

The role of market power in the EU food supply chain

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Food actors operate in an integrated supply chain that is subject to considerable changes. In the latest years, the balance of power in the food system is effectively shifting from farmers and processors to global retailers, due to fundamental factors such as increased technological concentration and advances. The associated structural changes that are occurring along the food supply chain have broad socioeconomic impacts affecting all actors in the food supply chain. The goal of this task will be to analyze the functioning of the EU food supply chain in terms of institutional market power and constraints with relevance for economic sustainability metrics. We will perform an empirical analysis based on firm level data from different actors in the supply chain.



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DELIVERABLE SHORT SUMMARY FOR USE IN SOCIAL MEDIA

There is extensive debate on the position of farmers in the food chain and how global price volatility and increasing concentration up and down the value chain is affecting famers, taking into account increasingly complex vertically-related markets. Market concentration and technological advances are claimed to have shifted the balance of power in the food system to global retailers and other concentrated sectors.

Most existing studies on the risk factors affecting the functioning of food supply chains have focused on price volatility at farm-level, while downstream sectors (i.e. processors, wholesalers and retailers) have been mostly ignored. Yet, the focus of attention is mostly on detecting and analyzing output price volatilities rather than margins (differences between input and output prices). This report is the first to analyze the functioning of the food supply chain in terms of mark-up volatility of its actors.

We estimate firm-level mark-ups over time and analyze the mark-up volatility along the agri-food chain, using an innovative estimation procedure developed by De Loecker and Warzynski (2012) on annual data from more than 100,000 companies in France and Italy during the period 2006-2014.

This methodology allows to generate firm-level and time-specific mark-up estimations and to investigate the behavior and volatility of the mark-ups along agri-food supply chain.

A key insight that emerges from our study is that mark-up volatility is much higher at the farm-level than at other levels of the food chain.

These findings provide interesting indicators for policy debate on the economic viability of the agricultural sector with respect to market volatility and on how lessons can be drawn from other companies in the food value chain to stabilize mark-ups for farmers.

TEASER FOR SOCIAL MEDIA

In recent years, there has been growing interest on the functioning of food supply chains in the face of significant external challenges, such as a growing demand for agricultural production worldwide and price volatility. This report is the first to



analyze the functioning of the food supply chain in terms of firm-level mark-up volatility of its actors. The results show that farm sector have a significantly higher volatility than its counterparts in the food supply chain.

A good understanding of mark-up dynamics is crucial for improving the economic sustainability of the food supply chain #food-supply-chain #firm-level markups.



ABSTRACT

This paper is the first to estimate firm-level mark-ups along the food supply chain using the methodology of De Loecker and Warzynski (2012). We estimate markups of farmers, processors, wholesalers and retailers, how they change over time, and their volatility. We use detailed micro-level data from Italy and France for the period 2006-2014. We also compute markup volatility indicators for the different agents in the chain. The results show that farmers have a significantly higher volatility of mark-ups compared to other agents in food value chain, such as food processors, wholesalers and retailers.



INTRODUCTION

There is extensive debate on the position of farmers in the food chain and how global price volatility and increasing concentration up and down the value chain is affecting famers, taking into account increasingly complex vertically-related markets (McCorriston 2016; Sexton 2013; Swinnen et al. 2015). Market concentration and technological advances are claimed to have shifted the balance of power in the food system to global retailers and other concentrated sectors (European Commission, 2009; Bukeviciute, Dierx, and Ilzkovitz, 2009; Kaditi, 2013a; Swinnen and Vandeplas, 2007).

The EU-funded SUSFANS project aims at improving our understanding on how to strengthen food and nutrition security (FNS) outcomes in the EU and at assessing how to improve the performance of the food system in the EU from the perspective of social, environmental and economic sustainability. The project adopts an holistic and integrative approach, including a conceptual framework, metrics and analytical tools for measuring, assessing and monitoring the current state of FNS in the EU (Rutten et al., 2016).

SUSFANS extends the concept of FNS to include different dimensions of sustainability for the EU food system by combing an environmental, social and economic perspective.¹

The economic dimension of sustainability implies that those who produce food at different levels of the value should be able to run a viable and competitive business. In this context, this paper contributes to the current research on the functioning and economic sustainability of the food supply chain by analyzing the mark-up dynamics over time across the food supply chain, i.e. farmers, processors, wholesalers and retailers.

A number of theoretical and empirical studies have tried to better understand the distribution of surplus and impacts of external changes along the food chains. This includes research on asymmetries in price transmission along the food chain (McCorriston, Morgan, and Rayner 1998, 2001; Azzam, 1999; Zachariasse and Bunte, 2003; Bukeviciute, Dierx, and Ilzkovitz, 2009; Vavra and Goodwin, 2005); and on the impact of consolidation on firm performance and market structure (e.g. Durand, 2007).

¹ SUSFANS concept of FNS reflects the EU food policy goals, which were formulated across different stakeholder groups, namely: 1) deliver a balanced healthy diet to consumers, 2) reduce the systems' negative environmental impact, 3) build a viable, competitive and socially balanced agri-food sector, and 4) contribute social equity goals and global food security. For more details on the SUSFANS conceptual framework please see Zurek et al., (2018).



Another important issue for food value chains which has received much attention in the past decade (in the public debate and among policy-makers) is that of price volatility and how risk and uncertainty caused by price volatility affect the functioning of food and agricultural markets – and the need for governments to intervene. A recurring argument is that the uncertainty associated with such volatility of prices causes inefficiencies, by making it difficult for consumers and producers to formulate optimal decisions and lowering their confidence in the market and in investment returns (Bureau and Swinnen, 2017; Barrett, Bellemare, and Just, 2013; Dawe and Timmer, 2012; Pieters and Swinnen, 2016).²

Studies on the effects of price volatility have focused mainly at the farm stage (e.g. Martin, 1996; OECD, 2000; Hall et al., 2003). They analyze how agricultural producers manage their price-risk strategies. A few studies, mostly qualitative, have addressed this issue for downstream sectors (Heyder, Theuvsen, and Davier, 2010; Davier, Heyder, and Theuvsen, 2010; Assefa, Meuwissen, and Oude Lansink, 2017). However, not the same attention has been paid to how food actors cope with uncertainty caused by price volatility, in particular related to their mark-ups. In managing risk strategies, food chain companies are ultimately more concerned about the stability of margins (increase in input price or decrease in output price) than price volatility (Assefa, Meuwissen, and Oude Lansink, 2017).

