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Potential gains from specialization and diversification further to the reorganization of activities[☆]

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ABSTRACT

In economic activities, two main forces guide firm and market structures: specialization and diversification. This paper provides new insights on this topic. We propose measuring gains due to simulated division and/or merger processes of firms. Potential gains come from a reorganization of activities through specialization/diversification and/or size effects. From a database of French farms, our findings demonstrate that even if both processes are beneficial for farming systems, the division gains outweigh the gains obtained by a merger. Moreover, mix changes are more important following a division than following a merger, implying more specialization gains than diversification gains.

1. Introduction

In economics, it is well known that the market structure and number of firms in the industry are directly linked to specialization and/or diversification phenomena. While labor division and the specialization of units facilitate technical progress and productivity enhancements, diversification is recognized as a factor of a scope economy linked to environmental synergies between different firms' activities and risk-management strategies. Economies of scope are defined as cost savings resulting from producing jointly many goods by one diversified firm rather than producing them separately by several specialized firms [30,5].[1] In some industries, however, economies of scope do not necessarily imply an absence of the benefits of specialization (*vice versa*). Indeed, specialization and diversification processes can coexist and must collide. So a relevant question is: Between specialization and diversification, which process generates the most gains for firms and is the most economically justifiable?

In this context, the development of tools to disentangle the two processes and assess cases in which one process economically dominates the other is a major methodological challenge. As such, this paper provides new insights into the diversification and specialization phenomena. More precisely, we measure and compare the potential gains in terms of cost reduction that firms may realize with a higher degree of specialization or diversification. We further decompose the gains obtained from the two types of reorganization – division and merger – into technical, size and mix gains. Explicit analysis of gains is an important task in determining the best direction to steer the reorganization (e.g., a division or a merger with or without mix changes). Moreover, by examining the output mix effect, we can determine whether the firm should go toward more specialized or mixed activities and compute the potential gains from the specialization and diversification processes.

To measure the potential gains *a priori* due to a merger, our approach is quite similar to the one adopted by Bogetoft and Wang [7] or Kristensen et al. [26]. Following these authors, we also employ the same concept of mix to capture the effect of this reorganization. However, our study differs from the above papers and others (e.g., [18,23,15,16]) in two important respects. First, in addition to the merger, we also examine the division process by relying on the methodology developed by Blancard et al. [3] for quantifying potential gains. Second, we estimate these two types of gains using non-convex technologies. Indeed, as Farrell [20] stated and Cherchye and Post [14] re-expressed, the convexity assumption that implies additivity and divisibility does not allow the highlighting of gains achieved through specialization and can only reveal economies of scope. More recently,

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[1] Economies of scope can come to the cost complementarity between two productions and/or the sharing or joint utilization of quasi-fixed inputs.

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Sahoo and Tone [38] recalled that the convexity assumption of production technologies might be prejudicial in real-life case studies. Carvalho and Marques [9] also emphasized that the imposition of convexity led to the results which support economies of scope. Hence they proposed a novel approach based on partial frontier nonparametric methods. This second point, which consists of rejecting this assumption, allows us to deviate from Ray [34] and Peyrache [31] in particular.

From the methodological viewpoint, we identify potential gains from both specialization and diversification based on an activity analysis framework [25,4]. Our starting point is activity analysis models without convexity. The Free Disposal Hull (FDH) model was introduced by Deprins et al. [17]. This model relaxes the convexity assumption by ignoring both additivity and divisibility. Later, Tulkens [40] and Bogetoft [6] introduced the Free Replicability Hull (FRH) by rejecting divisibility only. Ray and Hu [36] proposed that integral replications of all observed input-output combinations are feasible. More recently, Green and Cook [22] considered only additivity without replicability in the Free Coordination Hull (FCH) approach. In our paper, we employ the FCH and FDH models to analyze specialization and diversification processes.[2] An attractive feature of the FDH and FCH approaches is to allow only directly observed Decision Making Units (DMUs) to define the production technology. Additionally, by assuming only the additivity assumption, the FCH approach can allow the summation of these observed DMUs. Therefore, it appears appropriate for analyzing the reallocation of large firm activities among smaller units (division process) and, alternatively, the reallocation of small firms' activities among a larger unit (merger process).

The utility of this methodology is demonstrated on a sample of 608 French farms specializing in crops, in livestock and diversified during 2003.

Several papers in the agricultural literature have dealt with diversification. Fernandez-Cornejo et al. [21], for example, identified substantial dynamic economies of scope between cattle and other German agricultural products (crops, hogs and milk). Chavas and Aliber [12] highlighted important economies of scope of farms in Wisconsin that produced crops and/or livestock, and Morrison Paul and Nehring [29] found that product diversification contributed to US farms' economic performance. Later, in a sample of farms in Missouri, Wu and Prato [42] showed that the cost of joint production of crops and livestock is less than the cost of separate production. More recently, Chavas and Di Falco [13] investigated farm diversification linked to economies of scope and risk management. An empirical analysis of Ethiopian farms demonstrated a significant incentive for farmers to diversify.

