Universitat Autònoma de Barcelona

Productivity Essays on Coopetition, Organizational Downsizing and Restructuring

Jonathan Calleja Blanco

Autonomous University of Barcelona

Department of Business

Doctorate in Economics, Management and Organization

DOCTORAL DISSERTATION

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A mi padre y…

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Now, this closure gives space to new challenges and, as my advisor would like to say, I will do my best to "work hard and enjoy life".

Abstract

This dissertation aims to provide answers to traditional questions in the business literature using well-adopted economic tools. By bringing together accounting and productivity fields, it analyzes the contribution to the financial performance change from different drivers of productivity change. The methodological contributions throughout the dissertation provide novel instruments to the management on their decision making to enhance the competitiveness of the business.

Chapter One proposes a definition of the potential economic incentives for competitors to collaborate with each other: *coopetition*. With a non-parametric approach based on a financial performance measure (return on assets, ROA), it compares between non-coopetition and coopetition statuses. Potential ROA gains from coopetition are decomposed by economic driver. Using the European automobile industry, a sample of over forty-five thousand cases of two-plant potential cooperation is created, in the period from 2000 to 2012. Roughly twelve thousand of these cases presented ROA gains from coopetition, mainly driven by higher productivity gains of coopetition. As well, smaller plants find stronger economic incentives for coopetition, but this effect is only fruitful when they actively engage to coopetition. The chapter offers some policy recommendations on the legal framework of competition issued at the EU level.

Chapter Two proposes a novel methodology to define and measure *organizational downsizing*, which encompasses not only changes in labor but also all the inputs employed by an organizational unit. This definition is used to assess the downsizing effect on productivity changes, which can be directly linked to changes in ROA. Thereby, it directly measures the contribution from downsizing to the financial performance change. A natural extension of that definition is presented for *labor downsizing*, which relates to the commonly adopted definition in the literature, merely dependent on labor changes. The methodology is illustrated using European automobile production plants from 2000 to 2012. Organizational downsizing among automobile plants was found to have no effect on ROA, whereas related effects worsened the financial performance all over the period.

Chapter Three expands upon the previous one, defining *organizational restructuring*: upsizing or downsizing. The chapter is a deeper analysis of the performance outcomes of different restructuring processes in the Automobile industry in Europe. It compares two opposite samples of organizational downsizers and organizational upsizers to understand better their differences. Several hypotheses were introduced, which directly compare the restructuring-related contributions to financial performance in the two groups. Results for the two subsamples in that industry were significantly different: organizational downsizing contributed to worsen financial performance whereas organizational upsizing contributed to improve it. On average, upsizers obtained higher contribution to financial performance from restructuring, technical change and efficiency change (three drivers of productivity change). For downsizers, input prices reductions did not compensate the detrimental productivity losses.

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Introduction

An Integrating Approach

Many management decisions at enhancing competitiveness are essentially rooted in well-known financial performance measures. Stakeholders and markets put pressure on managers to make a move in some direction. Over the last decades, benchmarking analysis has been a raising instrument among practitioners (e.g., consultancy agencies) to analyze the performance of firms and improve decision making. Basically, benchmarking refers to the identification and implementation of best practices aimed at improving performance. Productivity analysis can be used as a direct connection between the benchmarking and financial performance. Though, this connection is lacking more development to provide practitioners sufficient knowledge to guide their decisions.

This dissertation is an effort to understand better the impact of productivity changes on well-adopted measures of financial performance. Thus, we use economic tools and approaches to answer traditional questions in the business management literature. The thesis departs upon some of the contributions that Grifell-Tatjé and Lovell (2015) have made in this vein. They link economics and business literatures in an attempt to find more exact relationships between the evolution of productivity and the financial performance. Ultimately, they assess the exact impact of some productivity components on the financials. That is, they establish direct relationship between the financial performance and the drivers of productivity change. Hence, this thesis uses such an approach, blending together accounting and productivity fields, to contribute to expand the knowledge on some productivity components, which eventually may drive the financial performance. Throughout the dissertation, business and economic concepts complement each other.