This paper contributes empirical evidence on both issues: the evolution and the volatility of mark-ups along the value chain during the period of high food price volatility. We estimate firm-level markups of various companies in the EU food chain (i.e. farmers, processors, wholesalers and retailers), using the methodology of De Loecker and Warzynski (2012) (DLW), and measure the markup volatility in the food chain. Earlier mark-up studies on the food chain (Kaditi, 2013a and 2013b) ³ used a production function approach developed by Hall (1986) and extended by Roeger (1995). Their method exploits variation in the primal and dual Solow residual to derive a consistent estimate of the mark-ups and to deal with potential endogeneity problems when estimating the production function.

² However, other studies, which have theoretically analyzed the effects of price volatility on consumer and producer welfare, have reached more nuanced conclusions (for a review on this topic see Bureau and Swinnen (2017).

³ Earlier mark-ups studies on the food chain have mostly focused on analyzing the degree of competition in the food supply chain and thus estimated using mark-up pricing as indicator of efficiency and surplus distribution in the food chain (Kaditi 2013a and 2013b). The analyses of mark-ups in the food chain are applications of more general studies and recent advances in the empirical industrial organization literature (Hall, 1986; Tybout, 2003; Roeger, 1995; Konings and Vandenbussche, 2005; Konings, Roeger, and Zhao, 2011; Konings, Cayseele, and Warzynski, 2005; Abraham, Konings, and Vanormelingen, 2007; De Loecker, 2011; De Loecker and Warzynski, 2012).



However, a major shortcoming of this previous methodology is that it only generates estimates for the average sector-specific mark-up in the sample.

In our study, we use a new econometric methodology proposed by De Loecker and Warzynski (2012), which allows to generate firm-level and time-specific markup estimations, while addressing the simultaneity problem in estimating production function coefficients. This method thus allows us to investigate the behavior and volatility of the mark-ups along agri-food supply chain. We use firmlevel data from the Amadeus database, which is compiled by a commercial data provider, Bureau van Dijk (BVD)⁴, and contains company account data. Our analysis uses data from more than 100,000 firms in the food supply chain of France and Italy between 2006 and 2014. The period 2006-2014 was characterized by major price volatility in global agricultural and food markets. We use data from France and Italy because they are the two EU countries for which the quality of data along the supply chain is best and which are important producers of agricultural products and food in the EU.⁵

A key insight from our study is that mark-up volatility was much higher at the farm-level than at other levels of the food chain. This conclusion has potentially important implications for the policy debate on whether governments have a role to play in supporting farms in dealing with market volatility.

The paper is structured as follows. Section 2 discusses the price developments along the food supply chain in the EU, France and Italy. Section 3 explains the empirical methodology applied in the estimation of the firm-level mark-ups and measurement of mark-upvolatility. Section 4 describes the dataset. Section 5 presents the broad patterns of mark-ups at each level of the food chain and the results of mark-up volatility over time for different agents in the chain. Section 6 provides a discussion on the results. Section 7 concludes.

⁴ https://amadeus.bvdinfo.com

⁵ Their food sectors are the second and the third largest in the EU. In 2013 their food sectors, taken together, represented almost 30% of the EU food industry turnover (Eurostat). France and Italy also accounted for almost a third of the value of agricultural production in the EU. France is the leading agricultural producer with 16 % of the value of total EU agricultural production, while Italy is the third largest (12 %) (Eurostat).



PRICE DEVELOPMENTS ALONG THE EU FOOD SUPPLY CHAIN

The 2006-2014 period which our analysis covers is an interesting period to analyze mark-up volatility since it was a period of strong price and demand fluctuations. One could expect that these price fluctuations will affect the markups along the food chain, especially when price transmission is imperfect. In fact, McCorriston (2015) argues that one can interpret the relationship between price fluctuations and mark-ups as an indicator of the bargaining power and rent distribution in the food chain.

Figure 1 presents price fluctuations for the EU during the period 2007-2016. One can observe large differences in prices over time and also between different stages in the food chain. Agricultural prices are much more volatile than processor and consumer prices (Figure 1). Agricultural prices increased very strongly in the second half of 2007, fell from mid-2008 to mid-2009, and similarly increased again significantly from the second half of 2009 and up to early 2011. Since their peak at the end of 2012 prices paid to farmers have decreased. In July 2016, the index (2010=100) for all agricultural commodities was almost 20% below its peak level of 2012. Over the same period, average processor prices decreased by around 5%, while average consumer prices remained more or less stable. The difference in volatility is strong.

Looking at the development of prices of the two selected EU countries, during the period 2005–2016 we see similar developments as in the EU as a whole (Figure 2). They are also characterized by high volatility in agricultural prices. In France and Italy, the index (2010=100) of farmer prices also displayed stronger fluctuation compared to the processor and consumer prices. In France, for example, it moved from 87 at beginning of 2005 to 110 in the second half of 2008 back to 90 in September 2009, to rise up again in 2011 and mid-2012. Agricultural prices paid to farmers decrease steadily since the end of 2012 until 2016. In 2009, processor and consumer prices tend to increase constantly over time, with the exception of spike for processor price in the second part of 2008 (European Commission, 2016b a). The Italian food supply chain displays a comparable pattern with a lesser intensity in price volatility for the agricultural sector (Figure 2).

