Farms' Performance and Short Supply Chains in Italy: an Econometric Analysis

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Paper prepared for presentation at the 2nd AIEAA Conference
"Between Crisis and Development: which Role for the Bio-Economy"

6-7 June, 2013
Parma, Italy

Summary

In spite of several cases study existing that assess the profitability of farms participating in direct sales activities (Brown, 2002; Brown and Miller (2008), no analysis has verified whether the notion that farmers participating in short supply chains are profitable holds to the empirical test. The objective of this analysis is that of testing econometrically whether farmers joining short supply chains do experience better performances, accounting for confounding factors and endogeneity of channel choice decision. To that end, we use the Farm Accountancy Data Network (FADN) referred to 2010. Results indicate that participation in SSCs doesn't positively contribute to farms profitability. We use this preliminary empirical evidence to shape future research steps in this domain, and namely to further investigate the differential impact of participation in SSCs on gross sales and variable costs.

Keywords: short supply chains, Price-Cost-Margin, GMM, Italy

JEL Classification codes: Q13

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1. INTRODUCTION

In recent years the number of farmers selling through short supply chains (SSCs), i.e. participating in Farmers Markets (FMs), Community Supported Agriculture (CSA) or in direct selling via on-farm shops, has increased largely among developed countries (Fondse et al., 2012). In the USA the number of FMs has increased threefold in fifteen years (1994-2009), from 1,755 units to 5,274 (Martinez, 2010), supplying a range of products which span from fresh fruits and vegetables, to flowers, and from baked goods to dairy products. In the EU the situation is similar. In France, in 2007, direct selling was well established and covered 15% of consumers' food purchases. In the UK there are over 500 FMs, patronized by 15 million consumers a year, for 166 million pounds in sales (www.farma.org.uk), and a similar number of FMs currently operate in Germany (www.farmersmarkets.net). In Italy FMs have grown in recent years (Pascucci et al., 2011): Coldiretti (the largest Italian farmers' association) reported 1,105 FMs (Coldiretti, 2012) which include 4.739 farms, visited regularly by circa 7 million consumers and occasionally by 21 (more than one third of the Italian population). The phenomenon of direct sales in Italy shows large growth: 2009 data (Coldiretti, 2009) reported circa 63,600 farms selling their products directly to consumers for an increase of 64% compared to 2001. Most of them are located in the North and Centre of the Country, with Tuscany being the region with the highest number of sales at the farm level, Lombardy and Piedmont following closely (Aguglia, 2009). Farms selling directly to consumers in Italy sell mostly fresh fruit and vegetables, and/or processed products (wine, olive oil, canned vegetables or fruit) (Pascucci et al., 2011). The latter are particularly suited to be marketed through direct channels, thanks to the possibility of emphasizing their value added features achieved through processing and, furthermore, their shelf-life allows for greater flexibility in the timing of sales (Cicatiello, 2008).

Reaching consumers directly can represent a good opportunity for farmers to bypass the presence of middlemen, and to internalize additional margins that would, otherwise, go to the other agents in the supply chain, mostly retailers. As Gilg and Battershill (1998) point out in the case of "*vente directe*" in France, selling product directly to consumers can be a strategy to access consumers with higher w.t.p. for produce produced less intensively, and, at the same time, for farmers to internalize higher margins. Also, Verhaegen and Van Huylenbroeck (2001) find that farmers participating in six different forms of direct channels in Belgium, experience higher costs but also higher revenues, with overall better profits. Similarly, using the case of the UK market, La Trobe (2001) argued that FMs can facilitate farmers to overcome crises as they allow them to internalize higher shares of the channel profits. Furthermore, farmers' participation in direct channels has been found to have benefits going beyond farmers' performances. Brown (2002) and Brown and Miller (2008) literature reviews assess the role of FMs and CSAs for local communities, participant farms, and consumers in the US, finding a substantial impact on income of participant farms (especially small ones), improvement of human capital, improving access to local fresh produce to consumers, and positive impacts (from both a social and an economic perspective) for the communities where they locate.

As the recent economic recession unfolded, countless business reports described retailers being forced to cut their prices to face shrinking demand from cash-stripped consumers, giving them an incentive to squeeze margins out of their suppliers, which may in turn impact upstream farm margins. In spite of several cases study existing that assess the profitability of farms participating in direct sales activities (see the literature reviews in Brown (2002) and Brown and Miller (2008)), no analysis has verified whether the notion that farmers participating in direct sales/short channels are profitable holds to the empirical test. The objective of this analysis is that of testing econometrically whether farmers joining short supply chains do experience better performances. To that end, we use Italian Farm Accountancy Data Network (FADN) data, for the year 2010, and a reduced form model where a proxy of economic margins is used as dependent variable, and where confounding factors and endogeneity of channel choice decision are accounted for.

