation where marginal revenue product equals the price of the material inputs (especially agricultural raw material, which dominates the material inputs in the analysed food processing industry). Then, the positive value of the relative mark-down represents non-competitive behaviour. In particular, an increasing relative mark-down is associated with increasing market imperfections or, in general, increasing abuse of market power, i.e. the food processor has a greater degree of oligopsonistic power (e.g. due to the higher bargaining power) to charge mark-down ($MRP_x > P_x$) with respect to suppliers (in this case farmers). Another interpretation of the $MRP_x > P_x$ is in terms of game theory, i.e. coordination of the firms' pricing behaviour – collusion. With respect to the different interpretation of the surplus of marginal revenue product over the input price, we will relate the increase in relative mark-down to an increase in the degree of non-competitive behaviour, which is more general compared to the increase in oligopsonistic power interpretation.[7] Analogically, the relative mark-up (MU) and the Lerner index lay in the interval 0 and 1, where 0 indicates competitive behaviour and market imperfections increase with increasing MU or Lerner index, respectively. The results indicate some degree of non-competitive behaviour in both, input as well as output market. However, the market imperfections are more pronounced in input processing market, i.e. in the relation between farmers and processors.

Table 3: Summary statistics

	Mean	Std.Dev	Minimum	Maximum
Relative mark-down	0.216	0.091	0.000	0.472
"Lerner" index - mark down model	0.173	0.063	0.000	0.320
Relative mark-up	0.168	0.104	0.000	0.579
Lernder index - mark up model	0.138	0.072	0.000	0.367

Source: own calculations

The distributions of both Lerner indices are relatively narrow, with standard deviations of 0.063 and 0.072, respectively, and slightly skewed toward smaller values. These figures indicate that only small number of companies are characterized by considerably high degree of non-competitive behaviour.

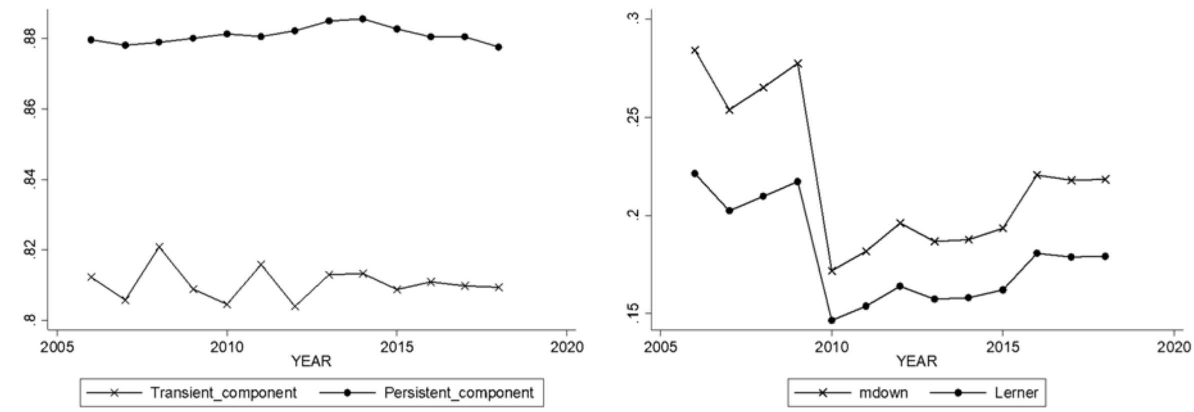
Figure 1a and 2a shows that both transient as well as persistent one-sided components indicate significant differences from the perfect competition which is characterized by the identity $MRP = w_x$ for input market oriented optimization problem and P=MC for output market oriented optimization problem. The transient components provide the information on short-run

[7] The interpretation in terms of oligopsonistic power can be misleading; see e.g. IVALDI et al., 2003, p. 50.

deviations which can be related to, for example, contract changes and is expected to be volatile through time. The persistent component might be associated with the measure of market power due to its source in company strategy.

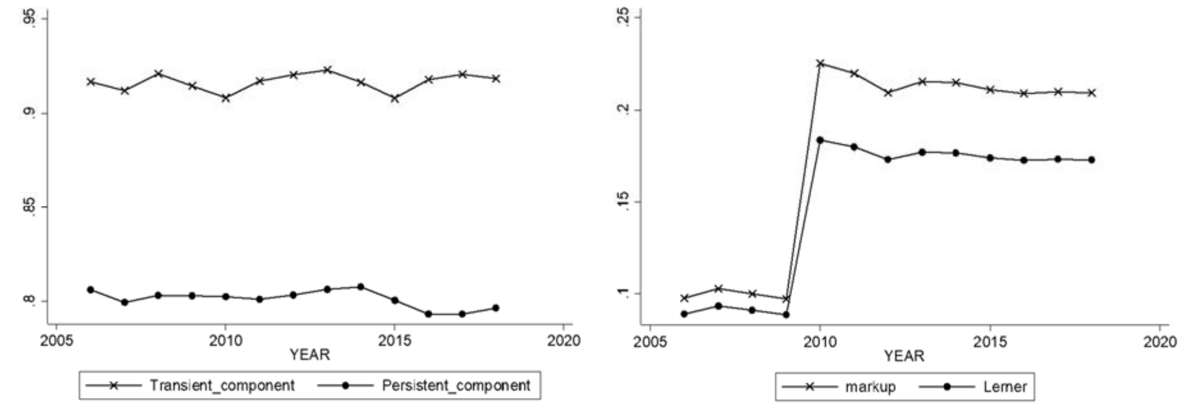
Figure 1b provides the development of the relative mark-down and "Lerner" index. The figure show the significant change in 2010. In particular, the indices drop down by approximately 10% in this year and only slightly recovered in the years after that. This suggests that market power imbalances have considerably changed in favour of farmers, i.e. they get higher price for their products.