The Chapters

The thesis explores further the link between productivity and financial performance, providing management novel decision tools. Whereas literature has up to now studied that link separately, often finding a connection, here were are more interested on the direct impact of productivity changes. The first chapter explores the impact that collaboration has on the financial performance. Following some ideas in Bogetoft and Wang (2005), we explore from an economic perspective potential cases of coopetition, collaboration among competitors. We consider coopetition as the case where two competitors remain independent but collaborate to increase their joint production. Commonly, a merger can either be meant to shrink the inputs or expand the outputs. Also, a merger would blend competitors in a single decision-making entity (i.e., a single Board) and the agreement is not easily reversible. Instead, in collaboration the parties individually keep the control over their input quantities and the common aim is to increase the output. And the agreement can be terminated whenever the economic incentive of the collaboration disappears. That implies that the decision making is bilateral. In the chapter, we isolate the direct impact that coopetition has on the financial performance, via productivity. Consequently, it provides the tools for the management to quantify the potential economic gains of one-time agreement.

The second chapter analyzes which is the effect of organizational downsizing on the financial performance. It provides a new and integrative measure of downsizing, where all inputs in the organization are included. Then, we isolate the effect of organizational downsizing on the financial performance. Traditionally, business literature has massively relied on labor-related definitions and measures of downsizing. That may mislead both results and decisions. We try to overcome that drawback by proposing a novel theoretical definition of downsizing that gathers all inputs in an organizational unit. This definition fulfills an important property that makes it suitable for usage: it takes an index number form that directly measures the contribution of organizational restructuring (e.g., downsizing) to ROA changes.

Finally, the third chapter expands upon Chapter Two and compares the financial performance effect that restructuring had for two opposite samples: organizational downsizers and organizational upsizers. The literature has paid less attention to upsizing and the comparison to downsizing is scarce and inconclusive. Thus, this chapter contributes to understand better the processes of restructuring by directly comparing these two different groups. We do the analysis within the European automobile production industry (at plant-level), which has carried out significant restructuring processes over the last years.

Methodological Notes

The main three chapters of the thesis use non-parametric techniques for the empirical applications. The first chapter on potential coopetition gains makes use of production theory to introduce well-known measures of performance into a financial performance change context. Departing from a return on assets (ROA) duPont decomposition (Johnson, 1975), we build up on index numbers theory to obtain price and quantity index numbers and its impact on the ROA change. It requires the calculation of distance functions using Data Envelopment Analysis (DEA), which was introduced by Charnes, Cooper and Rhodes (1978) and extended by Färe, Grosskopf and Lovell (1985). To further decompose the changes of coopetition gains, we follow some ideas proposed by Bogetoft and Wang (2005), which analyze potential productivity merger gains. We take some of their insights and accommodate it within an economic perspective. We isolate coopetition effect as a driver of productivity change. Namely, the chapter proposes the decomposition of the ROA change into technical efficiency change, a component of passive coopetition and a component measuring the pure coopetition effect.

The second and third chapters introduce a dynamic approach on the decomposition of ROA changes. Whereas in the case of coopetition the ROA change is compared between different production statuses, now it is analyzed between subsequent periods of time. We first introduce a novel measure of downsizing (broadly, restructuring) relying on a cost function approach. Then, the third chapter is a follow-up and deeper study of the automobile production industry in Europe using the definitions proposed in Chapter Two. Starting with the same financial context decomposition, index numbers theory is used to split price and quantity effects. We now introduce cost functions to further decompose it. By using some insights from Grifell-Tatjé and Lovell (2015), we decompose the productivity change into a term that measures the direct impact of the organizational downsizing and a term that gathers other types of related effects. That last term was labeled manufactured productivity change. Our measure of organizational downsizing conforms to a specific way of restructuring, based on theoretical cost-efficient quantities of inputs. In Chapter Two we show this decomposition from a Laspeyres-Paasche approach, while introducing the final equation for the case of Paasche-Laspeyres approach. In Chapter Three, we pose the methodology from a Fisher approach. Additionally, the last element termed manufactured productivity change is decomposed into technical change and a cost efficiency component. These components are directly related to changes in the financial performance, via productivity.

Methodologically, there is an evolution from the first to the other two chapters. When rewriting the expression that measures the return on sales (or return on revenue) the productivity component includes a weight that is not immune to changes in productivity. That happens in Chapter One but we solve this limitation in the last two chapters. The cost approach enables us to isolate these weights, which take the form of a normalized unit profit. That is, in the methodological solution proposed, the measure of productivity change does not use as weights these normalized unit profits. Instead, they play the role of output prices, which are independent on productivity changes and now are part of the price recovery component only.