Figure 3 shows that in the EU the expenditures on food and drinks increased during 2007-2008 when agricultural prices where increased strongly, but when



food consumer prices remained stable. During the 2009 Great Recession, food expenditures declined somewhat, but interestingly their share in total expenditure increased - probably reflecting a strong cut back in luxury products by consumers. Food expenditures increased again from 2010 onwards. France and Italy report higher level of food expenditure, both in monetary terms and as share in total expenditure, compared to the EU average level. During the recession period, expenditures on food and drinks remain stable, but their share in total expenditure increased, suggesting a similar consumer behavior as for the case of the EU as a whole.

Although agricultural prices varied more than processor and consumers prices. this does not necessarily indicate an asymmetric price transmission (Swinnen and Vandeplas, 2015). The authors notice how in the public debate there was strong sentiment that "in the EU, during agricultural commodity price spike in 2007/08 these price increases were passed on to consumers but, the subsequently prices declines in 2008/09, were less than fully transmitted to consumers, hindering demand recovery and exacerbating the negative effect of declining producer prices on farm household" (p.2).

The data presented here do not shed light on this. If anything they indicate limited pass through in all directions (see the studies in McCarriston (2015) for more arguments and analysis on this). This is consistent with other studies' conclusions. For example Assefa, Meuwissen and Oude Lansink (2017) conducted interviews with farmers, wholesalers, processors and retailers in six EU food supply chains (i.e. Bulgarian wheat, French wheat, German pork, Dutch cheese, Dutch tomatoes, and Spanish tomatoes supply chains) in order to have a better understanding of the price volatility perceptions and management strategies of these players. The authors reported that "farmers' strategies were mostly survival strategies through output and cost reduction in response to adverse price movements. Wholesalers and processors focus on adaptive strategies that allow them to secure stable margins regardless of price movements. Retailers' main focus is to secure a continuous supply of quality produce for their customers rather than to reduce price volatility." (Assefa, Meuwissen, and Oude Lansink, 2017, p.16).

Differences between commodities

There are substantial differences in the price fluctuations between commodities. This is likely to influence mark-ups. As Figure 4 illustrates, in France and Italy prices of grains and oil and fats had stronger fluctuations than prices of other



commodities, with price spike in late 2007 and early 2008 and again in 2011 and late 2012. Dairy and meat prices fluctuates much less in France and Italy (Figure 4). Moreover, grain prices are output prices for grain producers, but input prices for livestock producers (Swinnen, Knops, and Van Herck, 2014). In both Italy and France, the evolution of the grain/fertilizer price ratio and the animal output/feeding stuff prices reflect a similar trend as reported in the EU with the cereal sector showing stronger fluctuation than the livestock sector (Figure 5). We will analyze to what extent this is also reflected in different mark-up volatility.⁶

⁶ Moreover there were large changes in energy prices over the same period, which contributed to strong volatility for gran/fertilizer price ratio in the EU over the 2006-2012 period. It has experienced a rapid increase in 2006 and 2007, followed by a strong decline in 2008 and then significant growth in 2010. On the contrary, the animal output/animal feed price ratio has steadily declined since 2006. The 2012 ratio was around 25% lower than in 2005 as the increases in animal feed prices more than compensate increases in final prices of animal output (Figure 5).



METHODOLOGY

Estimating Firm-level Mark-ups

The estimation of mark-ups has a long history in the field of industrial organization. In his seminal work, Hall (1986) proposes a simple way to estimate mark-ups by comparing the growth rates of the output to the ones of inputs and exploiting the fact that, under imperfect competition, cost and revenue shares of inputs differ. To deal with potential endogeneity problems when estimating the production function, Roeger (1995) extended Hall's methodologies and proposed a method which exploits variation in the primal and dual Solow residual to derive a consistent estimate of the mark-ups.

A major shortcoming of these methodologies based on a production function approach, is that they only generate estimates for the average sector-specific mark-up in the sample. To address this, DLW (2012) propose a flexible approach for mark-up estimation, which provides an empirical framework to obtain firmlevel mark-ups. They rely on the assumption of standard cost minimization for variable inputs free of adjustment costs and relate the output elasticity of an input to the share of that input's expenditure in total sales and the firm's mark-up. Exploiting the insights of Olley and Pakes (1996), Levinsohn and Petrin (2003) and Ackerberg, Caves and Frazer (ACF) (2006), DLW employ a two-step procedure to address simultaneity problems and control for unobserved productivity shocks using a control variable in the estimation of the production function and of the output elasticities. The key advantage is that this procedure allows to estimate firm and time-specific mark-ups without making assumptions on any particular consumer demand structure and any of specific price setting model, while simultaneously dealing with the econometric issues of production function coefficients.

Defining Mark-up

Consider a production function of the following form

$$Q_{it} = \Omega_{it} F(L_{it}, M_{it}, K_{it}), \tag{1}$$

where Q represents quantity of gross output produced while Ω , L, M, and K are productivity, labor, material and capital respectively. One restriction imposed is that the production function is continuous and twice differentiable with respect to its arguments. Assuming that producers are cost minimizers, the following first



order condition of the cost minimization problem with respect to the variable input X^{V} is obtained:

$$P_{it}^{X^{V}} - \lambda_{it} \ \frac{\partial Q_{it}(X^{V}_{it}K_{it})}{\partial X^{V}_{it}} = 0,$$
⁽²⁾

where $P_{it}^{X^V}$ denotes a firm's input price for variable input X^V and λ_{it} is the lagrange multiplier associated to the technological constraint. Using the definition of mark-up for firm *i* in time *t* as $\mu_{it} \equiv \frac{P_{it}}{\lambda_{it}}$ and multiplying both sides by $\frac{X_{it}}{Q_{it}}$ condition (2) can be rearranged and expressed μ_{it} in terms of elasticities as follows:

$$\mu_{it} \equiv \theta_{it}^X \left(\alpha_{it}^X \right)^{-1} \tag{3}$$

where θ_{it}^{X} is the output elasticity with respect the variable input X_{it} and α_{it}^{X} is equal to the share of expenditures on input X_{it} in total turnover ($P_{it}Q_{it}$). To estimate the price-cost margins, we follow Brandt et al. (2012, 2017) and choose to use material as a perfectly variable intermediate input, whereas labor is treated like capital, as quasi-fixed input, subject to adjustment costs ⁷.