Preliminary empirical results do not provide support to the belief that participation in SSCs impacts positively economic margins. We use this preliminary empirical evidence to shape future research steps in this domain, and namely to further investigate the differential impact of participation in SSCs on gross sales and variable costs.

2. EMPIRICAL MODEL, DATA AND ESTIMATION

Our modelling strategy draws from traditional industrial organization theory. According to the Structure, Conduct, Performance (SCP) paradigm (Bain 1951; 1968) the structure of a market (i.e. demand, technology, etc.) impacts the conduct (i.e. the behavior) of the firms in the industry and therefore the industry performance. Traditionally, SCP models have been used to investigate the relationship between industry performance and structural industry features, mostly concentration (e.g. Clark, Davis and Waterson, 1984; Conyon and Machin, 1991) with major focus on manufacturing and retailing industries SCP analysis focusing on farming data are scant. In this analysis, we treat the ability of adopting a direct sale channel as a strategic decision to enter and operate in a different market, where margins are not shared with other agents in the channel. Thus, a farmer's decision of participating in a short supply chain will lead it to face different consumers' demand and to incur different costs. In spite of not having empirical evidence from large samples of farmers, anecdotal and small scale studies support the notion that farmers operating in short supply chains perform better than those who sell their products via mainstream supply chains. In that sense this notion is consistent with other work in food industries where groups of firms showing an attitude more responsive to the market are able to gain higher margins[1].

Before continuing with the exposition of the model, a note on the measure of performance used is required, since choosing an appropriate dependent variable is of paramount importance, as the empirical SCP studies offer different variables of choice[2]. One of the most commonly used proxy for profit margin is the ratio of gross profits to sales (e.g. Clark et al., 1984; Fisher, 1987; Conyon and Machin, 1991) which, however, presents some limitations. For example Dickson (1994) points out that an index obtained dividing gross profits by value added would be preferable in industries where there are differences in vertical integration or where firms operate at different stages of the production process[3]. Furthermore another issue is

[1] Oustapassidis (1998) finds the existence of two strategic groups among the Greek Dairy industry, where the group selling branded products are more profitable and able to apply different strategies to increase profits that those who do not.
[2] For a review of the measures of profitability used in SCP studies, and the issues (or advantages) related with their use, see Perloff, et al. (2007).
[3] He argues that using such index one would have an effective rate of market power, while using sales at the denominator would lead to a nominal rate, potentially distorted by stage of production effects.

that, as elasticity of demand is often unavailable, dividing by sales could be causing omitted variable bias[4]. These factors are unlikely to apply to our case as we use farm-level data (i.e. all the firms in our dataset operate at the same level of the supply-chain) and we account for channel choice and demand shifters, which, at least up to a certain extent, should account for changes in demand.

Another issue that arises in a SCP framework, is that of one should control for sources of biases due to use of accounting data. As Fisher (1987) points out suing accounting data instead of actual economic measures of a firm's marginal cost, one is forced to use average variable cost in place of marginal cost. That is, a performance measure based on average variable cost instead of marginal cost is likely biased because of the relationship

$$MC = MC = AVC + \frac{(r+\delta)(p_k K)}{q} \quad (1)$$

where *MC* is the constant marginal cost, *AVC* the and average variable costs, *r* the competitive rate of return of capital, δ the depreciation rate, p_k the per-unit cost of capital and the ratio *K/q* represents the amount of capital needed to produce one unit of output. In single output industries, where all firms are homogenous and have the same size, one can modify the classical monopoly solution from $(p - MC)/p = -1/e_j$ to

$$\frac{p - AVC}{p} = -\frac{1}{e_j} + \frac{(r+\delta)(p_k K)}{pq} \quad (2)$$

Thus, our empirical model, to assess the relationship between performance and participation in short supply chains can be represented as follow:

$$PCM = \frac{P}{S} = \alpha_o + \alpha_{Sc} SC + \sum_j \alpha_j X_j + \sum_f \beta_f Z_j + \sum_l \tau_l KS_l + \sum_m \gamma_m OTH_m + FE + REG + \varepsilon \quad (3)$$