The Case of the European Automobile Production Industry

This thesis makes use of the European automobile production industry. This industry directly employs more than two million workers in Europe, so that it is a prime actor in the economy. Adding indirect employment, the figure goes over three million. This industry is particularly intense in labor, which makes it more interesting from the productivity point of view. However, it is also true that it is suffering drastic changes in its configuration. All steps in production are strongly being robotized and employees are now in charge of more refined tasks.

The industry that traditionally has evolved upon mass production is now characterized by demand-based cars. This makes the markets more competitive and the adaptability is crucial. In the near future, this sector is surely facing a total change in the paradigm of production. The more and more restrictive regulation on emissions, forces the actors to rethink all the process of building automobiles. Simultaneously, and related to that, new competitors are coming into place, such as companies now focusing on hybrid or electric cars (Tesla, Google, among others). Whereas they yet do not provide good standards in terms of range, performance and cots, its introduction probably means that old strategies to compete will become obsolete and new ways will appear.

The data on this sector was drawn from the Amadeus dataset. It was downloaded between 2011 and 2012. It basically provides accounting information for European based firms. Particularly, the interest was in companies that produce automobiles (NACE code: 2910). Thus, our dataset collects information on automobile production plants which provide individual accounting records. Only production plants in the EU-28 were selected, as they faced similar policy conditions during the period analyzed.

In total, 160 plants are part of the sample, but the data is strongly unbalanced. Initially, a high rate of birth and death of plants is found during the period. Both facts are presumably related to some off-shoring processes that some of the major groups were carrying out to peripheral countries. Moreover, when selecting the observations, special attention was paid to avoid extremely abnormal trends for some of the relevant variables. This made necessary to discard some observations per year. Further insights on the selection of the sample are given per chapter.

The Approach and Potential Concerns

The methodology of the three chapters of this dissertation is built upon an accounting definition of profits. This definition has important advantages as the accounting information it is extracted from is regulated by international standards. During the decade of 2000s all organizations gradually adopted the international financial reporting standards (IFRS) to present their accounting records. These accounting procedures are widely homogeneous. Furthermore, this information is audited to ascertain that it provides the true and fair view of the organization. European regulation usually enforces establishments with more than fifty employees to audit their financial disclosure. In our sample, only production plants with more than a hundred employees were considered. In addition, most of them belong to a parent company which is undoubtedly audited.

The definition of accounting profits includes costs of all inputs that the organization uses (i.e., intermediate materials, labor and capital). Within the accounting data that we use, total costs of the intermediate materials of the plant are provided. However, there is no sufficient information to split prices and quantities of these intermediate materials. Therefore, we use a value added approach, which is calculated as total revenue minus total cost of the intermediate materials. In this approach, we use labor and capital as the two inputs.

An economic definition of profits is an alternative methodology to the accounting profit. That definition relies on economic principles. It includes, together with the total costs above mentioned, other type of implicit costs that the organization bears (i.e., opportunity costs). This definition is usually meant to represent the real value creation of the organization, since it considers all kind of costs. That characteristic makes it more valuable from the shareholders' perspective, as it truly assesses the underlying cash flows of the business and represents the value creation to equity investors. However, it has some limitations. The calculations might be less standardized and the costs are dispersed over time (e.g., opportunity costs are harder to be bounded to a period of time). Additionally, not the economic approach but the accounting one is the most referred to validate management decisions. That justifying our accounting approach, we comment here below some measures that an economic perspective would consider.

For the case of labor, we calculate unitary labor price as total cost of employees, total compensation, divided by the number of employees. More than wages, total compensation includes any other item related to the cost of labor. Namely, costs incurred to attract, motivate and/or retain employees. For instance, a company may be paying labor on its quality or motivating to increase productivity (e.g., efficiency wages or rents, in the economic argot). The data does not allow us to isolate these components and, besides, such an economic conception would not fit into our definition.

As for the capital, we approach the period investment by the change in capital fixed assets between periods. To calculate the stock of capital, the investment is valued in constant prices and added to the depreciated measure of tangible fixed assets that the balance sheet reports. One concern in our approach is that different plants use different depreciation methods. For instance, each plant can estimate a different service life for the infrastructure and decide on whether accelerating or not its depreciation. Different tax systems may provoke higher or lower incentives to accelerate depreciation. In our case, the depreciation schemes are not standardized across countries so that faster or slower rates affect the stock either way. Then, some differences could arise when comparing different plants. Likewise, inflation rates vary substantially over time and affect the magnitude of the depreciation rates. Thus, a comparison exercise should be cautiously done.