In our analysis we adopt a Cobb-Douglas (CD) gross output production function of labor, capital and material, as follows:

$$y = \beta_k k + \beta_l l + \beta_m m + \omega \tag{4}$$

In order to compute firm level mark-ups, we need to estimate the output elasticity of material θ_{it}^{M} . In case of a CD production function, the mark-up will be given by:

$$\theta_{it}^{M} = \hat{\beta}_{m} \tag{5}$$

⁷ This choice is due to the fact that labor is unlikely to be as easily adjustable as material, where market frictions, restrictions on hiring or firing, and work rules can be prevented firms from freely adjusting their labor force to minimize their costs (Brandt et al. 2012).



Estimating Output Elasticity

Assuming the productivity being a Hicks-neutral scalar term and having common technology parameters across the set of producers (DLW, 2012), the following log transformation of the gross-output production function can be computed:

$$q_{it} = f(m_{it}, l_{it}, k_{it}) + \omega_{it} + \epsilon_{it},$$
(6)

where q_{it} is the log of gross output, $m_{it}l_{it}$, k_{it} are the log of material, labor and capital respectively. The constant can be interpreted as a measure of average efficiency across firms while the last two terms are unobservable (to the researcher). However, the two differ in that ω_{it} , the productivity shock, is known by the firm and thus affects the firm's input choices, whereas ϵ_{it} peaks measurement error and idiosyncratic unexpected productivity shock as it is not observable to both the firm and researcher, it captures the unknown elements that affect the output but not the choice of inputs.

As the choice of inputs is correlated with the productivity shock (ω_{it}) , the estimation of the production function will in general yield inconsistent estimates of the elasticities of material, labor and capital, which affects the estimates of mark-ups. In order to address the endogeneity related to the estimates of inputs' coefficients of the production function, we closely follow the two-step procedure developed in ACF. In the first step, we obtain the estimates of ϕ_{it} and $\hat{\epsilon}_{it}$ by running the following regression:

$$q_{it} = \phi_{it} + \epsilon_{it} \,, \tag{7}$$

where $\phi_{it} = f(m_{it}, l_{it}, k_{it}) + h(l_{it}, m_{it}, k_{it}, e_{it})$ and h(.) represents the inverse of the material demand function that serves as proxy of the productivity term.⁸ In the second step, the elasticities on production parameters are estimated through GMM, using as instruments the inputs orthogonal to the unexpected productivity shock.

After the first stage, we can employ the estimated value $\widehat{\phi_{\iota t}}$ to compute the estimate for productivity ω_{it} for each value of β_s as following:

⁸ The unknown function h(.) can be approximated parametrically by polynomial expansion of order J in the parameters. In the empirical exercise we will use a third order polynomial.

$$(\widehat{\omega_{it}}) = \phi_{it} - \beta_k \, k_{it} - \beta_l l_{it} - \beta_m m_{it} - \beta_{kk} k_{it}^2 - \beta_{ll} \, l_{it}^2 - \beta_{mm} \, m_{it}^2 - \beta_{lk} l_{it} \, k_{it} - \beta_{lm} l_{it} \, m_{it} - \beta_{km} k_{it} \, m_{it} - \beta_{lkm} l_{it} k_{it} \, m_{it}$$
(8)

This second stage relies on the law of motion for productivity. The law of motion of productivity is described by the following g(.) function:

$$\omega_{it} = g\left(\omega_{it-1}\right) + \xi_{it},\tag{9}$$

where $\xi_{it}(\beta)$ is the innovation to productivity. To recover ξ_{it} , one can use a nonparametrical regression of ω_{it} on the third order polynomial of its lag ω_{it-1} as constructed in (9). Given the assumptions above, ξ_{it} is independent of the predetermined working capital stock k_{it} and l_{it} , as well as the lagged variable inputs m_{it-1} . In the case of our three-input CD production function with labor and capital quasi-fixed and intermediate inputs fully flexible, the following moment conditions to estimate parameters in the production function are used:

$$\mathsf{E}[\xi_{it}(\beta)Z_{it}] = 0 \tag{10}$$

$$Z' = (m_{it-1}, l_{it}, k_{it})$$
(11)

The production function coefficients are then used together with data on inputs to compute the output elasticities as expressed in (5).

Measuring Mark-up Volatility

To measure mark-up volatility across the different actors of the chain, we adopt an approach and measurement that are commonly used in the price volatility literature. We follow Gilbert and Morgan (2010) and Pieters and Swinnen (2016) and compute markup volatility as the standard deviation of the logarithm of firmlevel markups as follows:

$$v = sd(r) = \left[\sum_{T=1}^{1} (r_{it} - \bar{r})^2\right]^{0.5}$$
(12)

where $\bar{r} = \sum \frac{1}{T} r_t$, $r_{at} = \ln \left(\frac{\mu_{it}}{\mu_{it-1}} \right)$ and μ_{it} is the mark-up of firm *i* in time *t*.



As explained in Gilbert and Morgan (2010) and Pieters and Swinnen (2014), measuring volatility as the standard deviation of the difference in logarithm of markups addresses the issue of de-trending the series.⁹

DATA

The data we use are firm-level balance-sheet data from France and Italy for the period 2006-2014 from the Bureau van Dijk's (BVD) Amadeus database. We use data from firms in five sectors (by 2-digit code in the European NACE Rev. 2) that operate along the food value chain: (1) the agricultural sector, (2) the food processing sector, (3) the drink sector, (4) the food wholesale sector and (5) the food retail sector.¹⁰

As explained in the previous section, the extent of price volatility has differed by agricultural activity. Hence, in a second step we split the agricultural sector further into sub-sectors such as: (1) the cereal sector, (2) the livestock sector, (3) the fruits, nuts and vegetables sector, (4) other crops (perennial and non-perennial), (5) mixed farming, (6) other agricultural activities, and (7) fishing and aquaculture sector.¹¹

The BVD Amadeus database includes financial and balance-sheet information from business registers collected by the local Chambers of Commerce to fulfil legal and administrative requirements and are relayed to BvD via different information providers (see Table in Appendix A for a list of the information

⁹ For a further discussion on this issue see Gilbert and Morgan (2010); Pieters and Swinnen (2014); Minot (2014); Dawe et al., (2015).