Figure 1a,b: Mark-down model



Source: own calculations

Figure 2a,b: Mark-up model



Source: own calculations

Figure 2b show the reverse development as compared to the Figure 1b. That is, the shift in the relation between the price for the raw material with respect to marginal revenue product was compensated by the shift in the relation between the price of processing product and marginal costs. This suggests that the market imperfections did not decrease in the study period but only reallocated within the tomato value chain in the Italy.

Table 4 presents the figures on Lerner indices according to the size of the company. As opposed to our expectations, small companies have higher "Lerner" index in the input market as compared to medium, large and very large companies that have similar mean values of the index. On the other hand, the distribution of Lerner index for output market indicate higher mean values for large and very large companies which is in line with our expectations about higher bargaining power of larger companies.

Table 4: Market power according to the size

	"Lerner" index: mark-down model		Lerner index: mark-up model	
Size	Mean	St.Dev.	Mean	St.Dev.
Small	0.209	0.036	0.114	0.069
Medium	0.168	0.067	0.106	0.068
Large	0.170	0.059	0.161	0.058
Very large	0.175	0.072	0.225	0.061

Source: own calculations

6 Discussion and conclusions

The analysis carried out support that there have been changes over time in the degree of market imperfections in the input and output tomato processing market. The balance between a competitive and non-competitive behaviour between tomato processing chain actors is a crucial aspect in the development, evolution, and sustainability of the chain. The tomato processing chain management has addressed the need to mitigate the economic difficulties that some of the actors of the Italian tomato chain were encountering and to ensure adequate tomato production and commercialisation stability.

The main agents in the tomato processing value chain are similar in different parts of Italy. Organization, governance and functionality of relationships between the members (producers, POs cooperatives, processing companies, retailers) may have different stages of development and coordination between actors. However, tomato processing chain dynamics undergoing in parts of the Italian territory influence the whole national tomato market.

The upstream and downstream tomato processing chain dynamics support the interpretation of the results of the present research. Upstream of the chain the actors' relation is aimed at strengthening market concentration and social collaboration between the actors. The aim is to achieve a higher competitiveness and ensure the stability of the mutual dependability between producers and processors. Producers commit to limit the number of hectares for tomato production, in agreement with processors. This aims at ensuring an adequate balance between the available tomato and the forecasted processed tomato that processors expect to sell. This depends on market sales projections and stock availability that may be at the disposal of processors from previous years. Limiting tomato production avoids overproduction and thus allows to keep the price level high. This agreement founds on a commonly defined reference price that both parties are aware of when signing a contract. This price can be adjusted depending on quality standards and on one-to-one contractual negotiation that sets free both parties. This negotiation dynamic is renewed yearly and ensures trade relationships that remain quite stable over time. We may say that tomato producers and processors aim at strengthening both producers and processors competitiveness by finding agreements that may be beneficial for both parties and by anticipating difficulties that may hinder all actors. Processors need raw material produced according to respected quality standards and ensured timing. Farmers need to know they will sell their produce according to a set price. Mutual collaborative trust is at the basis of this relationship. Some relationships between producers and processing industry exist since a long time, are oriented to be long-term, and are based on collaboration and trust. Furthermore, this allows to realize innovation and improvements in the value chain implemented thanks to a good level of collaboration.

The research paper results support the existence of a significant change around the year 2010. This result may be explained by the evolution in the relation among tomato processing chain actors intervened since 2000's. Producers and processors were undergoing a time of crisis and developed strategies at chain level that in 2011 brought to the formalisation of a body (IBO) based on the concept of mutual cooperation. The system constantly faces some challenges and requires adjustments to consolidate the effectiveness of the established instruments. The current research support that there have been limitations in the market power imbalances and that market imperfections may be reallocated. Part of these achievements may be the result of mutual knowledge and awareness based on long-term relationship and acknowledgment of reciprocal dependency.

The tomato processing case analysed in the present research shows that the sustainability, integrity and resilience of the chain is related to the managerial governance of the chain. Thus chain actors can contribute in finding a balance between competition and collaboration, so to aim for all chain actors higher level of competitiveness. Relationships within and outside the chain may vary over time as exposed to new challenges. Relevant initiatives have then to be dynamic and responsive.

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