The cost of capital includes the depreciation and the interest paid, both detailed in the accounting data. Thus, the unitary price of capital is such cost divided by the stock of capital. The depreciation shares the same aforementioned concerns. The interest paid only considers the cost of the debt, while disregarding the implicit cost of the equity: opportunity cost of capital. Not to mention that the plant could also be financing part of the capital with other items, such as profits or dividends. From an economic viewpoint, not including equity is a relevant shortcoming. For instance, when attracting investment, the company must provide the return on equity, whereby the cost of equity is implicit. In this vein, there are methods to calculate the total cost of the capital. A commonly adopted approach is the weighted average cost of capital (WACC), where the cost of equity is calculated with the capital asset pricing model (CAPM).

The CAPM formula includes a risk-free rate and a parameter, labeled *beta*, which is a measure of volatility. That volatility is based on the organization’s stock price. Our multi-plant setting does not provide that information. It could be approached by using the beta of the matrix the plants belongs to (if the matrix is listed). Though, the risk-free rate seems less clear. Each plant could be assigned the risk-free rate of the country where its matrix is based, only if the plant is financed by the group or it is located in the same country. Whenever the plant is situated in another country, there is not a direct approach to assign that rate. Furthermore, if the plant does not belong to any group or the group is not listed, none of the components is easily addressed. Consequently, calculating the total cost of capital (debt and equity) for this multi-plant sample entails several difficulties. This economic approach is a line of research prone to be developed in the near future.

Another concern about our results in the applied part is how the decision making is done. Within our sample, most of the plants belong to mayor matrixes that eventually direct them on some important actions. For instance, the matrix can directly allocate prices seeking for tax advantages but our information does not foresee it. Indirectly, the matrix could make plants fight for the production of a car model offering advantageous conditions in terms of costs. Thus plant-level decisions are undoubtedly shaped from the group. The decision on restructuring may not come from the plant itself but it is the group who decides, directly or indirectly. Thus, the answer to whether performance levels provoke restructuring or restructuring influences performance levels is more aligned with the former. The group may drive the bad performer to downsizing to compensate its effect in the consolidated performance.

The last aspect to consider, for chapters two and three, is the exclusion of observations (a plant in a period) that report negative profits. In the price recovery component, the ratio in the numerator is calculated using some previously defined weighs. These weights play the role of output prices. Their definition is based on the normalized profits of the plants. Thereby, a negative profit value would make that created output price meaningless. It would still be useful if the profits were negative for two consecutive periods. The difficulty appears when profits go from positive to negative, and vice versa. This drawback in the methodology faces a quite common situation of organizational units obtaining negative results. Therefore, it is pending on future developments that allow it to be corrected.

Main Findings in the Applied Part

The first chapter on potential coopetition finds that competitors can notably increase their ROA when collaborating. The pure contribution to ROA change, via productivity, is important. However, it is also relevant to mention that production plants may achieve individual gains prior to collaboration. That leads to question whether the collaboration could be an opportunity for these plant to reorganize their operations. When we analyze coopetition gains per period, we found that before the crisis the gains are significantly higher than in the crisis time. Per size, smaller plants in our sample were found to have higher initial levels of ROA. When collaborating, these plants do not find economic incentive unless they actively enroll in coopetition.

The second chapter, as an illustration in the automobile industry, finds no ROA gains of organizational downsizing. That is, downsizing did not contribute to improve the financial performance. Simultaneously, our decomposition shows that these plants carrying out organizational downsizing did not develop it adequately. Results suggest that production plants did not profit from other types of side effects when downsizing. All together lead to important productivity declines which eventually worsened their financial performance. The last chapter is a deeper analysis on the restructuring outcomes of automobile production plants. The results reinforce the same conclusion: whereas organizational downsizers did not find contribution to improve their financial performance, organizational upsizers did. Reversely to our hypotheses, results show that organizational upsizers obtained better restructuring effect, better technical change effect and better efficiency change effect than their downsizing counterparts. These three effects together cause organizational upsizers to get higher productivity contributions to improve their ROA. Eventually, whereas organizational upsizers obtained ROA gains, organizational downsizers found it much worse. The only positive contribution to improve the ROA of organizational downsizers was a reduction on the prices of the inputs while restructuring, which goes in line with some previous findings in the literature.