¹⁰ In terms of NACE classification these sectors belong to the following code categories: Agriculture and Fishing (NACE2 A 01 and NACE2 A 03), Food Manufacture (C 10) Drink Manufacture (C 11), food and drink wholesale (G 46.2 and 46.3) and food and drink retailer (G 47.1 and 47.2).

¹¹ In terms of NACE classification these sub-sectors belong to the following categories: (1) Cereal sector including "cereals (except rice), leguminous crops and oil seeds" (NACE A 01.11) and "rice" (NACE 01.12); (2) Livestock sector including "animal production" (NACE A 0.14); (3) Fruits, nuts and vegetables sector including "vegetables and melons, roots and tubers" (NACE A 01.13), "grapes" (NACE A 01.21), "tropical and subtropical fruits" (NACE A 01.22), "citrus fruits" (NACE A 01.23), "pome fruits and stone fruits" (NACE A 01.24), "other tree and bush fruits and nuts" (NACE A 01.25), and "oleaginous fruits" (NACE A 01.26); (4) Other crops (perennial and non-perennial) sector including "sugar cane" (NACE A 01.27), "fibre crops" (NACE A 01.16), "other non-perennial crops" (NACE A 01.28), and "other perennial crops" (NACE 01.29); (5) Mixed farming including "mixed farming" (NACE A 01.5); (6) Other agricultural activities including "plant propagation" (NACE A 01.3), "support activities to agriculture and post-harvest crop activities" (NACE A 01.6), and "hunting, trapping and related service activities" (NACE A 01.7); and (7) Fishing and aquaculture sector including "fishing" (NACE A 03.2)



providers to BvD for France and Italy). Data include turnover, total assets, material costs, number of employees and total wage bill for each firm.

All the variables used in the mark-up estimations are deflated using national 2digit industry deflators, when available. Turnover and material costs were deflated using the gross product output and intermediate input deflators from OECD STAN. For labor costs use was made of a labor cost deflator taken from the European Central Bank, while firms' total assets were deflated using the gross fixed capital formation deflator from Eurostat.

We eliminated all observations that report zero or negative values of production variables. Following Eberhardt and Helmers (2010) and Olper, Curzi, and Raimondi (2017) we also dropped observations in the bottom and top 5 percentile of the distribution of the relevant variables used for the mark-up estimation.¹² After estimating firm-level mark-ups, this results in an unbalanced dataset of a total of 36,976 firms for Italy and 63,340 for France. Table 1 provides an overview of the number of companies and how they are distributed across sectors in the two EU countries. Wholesalers account for the largest share in the Italian sample, while the majority of the firms in the French sample operates in the food retail sector.

The sample of firms in the database tends to be biased to economically large firms, which are generally subject to more extensive accounting rules than small and medium-sized firms. However the dataset still contains many small firms in terms of number of employees. Table 2 report selected summary statistics of the variables used in our empirical estimation of mark-ups for each level of the food supply chain in the two EU countries. They show that the average number of employees per firm ranges between 7 and 15. In both countries the drink sector¹³ has the largest value of turnover and number of employees, except in Italy, where the highest number of employees is recorded in the food processing sector.¹⁴

¹² In the case of the French dataset, *manufacture of bakery and farinaceous products* (NACE 4-digit code 10.71) account for almost 50% of the overall food processing sector (NACE 2 C 10). Most of these firms are composed by no employees and could represent a potential outlier. For this reason, following other papers dealing with the same issue (e.g. Gaigne, et al., 2015), we have applied a further cleaning within this subsector, i.e. we have removed those companies reporting less than 5 employees.

¹³ The drink sector refers to the manufacture of beverages (NACE 2 C 11). This division includes the manufacture of beverages, such as non-alcoholic beverages and mineral water, manufacture of alcoholic beverages mainly through fermentation, beer and wine, and the manufacture of distilled alcoholic beverages. ¹⁴ The food processing sector refers to the manufacture of food products (NACE rev 2 C 10). This division includes the processing of the products of agriculture, forestry and fishing into food for humans or animals, and includes the production of various intermediate products that are not directly food products. This division is organized by activities dealing with different kinds of products: meat, fish, fruit and vegetables, fats and oils, milk products, grain mill products, animal feeds and other food products. This division does not include the preparation of meals for immediate consumption, such as in restaurants.



A constraint for our estimation of mark-ups is that physical output is not included in the dataset. Therefore we use deflated turnover as a proxy of physical quantity when estimating output elasticities. This approach is potentially subject to omitted output and input prices biases, which affect the estimates of the input coefficients and therefore estimates of the output elasticities, as discussed in De Loecker and Goldberg (2014). However, only the mark-up level is potentially affected by this bias, while the model is still robust on how mark-ups change over time (DLW 2012), when a Cobb-Douglas production function is assumed, as in our study. This implies that the changes over time of the mark-ups are estimated unbiased, but that a comparison of mark-ups in level between firms and sectors is problematic because of this potential bias.

It is therefore useful to rescale the value of the mark-ups in level by a value of reference. To do this, we transform the series of yearly weighted mark-ups¹⁵ of each chain sector into an index with base the food sector's average weighted mark-up over the period 2006-2014.

RESULTS

Our computed indices for the two countries (Figure 6 and Figure 7) show that in Italy, between 2006-2014 mark-ups increased in all levels of the supply chain, whereas in France only the food processing and retail sector display a positive trend over the same period.