Where the ratio between gross profits *P* (gross sales minus total variable input cost and cost of labor) and gross sales *S*, is the proxy for the Price-Cost-Margin (PCM) or Lerner Index (Perloff et al., 2007), *SC* is an indicator variable representing the participation to short supply chain(s), *X* is a vector of demand related variables (e.g. number of inhabitants per province, total household consumption at regional level[5]), *Z* is a vector of farm-specific variables, capturing characteristics of the farmer, as well as the presence of specific activities that can impact the level of output (irrigation), the vector *KS* represents the different types of capital used in the farm divided by *S* (land, working capital), *OTH* is a vector of other variables representing other factors that can impact profitability (*e.g.* use of organic and/or other quality certifications, whether the farm resides in a mountainous or less favourite area, presence of other production subsidy), *FE* are farm-type fixed effects (including multi crop farming) and *REG* are macro-area fixed effects. The α, β, τ, and γ, are parameters to be estimated and ε is an idiosyncratic error term. Thus, a farm's economic performance is

[4] Dickson points out that these factors could explain Conyon and Machin (1991) results, who found that when using Value Added or Net Output to deflate profits, the estimated relationship between industrial concentration and profit margins in the UK manufacturing industries is positive and significant, while they found no statistical significant relationship when they used Sales or Gross Output.

[5] It should be noticed that a firm's profitability is function of the slope of the demand curve it faces. To assess profitability of firms operating in homogenous product markets, one needs to control for variables capturing features of the aggregate demand curve for agricultural products. Thus, we include in the model total population at the province level (from ISTAT) and a proxy for total disposable income obtained multiplying the average monthly expenditure in a household for consumer goods times population divided by 2.4 (average household size in Italy).

assumed to be a function of the channel adopted, type of crops produced, a series of market controls and farmer's characteristics.

Equation (3) is estimated using data form the 2010 Italian Farm Accountancy Data Network (FADN), containing detailed information on more than 10,000 farm businesses, collected and organized by the Italian National Institute of Agricultural Economics (INEA). The data is representative of the Italian farmers population, and it is aligned with the formal procedures of the European Commission. The database contains information on farm location that allows us to match market-specific variables such as provincial population and regional household consumption to each observation. Table 1 describes the variables used to operationalize equation (3). Within the Italian FADN sample almost 9% of the farms are participating in, at least, one short supply chain.

Table 1. Descriptive statistics

Variable Description	Variable	Mean	std.dev	Min.	Max.
Participation in short supply chain(s) (1: yes; 0: no)	vend_dir	0.089	0.284	0	1
Share of land capital on total revenues	cap_fond_t	6.209	7.915	-0.56	146.30
Share of working capital on total revenues	cap_eser	1.470	2.478	-15.43	151.59
Utilized agricultural area (UAA) (ha)	sau	33.172	62.827	0.10	1731.29
Wine producer (1: yes; 0: no)	cod_vino	18.939	90.463	0	451
Quality certifications (1: yes; 0 no)	certificaz	0.073	0.260	0	1
Organic certification (1: yes; 0: no)	bio	0.030	0.170	0	1
Agricultural subsidies (000€)	aiuti	13.923	39.261	0	1622
Farmer Age	eta	58.7	13.6	17	99
Farmer educational level (8: post-graduated; 1: primary)	edu	3.441	1.348	1	8
Farmer gender (1: female; 0 male)	sesso	0.219	0.414	0	1
Mixed cropped farm (1: yes; 0: no)	ote_ind2	0.080	0.271	0	1
Mixed crops and livestock farm (1: yes; 0: no)	ote_ind3	0.295	0.456	0	1
Livestock herbivores farm (1: yes; 0: no)	ote_ind4	0.177	0.382	0	1
Livestock granivores farm (1: yes; 0: no)	ote_ind5	0.038	0.190	0	1
Horticulture farm (1: yes; 0: no)	ote_ind6	0.064	0.245	0	1
Arable crops farm (1: yes; 0: no)	ote_ind7	0.004	0.067	0	1
Fruit farm (1: yes; 0: no)	ote_ind8	0.080	0.271	0	1
Mountain location (1: yes; 0: no)	alt1	0.191	0.393	0	1
Hill location (1: yes; 0: no)	alt2	0.457	0.498	0	1
Partially disadvantaged location (par. 3) (1: yes; 0: no)	svan2	0.086	0.281	0	1
Totally disadvantaged location (par. 3) (1: yes; 0: no)	svan3	0.232	0.422	0	1
Disadvantaged location (par. 4) (1: yes; 0: no)	svan4	0.169	0.375	0	1
Partially disadvantaged location (par. 5) (1: yes; 0: no)	svan5	0.033	0.178	0	1
Other forms of management (1: yes; 0: no)	cond_ind1	0.007	0.082	0	1
With employees (1: yes; 0: no)	cond_ind2	0.027	0.163	0	1
With only subcontracting (1: yes; 0: no)	cond_ind3	0.006	0.080	0	1
Prevalence of non-familiar employees (1: yes; 0: no)	cond_ind4	0.100	0.300	0	1
Prevalence of familiar employees (1: yes; 0: no)	cond_ind5	0.235	0.424	0	1
Central Italy (1: yes; 0: no)	area1	0.184	0.387	0	1
Sicily and Sardinia (1: yes; 0: no)	area2	0.101	0.301	0	1
Southern Italy (1: yes; 0: no)	area3	0.264	0.441	0	1
North-western Italy (1: yes; 0: no)	area4	0.211	0.408	0	1
Province population (millions)	popolazion	0.581	0.556	0.06	4.04