Summing up, added to the academic contribution that we have explained above, it offers solutions to guide management decisions. This makes the dissertation relevant from the practitioner perspective. Last but not least, the first chapter advocates some policy recommendations that are worth revising, especially for the case of the European automobile industry that we analyze.

Academic Divulgation of Thesis

Earlier versions of the main chapters of this dissertation have been presented at different workshops and congresses. The main objective when attending these meetings was to obtain feedback in the development of the chapters. I am grateful for the insights that I received, as well as the experience gained at presenting.

As for Chapter One on coopetition, preliminary versions of the chapter were sent to be presented at:

- XXXI Jornadas de Economía Industrial. Palma (Spain). September, 2016.
- 13th International Conference on DEA. Braunschweig (Germany). August, 2015.
- 2015 International Workshop on Efficiency and Productivity. Alicante (Spain). June, 2015.

Its main spin-off was a book chapter published within the *International Series in Operations Research & Management Science* of Springer. This book chapter is referenced as:

‘Calleja-Blanco, J. and Grifell-Tatjé, E. (2016): “Potential Coopetition and Productivity among European Automobile Plants”. In Advances in Efficiency and Productivity (*pp*. 249-273). Aparicio, J., C.A.K. Lovell and J. Pastor (Ed.). *Springer International Publishing*.’

Earlier versions of the second chapter of the dissertation were also internationally presented at:

- 9th DEMO June Workshop. Barcelona (Spain). June, 2015.
- 14th European Workshop on Efficiency and Productivity Analysis. Helsinki (Finland). June, 2015.

The third chapter, which is a natural and more applied extension of the second one, has been developed recently so that its divulgation is still being done.

Last but not least, several ideas related to the chapters of this dissertation have been presented in early stage seminars at the Business Department of the Autonomous University of Barcelona that the doctorate program belongs to.

Final Remarks

Concluding this introduction, we make a note on the general organization of this dissertation. All figures, exhibits and tables are presented at the end of each chapter. All the references are presented together at the end of the thesis, in a single section after the chapters.

CHAPTER 1

Potential Coopetition and Productivity among European Automobile Plants

Abstract

The chapter proposes a definition of the potential economic incentives for competitors to cooperate with each other, namely *coopetition*. A non-parametric methodological approach based on the rate of return on assets (ROA), a well-known measure of financial performance, enables comparison between non-coopetition and coopetition statuses. The potential ROA gains from competition are decomposed by economic drivers. This methodology was applied to the study at plant level, focusing on cases of potential competition in the European automotive industry. The main results are based on an analysis of a generated sample of over forty-five thousand cases of potential cooperation between plants in the 2000-2012 period. Out of that sample, roughly twelve thousand cases (about 27%) presented potential ROA gains from coopetition. Results show that faster asset turnover and better productivity explain a higher potential ROA from coopetition. Results also reveal that medium–small and small plants have the strongest economic incentive for coopetition. The chapter concludes by offering some policy recommendations concerning the introduction of changes to the legal framework of competition, in the context of the European Union.

Chapter 1

Potential Coopetition and Productivity among European Automobile Plants

1.1. Introduction

– "The auto industry of the future is collaborative and borderless" –

"Automotive 2025: Industry without borders" IBM report

It is no longer enough to play individually in the automobile industry in order to be competitive. Separate efforts aimed at improving performance are paying off less and less. As a result, companies are looking for new ways to supply their customers while staying competitive by responding to new market trends, e.g., customization. The main producers, while being competitors, have identified the opportunities that cooperation offers. Firms look for suitable partners, including rivals, in order to enhance competitiveness. This study is a novel attempt to analyze, from an economic perspective, the potential or *a priori* impact of cooperation among independent automobile production plants in Europe from 2000 to 2012. In other words, we analyze the potential economic prospects as a basis for managerial decisions regarding cooperation.

The literature has devoted attention to the benefits of potential mergers, which are more likely to occur at firm level (e.g., Bogetoft and Wang, 2005; Bagdadioglu, Price and Weyman–Jones, 2007; Kristensen, Bogetoft and Pedersen, 2010; Halkos and Tzeremes, 2013; Zschille, 2015). In contrast, the economic gains that could be potentially achieved when cooperating with a competitor have been under-explored. The chapter contributes in this regard and can be placed within a *coopetition* framework: cooperation amongst competitors, i.e., the situation in which organizations that would normally compete with each other engage in a cooperative strategy to develop joint production. Hence, cooperation and competition, which are frequently studied separately, come together as part of the same strategy.