The figures show that mark-ups of the agricultural sector experienced more fluctuations compared to downstream players' mark-ups in both countries. In France, the mark-ups fell from 1.07 to 0.90 between 2006 and 2007, increased significantly to 1.20 by 2009 and dropped again to 0.90 in 2012. In 2014 it went back to 1.11, the levels in 2006. In Italy, the fluctuations are less pronounced, but still represent significant jumps, going from 0.83 to 1.05 between 2007 and 2014.

Interestingly, our analysis shows that mark-ups in the food processing industry were not only more stable compared to the agricultural sector, but even increased during the 2009-2010 financial crisis, which might suggest a counter-cyclical behavior. When the performance of the whole economy declined during the

¹⁵ We compute yearly sale-weighted average mark-up as follows: $M_{at} = \sum_{i \in a} s_{it} \mu_{it}$, where s_{it} - i. e. $s_{it} = \frac{s_{it}}{s_{at}}$ - is the annual share of firm *i*'s sales $S_{it} = P_{it}Q_{it}$ in total sales S_{at} of the food supply chain sector *a* in time *t*. In this way we take into consideration firm size in aggregating mark-ups. This is the most common way of aggregating mark-ups (De Loecker and Eeckhout 2017).



recession in 2009, the food sector performance increased. This is the case in France and in Italy.

On the contrary, the French drink sector presents a sharp decline in mark-up between 2006 and 2014. This industry is primarily made up of wine-producers, which in our sample account for more than 65% of total French drink companies. This downward trend seems to reflect the considerable decrease in the wine exports during the recession.¹⁶ In addition to this decrease in exports, the domestic market also faced lower wine demand: household consumption of wine, cider and champagne declined by more than 2% in 2008 and 1% in 2009.¹⁷

Furthermore, evidence from by Aleksanyan and Huiban (2016) reports a dramatic increase in bankruptcy rate for this sector since 2010. In their work the authors study the evolution of firms' bankruptcy risk and calculate that over the period 2001-2012, bankruptcies in the French manufacture of food products, beverages and tobacco products affected on average nearly 2,700 jobs each year, with a major peak in 2012, when food industry bankruptcies had an impact on more than 4,000 jobs.

The French wholesale sector faced a decline from 2007 to 2011, followed by an increase, which in 2014 leads mark-ups to reach the levels of 2006. The French food retail sector records an increase in mark-ups from 2009, suggesting a rapid recovering from the economic crisis. In Italy mark-ups of wholesalers and retailers are steadily increasing.

The "agricultural sector" average may hide important heterogeneity within "agriculture". As explained in Section 4, we have disentangled the analysis of the agricultural sector by splitting it into sub-sectors such as : (1) the cereal sector, (2) the livestock sector, (3) the fruits, nuts and vegetables sector, (4) other crops (perennial and non-perennial), (5) mixed farming, (6) other agricultural activities, and (7) fishing and aquaculture sector.

Figure 8 and Figure 9 present the evolution of mark-ups of these agricultural subsectors in Italy and France. They show that sectors experienced fluctuations, even though with different magnitudes. In France, the fishing and aquaculture sector displays strong fluctuations with mark-ups having a rapid increase in 2014. On the other hand, the other subsectors fluctuations are less pronounced.

¹⁶ According to Minister of Agriculture France experienced a decline in exports of 23% in value between 2008 and 2009 (*Agreste Conjunture*, 2010).

¹⁷ France AgriMer (2011).



In Italy, over the 2006-2014 period mark-ups increased in all agricultural subsectors. The livestock sector and other-crop sector present less noticeable fluctuations compared to the other sub-sectors. For example, the mark-ups in the cereal sector rose dramatically between 2007 and 2011, declined strongly in 2012, and increased again between 2013 and 2014. On the contrary, in the livestock sector the mark-ups increased gradually between 2006 and 2010, experienced a spike in 2011, before returning to the 2010 levels and then increasing slightly again up to 2014.

Volatility over time

We compute the volatility measures as expressed in equation (12) and results are reported in Table 3. The mark-up volatility in the agricultural sector is around 0.18 in France and Italy- substantially higher compared to the downstream players' mark-up volatility. In France, in particular, these findings are consistent with a visual impression of Figure 6 and Figure 7, where the mark-up indices tend to show higher peaks and deeper troughs than those for the other chain sectors.

A comparison with other sectors of the food chain shows that mark-up volatility of the agricultural sector is more than three times that of the wholesale sector in both countries. Compared to the food processing, mark-up volatility of the agricultural sector is more than double in Italy and more than three times in France. All these differences are statistically significant at the 1% level as reported in Table 3.¹⁸

Within the agricultural sector, in Italy the mark-up volatility of the cereal is 0.21, while that of livestock sector is 0.14, a difference that is statistically significant at the 1% level. On the other hand, the fishing sector fishing and aquaculture sector is around 0.26, higher compared to the cereal' mark-up volatility.

In France, the volatilities in mark-ups of the fishing and aquaculture sector (0.22), other agricultural activities (0.20) and fruit, nut and vegetable sector (0.18) are higher and statistically different from the cereal sector (0.14) (Table 4).

These findings may result from the fact that farmers tend to implement strategies, which are aimed at minimizing losses and are less adaptive to shocks compared to the downstream sectors. One potential reason is that farmers might not be able to respond easily to short-term shocks as they have a more limited set of

¹⁸As a robustness check, we have also computed the volatility by including only those firms which report mark-up estimates for at least 4 years. The results confirm a similar pattern in terms of volatility and are significant at 1% level. Results are available from authors upon request.



alternative risk management strategies than other agents in the value chain. As a matter of fact, both supply and demand of agricultural products tend to have limited price responsiveness.¹⁹ Moreover, depending on the characteristics of the product, some agricultural markets tend to exhibit cyclical price fluctuations (e.g. the phenomenon known as 'hog cycle') or asymmetrical price fluctuations (e.g. storable versus non-storable) (Tangermann, 2011).