Total regional household consumption (millions)	totcons	591.457	593.136	39.21	4404.43

Source INEA, 2010

Equation (3) could be estimated using Least Squared methods, and the estimated would be unbiased if all the variables in the model were (weakly) exogenous. However, both a farm's profitability and the farmer participation in SSC could be impacted by unobserved factors, which make, at least in principle, the SSC indicator endogenous, and estimated of the parameters in (3) biased. To solve this issue we use an identification strategy based on isolating variation in exogenous (to the individual farmer) market conditions that can facilitate the decision to sell products via short supply chain(s), i.e. we use variables capturing the pervasiveness of activities related to sales of agricultural products directly to consumers at the local level (the province where a farm operates) as instruments, and an instrumental variable method, the Generalized Method of Moment (GMM), for the estimation.

The instruments we use are the number of farms participating in the "Campagnamica" initiative by Coldiretti, one of the leading Italian Association of farmers (www.coldiretti.it), and the number of Solidarity Purchasing Groups[6] (SPGs) by province (www.retegas.org). These variables need to be both uncorrelated with other unobserved drivers of profitability (that is, need to be weakly exogenous) and also constitute exclusion restriction, in other words, they should impact profitability only through their effect on selling via a SSC. Intuitively, farms' profitability can only be impacted by the reach of farmers' associations in promoting direct sales *only if* they decide to sell via the short supply chain (namely the farm market and/or the SPG), and the same applies for the capillarity of SPGs through the local population. That is, these variables are likely to represent credible exclusion restrictions.

Conditionally on our variables chosen as instruments constituting valid exclusion restrictions, their exogeneity can be validated via statistical tests. We test for whether correction for the short supply chain indicator is necessary (conditionally on our instruments' choice) using a C statistic, obtained as difference of two Sargan statistics (Hayashi, 2000, pg. 232), distributed as standard Normal, under the null of exogenity. As we use two instrumental variables, we test for weak orthogonality of the overidentifying instrument using Hansen's (1982) J-statistic, distributed chi-squared with a number of degrees of freedom equal to the number of overidentifying restrictions (one, in our case), under the null of the overidentifying instruments being uncorrelated with the error terms. The instruments power is evaluated using Staiger and Stock (1997) "rule of thumb," indicating that weak instruments issues can be ruled out if the F-statistic for the joint significance of the instruments' parameters in the first stage regressions exceeds 10.

Table 2 highlights the main differences between farms participating in SSC and those non-participating s). It can be noticed that both the average and median PCM is slightly lower (-1.38% and -1.44% respectively) in farms participating than in farms non-participating in SSCs. Also, it emerges that participating farms have larger capital then non-participating ones, and that they are also more likely to face higher cost of labor. Thus, even though the average revenue of the participating farmers is 9% circa higher than non-participating ones (the median is 15% higher), the trade-off between higher costs and higher revenues results in the small negative % difference in PCM, suggesting that, on average descriptive statistics do not support the hypothesis that SSC adopting farmers experience higher profit margins.