We need to start clarifying the difference with the case of a merger. Generally, a merger blending two or more units can either be aimed at reducing the level of inputs or increasing the level of outputs. Two competitors that decide to merge become a single decision making unit (e.g., there is only one Board deciding). That contract, once the parties formalize it, can hardly be reverted. Alternatively, when two or more competitors decide to collaborate they remain individual. Thus, all of them keep the control over their own inputs and common purpose is to increase the output. The contract can be terminated when it expires or whenever the initial economic incentives disappears. The decisions of this agreement are bilateral, opposite to a merger.

It is also important to stress the difference between coopetition and collusion. Both strategies need cooperation, reducing overall competitiveness. Coopetition has the potential for collusive behavior and sometimes they are treated equally. However, the difference lies in the effect on the consumer. Whereas collusion generally occurs in the downstream activities, typically agreeing in prices, coopetition refers to upstream ones (Walley, 2007; Rusko, 2011). Under coopetition, firms can still compete in the downstream activities.

From an engineering perspective, there have been some efforts to approach the idea of coopetition. Based on the virtues of 'commonizing' technologies to produce similar products, some authors have analyzed the implications of such a strategy (Muffatto, 1999, Pasche and Sköld, 2012). This step, technically speaking, paves the way towards cooperation with a counterpart in order to take advantage of well-known technologies, equipment and machinery. This cooperation based on common technologies can optimize the cost of coordination between independent plants. A plant might cooperate with some products and not cooperate with others. Of course, competition in the market exists regardless of the decision about coopetition. There is competition in the products that are not the object of coopetition and for end products when coopetition occurs in the production of intermediate goods. It is also possible regarding products that are the direct result of coopetition, which may be commercialized under different channels and brands[1].

Platform sharing has been a natural response from automobile manufacturers to improve performance, making production plants more flexible. General Motors first did this during the inter-war period (Freyssenet and Lung, 2007) and many other actors have followed the same strategy since. Nowadays, almost all producers are trying to

[1] An illustrative example of cooperation and competition outside the automobile industry is shown for Sony and Samsung (Gnyawali and Park, 2011: 655).

reduce the number of platforms[2]. However, platform-sharing among independent plants remains less common in Europe.

There are two possible explanations to consider why the degree of coopetition among European plants is low. The first is purely economic. There must be an economic incentive in order for plants to be willing to engage in a coopetitive strategy. The final economic outcome of cooperation lies beyond the scope of the study (which includes trust, commitment and bargaining agreements), but an analysis of potentiality is offered, for actors to be able to identify their best options. In tandem with the economic reason, there are legal limitations that cause plants not to cooperate more. We discuss these limitations in the conclusion section. This chapter concludes that there are potential economic incentives for coopetition between European automobile plants. Hence, the legislation on competitiveness issued from the European Union (EU) and its member states must partially justify the poor level of coopetition.

This chapter contributes to this area in several aspects. The potential economic benefits that separate agents might obtain when they commit to coopetition are quantified. A new methodology to define the economic incentives for coopetition is presented in Section 3. It contributes to the need expressed in the literature with regard to further exploration of coopetition outcomes (Gnyawali and Park, 2011), as well as partner selection tools (Alves and Meneses, 2015). Furthermore, Bouncken *et al*. (2015) also consider efficiency as one of the potential dimensions of coopetition that urgently needs to be developed. Additionally, Blum (2009) discusses the need for more research into the quantification of the potential economic gains associated with coopetition. Section 3 can be seen as a response to the need for more research, from an economic perspective, and exploits the latest findings by Grifell-Tatjé and Lovell (2015), who have introduced productivity as one of the drivers of return on assets change. It is shown that this approach naturally accommodates Bogetoft and Wang (2005), who have been mainly used in the literature to study potential mergers (Kristensen *et al*., 2010). The methodology developed in Section 3 may be of interest to practitioners. Its application enables the identification of the best potential options for coopetition.

[2] It is important to clarify that a platform is a construction system (a sort of architecture that defines the main design, engineering, etc. of a vehicle). A producer may have different production plants and still use a single type of platform to produce several car models (e.g., ‘Ford plans to trim global vehicle platforms from 15 to 9 by 2016’). Industry experts expect almost half of world production to be manufactured using 20 core platforms in the coming years.