On the contrary, upstream sectors are found to be in a better position to deal with market volatility than farmers. They seem to be able to adopt either adaptive strategies to risk, allowing them to secure stable margins regardless of price fluctuations, or control strategies focusing on guaranteeing a continuous supply of quality products rather than to contrast price volatility. For example, anecdotal evidence of the implementation of more flexible price strategies was found in food processing companies in a French wheat chain (Assefa, Meuwissen, and Oude Lansink, 2017).

Interestingly, the drink industry is the second most volatile player - 0.12 in France and 0.9 in Italy (Table 3). One potential reason might be that wine producing companies, which account for the majority of firms within the drink sector in the sample of both countries²⁰, are generally highly export oriented and thus most exposed to international demand shocks such as those experienced during the economic crisis as reported above. Moreover, the wine sector shares some similar characteristics with agricultural commodity sectors, which make it exposed to similar sources of risk, such as climate and weather related events.

DISCUSSION

When discussing higher volatility in the agri-food markets, reference is typically made to the inherent risks in the agriculture sector. Studies generally distinguish between two main groups of risk: price risk, driven by imbalance between demand and supply chain resulting in strong price volatility; and production risk, referring to the possibility of output/yield falling below than an expected level due to uncertain events (e.g. JRC, 2008; Tangermann, 2011; European Commission, 2017). These risks are not independent, but are often correlated to each other. For example, production risk and price risk tend to be negatively correlated,

¹⁹ As noted by Tangermann (2011): "On the supply side, the time required to complete the production process, for crops typically a year, means that output cannot be much adjusted in the short run when the price changes. On the demand side, the essential nature of food as a necessity results in a low price elasticity." (p.2).

²⁰ The share of manufacture of wine grape in total drink manufacture is also around 65% in the Italian dataset.



resulting in lower fluctuations compared to those of either price or yield (Tangermann, 2011).

When assessing the multiple and diverse sources²¹ of risk, which can threaten the functioning and economic sustainability of the food supply chain, recent attention has been given to market risks related to farmers' relationships with other participants in the agro-food chain. In the EU policy debate, one specific practice that is commonly associated to the so-called "unfair trading practices" is the transfer of disproportionate risk to other upstream trading partners. One recurring argument is that consolidation and rising concentration, mostly in downstream sectors, have resulted in imbalances of bargaining powers for some players, which allow them to shift these excessive risks to upstream trading partners.

However, while evidence of the impact of these excessive and unpredictable transfers of risk to farmers is mostly anecdotal and challenging to identify (Fałkowski, 2017)²², their likelihood of the occurrences has been questioned from a theoretical perspective. Sexton (2017) notes how transferring costs to trading partner who is less efficient at bearing that cost will result in a reduction of gains of the transaction. Hence inflicting excessive risk to the other participant will reduce the likelihood of continuing doing business.

Furthermore, there are also studies showing how imbalances of bargaining power do not necessarily lead to farmers' exits or marginalization. Mérel and Sexton (2017) show how under the right market conditions, more consolidation and concentration in procurement markets result in more efficiency and secure farmers a fair or competitive return on investment trade. There is also evidence of positive vertical integration where processors tend to have long-run strategies with farmers, providing them incentives to invest and thus increase productivity and upgrade their supply chain (Dries et al., 2009; Dries, Reardon, and Swinnen, 2004; Swinnen, 2007).

While the focus of this paper is not to empirically identify a causal relationship between mark-up volatility and specific risks or source of risks, our findings

²¹ These go from climate and weather related events; to sanitary and phytosanitary conditions and animal diseases; from fluctuations to high volatility of energy and input prices, such as fertilizers; to demand related risk, for example, to quality requirements and the emergence of new products to financial uncertainties and policy and regulatory risks.

²² This is related to the problem of attribution. As Fałkowski (2017) pointed out, the presence of many confounding factors makes it very difficult to determine whether specific events threatening farm survival are due to unfair practices on the part of the stronger trading party or rather are determined, for example, by idiosyncratic risks of specific farmers.



provide interesting indicators about food actors' coping strategies with uncertainty caused by market volatility, in particular related to their mark-ups. In managing risk strategies, food chain companies are ultimately more concerned about securing their margins (increases in input price or decreases in output price) than price volatility per se.

From a policy standpoint, these results raise certain issues that need to be further explored to better understand how the food system in the EU performs from the broader and multidimensional perspective of sustainability, as adopted in SUSFANS' approach.²³ They suggest a need for further exploring both public and private intervention in dealing with uncertainty and risk in agricultural and food markets for farmers – and in identifying lessons for farmers from existing best practices of other companies in the food value chain in coping with risk and uncertainty to stabilize their mark-ups.

²³ As explained in the research agenda of the SUSFANS project "a novelty in SUFANS' approach of analyzing FNS is the broadening of the concept of sustainability, which incorporates, next to the traditional environmental dimension, also social (health), economic and global FNS dimensions" (Rutten et al., 2016, p.3).



CONCLUSIONS

In recent years, there has been growing interest from academics and policy communities on the functioning of food supply chains in the face of significant external challenges, such as a growing demand for agricultural production worldwide and price volatility. Most existing studies on the risk factors affecting the functioning of food supply chains have focused on price volatility at farm-level, while downstream sectors (i.e. processors, wholesalers and retailers) have been mostly ignored. Yet, the focus of attention is mostly on detecting and analyzing output price volatilities rather than margins (differences between input and output prices).

This paper is the first to analyze the functioning of the food supply chain in terms of mark-up volatility of its actors. More specifically, we estimate firm-level mark-ups over time and analyze the mark-up volatility along the agri-food supply chain, using an innovative estimation procedure developed by De Loecker and Warzynski (2012) on annual data from more than 100,000 companies in France and Italy during the period 2006-2014.

A major result from our analysis is that on average the agricultural sector as a whole display a significantly higher mark-up volatility compared to companies in other stages of the value chain.

These findings provide interesting indicators and raise a number of questions for policy debate on how risk management could help increase the economic viability of the agricultural sector and on how lessons can be drawn from risk-coping strategies by other companies in the food value chain to stabilize mark-ups for farmers.