[6] Gruppi di Acquisto Solidale – GAS

TABLE 2. Differences between farmers participating and non-participating in SSCs

	Non-participating in SSCs		Participating in SSCs		% difference farmers participating and non-participating in SSCs	
	Mean	Median	Mean	Median	Mean	Median
Price-Cost-Margin (PCM)	61.56	63.67	60.73	62.76	-1.38	-1.44
Net income (€)	60,151	19,172	61,634	19,868	2.41	3.50
Variable costs (€)	63,212	16,346	62,966	20,813	-0.39	21.46
UAA (ha)	33.07	13.04	34.24	12.18	3.43	-7.06
Land capital (€)	461,959	165,198	497,174	180,000	7.08	8.22
Working capital (€)	192,049	63,322	218,306	74,232	12.03	14.70
Agricultural working capital (€)	32,033	1,415	60,201	6,000	46.79	76.42
Total revenue (€)	139,544	48,666	153,251	57,537	8.94	15.42
Share of operating capital on total revenues	1.48	1.18	1.41	1.21	-4.77	2.51
Family employment (hours)	2,753	2,200	3,100	2,200	11.19	0.00
Family employment (€)	24,488	18,000	29,158	22,000	16.02	18.18
Agricultural subsidies (€)	14,249	4,059	10,566	3,662	-34.86	-10.84

Source: our elaboration on INEA, 2010

3. EMPIRICAL RESULTS

In table 3 we present preliminary results on the relationship between PCM and participation on SSCs, while controlling for all other factors indicating in equation (3). The results indicate that Farms participating in SSCs are more likely to experience a lower Price-Cost-Margin than those who do not, indicating that shortening the supply chain is not necessarily contributing to farm profitability more than participation in mainstream supply chains.

Also, it should be noted that we find evidence of the SC indicator to e endogenous (the p-value of the C statistics is 0.003) and that the instruments satisfy the orthogonality condition (the p-value of the J-test is 0.14, exceeding the customary value of 0.1). Also, our results are likely to be unaffected by weak instruments problems, sine the value of the F statistics for the joint significance of the Instruments in the first stage equation exceeds 10.

Table 3. Empirical Results: Equation (3); GMM

Variable	Coef.	Std.Err	P>z
vend_dir	-30.890	11.771	***
cap_fond_t	-0.200	0.029	***
cap_eser	-0.101	0.085	
sau	0.013	0.005	***
cod_vino	0.019	0.007	***
certificaz	1.393	1.363	
bio	0.787	1.775	
aiuti	-0.028	0.009	***
eta	0.028	0.016	*
edu	-0.110	0.191	
sesso	1.122	0.451	**
ote_ind2	2.243	0.864	***
ote_ind3	5.846	0.590	***
ote_ind4	-3.044	0.782	***
ote_ind5	-11.350	1.296	***
ote_ind6	3.516	1.243	***
ote_ind7	-7.780	3.184	**
ote_ind8	-1.939	1.166	**
alt1	3.531	0.989	***
alt2	4.867	0.527	***
svan2	1.778	0.725	**
svan3	3.861	0.838	***
svan4	1.143	0.604	*
svan5	1.606	1.047	
cond_ind1	-2.374	2.084	
cond_ind2	-9.113	1.343	***
cond_ind3	-11.395	2.275	***
cond_ind4	-12.779	0.718	***
cond_ind5	-4.685	0.461	***
area1	1.755	0.922	*
area2	-0.905	1.147	
area3	-2.032	0.680	***
area4	2.891	0.756	***
popolazion	-3.225	2.893	
Totcons	0.005	0.003	*
Cons	60.001	1.507	***

IVs: Number of campagna amica points (per province) and Number of SPGs (per province) instruments

Hansen's J χ^2=2.24 (p= 0.14) C Statistics χ^2=8.77 (p=0.003)

F-test instrument strength $F_{(2/10810)}$ 14.04 (p=0.00)

4. DISCUSSION AND CONCLUSIONS

In this paper we have presented a first attempt to conceptualize and operationalize the effect of farms participation in SSCs on their economic performance using a SCP approach and the extensive Italian FADN database. Our preliminary results indicate that the participation in short supply chains and direct sales doesn't necessarily provide higher economic benefits to farmers. At this stage of the research results should

be treated with caution. Combining empirical evidence from the descriptive statistics and the GMM approach we can tentatively highlight that the negative effect of participation in SSCs on farms' performances may be explained by a different impact on gross sales and variable costs (total variable input cost and cost of labor). Participation in SSCs increases gross sales, on average more than in farms non-participating in SSCs, however it increases the variable costs even more. This might be due to changes in the organization of the farm business, such that farmers have to internalize activities (such as marketing and sales) in which they are less experienced with, thus resulting in higher organization costs. A further investigation in the reasons behind such a differential impact is thus needed.

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