Contrary to these studies on diversification, Blancard et al. [3] were interested in potential gains from specialization in agricultural activities. Using a sample of farms located in northeast France, the authors revealed that the main way to reduce production costs is indeed to increase the specialization of farms in terms of crops or livestock. This could partly explain the increasing shift to greater specialization observed in the French agricultural sector over the past few decades. A few years earlier, Chavas [10,11] suggested that the benefits of specialization and the enhancement of productivity could explain the trend toward more specialized farms. However, as already stated, this does not necessarily imply the absence of economies of scope. More recently, Atici and Podinovski [1] consider the use of data envelopment analysis (DEA) for the assessment of efficiency of units whose output profiles exhibit specialization.

Given these various issues, the structure of this paper is as follows. The next section describes our alternative approach to the computation of potential gains derived to output mix, size and technical effects. Our findings from empirical analyses are discussed in the next-to-last section. Finally, some concluding comments are presented in the last section.

2. Methodology

The analysis of production structure and gains due to activity reorganization requires a representation of the underlying production technologies. The latter can be modeled thanks to an Activity Analysis Model (AAM) introduced by Koopmans [25] and Baumol [4]. AAM is a mathematical programming-based technique composed of multiple inputs and outputs. The main advantage of AAM is the ability to estimate technology without specifying any functional form between inputs and outputs. We employ the general framework developed by Shephard [39] to model the technology by production possibility set.

Consider the situation with K DMUs and $\Re = \{1,\ldots,K\}$ being the corresponding index set. We also assume that DMUs use a vector of N inputs $x = (x^1,\ldots,x^N) \in R_+^N$ to produce a vector of M outputs $y = (y^1,\ldots,y^M) \in R_+^M$. The respective index sets of inputs and outputs are defined as $\mathfrak{N} = \{1,\ldots,N\}$ and $\mathfrak{M} = \{1,\ldots,M\}$.

Following Green and Cook [22] and Blancard et al. [3], we now consider different technologies by postulating (or not) the additivity assumption (FCH or FDH technologies). Furthermore, we consider the set of all DMUs and different subsets composed only of similar DMUs in terms of output *mix* relative to the evaluated DMU (hereafter denoted smix). By denoting $s = \text{FDH or FCH}$ and $r =$ all or smix, the production possibility set $T(s,r)$ is defined by:

$$T(s,r) = \left\{ (x,y) : \sum_{k\,\in\,\Re(r)} \lambda_k y_k^m \geq y^m,\ \forall\ m\ \in \mathfrak{M}, \right.$$

$$\left. \sum_{k\,\in\,\Re(r)} \lambda_k x_k^n \leq x^n,\ \ \forall\ \ n\ \in \mathfrak{N}, \lambda_k \in \Lambda(s)\ \forall\ k\ \in\ \Re(r) \right\} \tag{1}$$

In (1),

$$\lambda_k \in \Lambda(s) :\ = \begin{cases} \lambda_k \in \{0,1\}; \sum \lambda_k = 1\ \ \forall\ k \in \Re(r)\ (\text{for } s = \text{FDH}) \\ \lambda_k \in \{0,1\}\ \ \forall\ k \in \Re(r)\ \ (\text{for } s = \text{FCH}) \end{cases} \tag{2}$$

In FDH and FCH technologies, λ is a binary variable leading to the Mixed Integer Program (MIP). Formally, the difference between FDH and FCH concerns the presence or lack of $\sum \lambda_k = 1$. Contrary to FDH, FCH allows one to sum DMU activities given the additivity assumption.[3] Hence, FCH is less restrictive than FDH.

To define subsets of DMUs given their mix of activities, we introduce $H(k,o)$ as a difference indicator in terms of output shares between two DMUs k and o :

$$\Re(r) :\ = \begin{cases} k \in \Re\ :\ H(k,o) \geq 0 & (\text{for}\ \ r = \text{all}) \\ k \in \Re\ :\ H(k,o) = 0 & (\text{for}\ \ r = \text{smix}) \end{cases} \tag{3}$$

In this paper, the Hamming distance[4] (denoted H) is retained to determine the DMUs with an output mix similar to that for the evaluated DMU. It is measured by summing the absolute deviations between two DMUs in terms of structure of output. Formally,

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[2] An alternative approach could be the FRH model instead of FCH allowing the replicability observed DMUs as developed by Ray and Hu [36] or Ray [33].

[3] This is particularly attractive when we aim to compare a sum of smaller units to a large one and so to reveal size inefficiency.

[4] The Hamming distance was proposed by Hamming [24] and initially developed in information theory.