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*Figure 1: Evolution of prices along the food supply chain in the EU, 2007-2016*²⁴

Source: European Commission (2016a)

²⁴ Note: For the EU level, the evolution of monthly prices are taken from DG AGRI Bulletin, which indicates that Eurostat monthly indices for EU farmer prices are not available since 2013. Until December 2015, they are estimated based on MS data weighted by their share in the agricultural output. Beyond, indices are estimated based on cereal, sugar, milk and meat monthly prices weighted by annual production (European Commission, 2016).











Source: Eurostat- Food Price Monitoring tool (2017)



Figure 3: Evolution of consumption expenditure of food products, 2006-2014



B. France







Source: Author's elaboration Eurostat (2017)





Figure 4: Evolution of agricultural commodity prices, by commodity, 2006-2014





Source: Eurostat – Food Price Monitoring Tool (2017)









B. Italy and France

Source: Author's elaboration from Eurostat (2017)



Figure 6: Evolution of mark-ups of the food supply chain, France 2006-2014











Figure 7: Evolution of mark-ups of the food supply chain, Italy 2006-2014

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Note: see Section 4 for the categorization of the agricultural sub-sectors



Figure 9: Evolution of mark-ups of agricultural sub-sector, Italy 2006-2014









Note: see Section 4 for the categorization of the agricultural sub-sectors



Table 1: Sample distribution of firms along the food supply chain in France and Italy (% total observations).

Country	Agriculture	Food	Drink	Wholesale	Retail
France	11.16	23.18	2.38	21.31	41.97
Italy	20.72	23.53	3.47	31.4	20.88

Source: Authors' elaboration from Amadeus database



Table 2: Descriptive Statistics France and Italy

Country	France		Italy				
Variable	N. Obs.	Mean	Obs.	Mean			
Agriculture							
Turnover	36,924	616	40,960	1,046			
Total Assets	36,924	799	40,960	2,157			
Material	36,924	174	40,960	659			
Cost of Labor	36,924	150	40,960	158			
N. Employees	14,826	10	30,469	9			
	F	ood Processing					
Turnover	76,674	976	46,521	4,303			
Total Assets	76,674	573	46,521	3,889			
Material	76,674	444	46,521	2,736			
Cost of Labor	76,674	287	46,521	460			
N. Employees	32,001	10	38,690	15			
		Drink					
Turnover	7,870	4,309	6,867	5,116			
Total Assets	7,870	5,979	6,867	7,128			
Material	7,870	2,578	6,867	2,946			
Cost of Labor	7,870	479	6,867	485			
N. Employees	3,124	13	5,970	14			
Food Wholesale							
Turnover	70,501	3,853	62,073	3,371			
Total Assets	70,501	1,326	62,073	1,830			
Material	70,501	2,960	62,073	2,644			
Cost of Labor	70,501	298	62,073	194			
N. Employees	29,745	8	49,682	10			
Food Retail							
Turnover	138,821	1,656	41,290	2,414			
Total Assets	138,821	442	41,290	888			
Material	138,821	1,246	41,290	1,830			
Cost of Labor	138,821	194	41,290	250			
N. Employees	61,156	7	32,879	11			

Note: Values are expressed in thousands of \in .



	France		Italy	
	Volatility	p-value	Volatility	p-value
Agriculture	0.18		0.18	
Food Processing	0.05	0.00	0.08	0.00
Drink	0.12	0.00	0.09	0.00
Food Wholesale	0.05	0.00	0.05	0.00
Food Retail	0.04	0.00	0.03	0.00

Table 3: Mark-up volatility of sectors of the food chain

Note: The reported p-values are the result of the t-test comparing agricultural sector against the other sectors.



	France		Italy	
	Volatility	p-value	Volatility	p-value
Cereal Sector	0.14		0.21	
Livestock Sector	0.14	0.80	0.14	0.00
Fruit Nut and Vegetable Sector	0.18	0.00	0.19	0.02
Other Crops	0.11	0.01	0.18	0.09
Mixed Farming	0.16	0.46	0.18	0.09
Other Agricultural Activities	0.20	0.00	0.14	0.00
Fishing and Aquaculture Sector	0.22	0.00	0.26	0.05

Table 4: Mark-up Volatility of the agricultural sub-sectors

Note: see Section 4 for the categorization of the agricultural sub-sectors. The reported p-values are the result of the t-test comparing cereal sector against the other sub-sectors.



APPENDIX A: FILING REQUIREMENTS AND DATA PROVIDERS

Country	Companies to file accounts	Data
		Provider
FR	 All of the following: les sociétés responsabilité limite (SARL et EURL) ; les sociétés de personnes (sociétés en nom collectif et sociétés en commandite simple), sous certaines conditions: les sociétés en nom collectif (SNC) dont au moins l'un des associés est une personne physique ne sont pas dans l'obligation de déposer leurs comptes annuels (pour plus de précisions, se référer l'article L. 222, 21 du Code de Commerce) ; 	Ellisphere
	 232-21 du Code de Commerce) ; les sociétés par actions (sociétés anonymes, sociétés par actions simple es et sociétés en commandite par actions) ; les sociétés commerciales dont le siège est situé à l'étranger qui ont ouvert un ou plusieurs établissements en France les sociétés d'exercice libéral (SELARL, SELAFA, SELCA, SELAS) ; les sociétés coopératives et unions sous certaines conditions (pour plus de précisions, se référer l'article R. 524-22-1 du Code Rural). 	
IT	 Includes: S.p.A. (Società per Azioni), S.r.l. (Società a responsabilità limitata), Sapa (Società in accomandita per azioni), Società Cooperative, Società Consortili, G.e.i.e, Società di persone (only consolidated accounts), Consorzi con qualifica di Confidi. Società a responsabilità a socio unico e società per azioni a socio unico. 	Jordan Limited

Source: Kalemli-Ozcan et al. (2015)