Before that, Section 2 presents the background of the European automobile industry. An introduction to the applied part of the chapter is given in Section 4, where the dataset is discussed. Section 5 presents the main results based on the study of a generated sample of over forty-five thousand cases of potential cooperation. Section 6 provides a set of conclusions, which have implications for industrial policy, the main point being the need to revise the European law on competitiveness in the manufacturing industry. Particular attention might be paid to automobile industry, for which legal framework is especially rigid.

1.2. Background

1.2.1. Previous Research on Coopetition

Although coopetition has become an accepted term in the management literature as a suitable firm strategy, the body of empirical articles studying the phenomenon still lacks a common definition. It sometimes overlaps with the idea of alliance, or the two notions are taken as part of the same action. A broad concept defines coopetition as a business relationship in which firms cooperate between and compete against each other simultaneously (Bengtsson and Kock, 2000). This characterization is still broad in its scope and allows for many different configurations. Thus, empirical studies have made use of many singular boundaries of the concept, while some revisionist literature has pointed out the need for a more refined terminology (Bengtsson and Kock, 2014; Bouncken *et al*., 2015). Cooperation among competitors has been analyzed without framing it under the name of coopetition (Oliver, 2004).

A central aspect associated with successful coopetition, of any kind, is the will among managers for cooperation. The ability of partners to strike a balance between cooperation and competition determines success and also requires a new orientation of management (Peng and Bourne, 2009). Some studies have gone in this direction by proposing guidelines for managers to achieve successful coopetition. Based on a literature review, Chin, Chan and Lam (2008) rank commitment, relationship development and communication as the key factors in order for a partnership to work.

Bengtsson and Kock (2000) dissect the definition of coopetition according to the proximity of the end client. Cooperation is generally far from the end client and competition occurs at a closer stage to the same, so that each part might be managed differently. Strategies are, in that order, related to value creation and value capturing, and may be of different relative importance in the agreement (Luo, 2007). Also, a greater number of similarities between products and technologies cause greater cooperation. Many firms cooperate at the initial stages of the product, preserving the competitive advantage for the final customization or sale. Wolff (2009), borrowing the term from a manager in the car industry, defines this situation as a *pre-competitive stage*, meaning cooperation in the generation of somewhat similar outcomes.

In the context of this pre-competitive state, many studies have focused on the benefits for innovativeness when engaging in coopetition, i.e., the initial stages of product development. Empirical results have proved the positive impact of coopetition on innovation (Li, Liu and Liu, 2011; Bouncken and Fredrich, 2012; Ritala and Sainio, 2014), knowledge creation (Zhang *et al*. 2010) and co-creation or technology development (Wilhelm and Kohlbacher, 2011, in the Toyota network). In general, this stream has found some type of value creation based on innovation (Ritala and Hurmelinna-Laukkanen, 2009).

While innovation development may imply some sort of mutual investments, cooperating solely in production would only need a certain type of input complementarities (Biesebroeck, 2007). In other words, what is needed is the correct reallocation of existing complementary resources. In fact, this is horizontal cooperation based on redundant capabilities. These capabilities and competitive market forces are the main factors dragging firms to cooperate (Madhok, 1996). Hence, coopetition in production must be based on the sharing of resources and technology up to a pre-competitive state. To our knowledge, the literature has paid little attention to this kind of coopetition. One exception is Ehrenmann and Reiss (2011), who advocate manufacturing firms to build up coopetition, in order to achieve their full performance potential. Here, excess capacity and mass customization are particularly important for the case of the automobile industry. This kind of coopetition, which is mainly based on the reallocation of existing complementary resources, should deliver higher productivity and output quantities. This is the main object of study in Section 3 of this chapter.

The next section depicts some examples of coopetition, from a somewhat broad perspective, that have appeared in the automobile industry, especially in Europe. These examples are mainly on a firm level given the scarce literature on the plant level, which is our unit of analysis.

1.2.2. Coopetition in the Automobile Industry

Car platforms have become a common practice in the automotive industry since General Motors initiated the concept. Automakers use platform sharing to combine lower-volume customized production with higher-volume standardized production. Thus, by sharing common technologies among different products, they are able to develop an additional number of models. It was initially designed for building cars of the same brand, or for cars belonging to the same matrix. Nowadays, competing groups are also integrating this tactic to share production with each other. It is an alternative to the wave of mergers that appeared a few decades ago. What is clear from the observance of this tendency is that remaining independent in the modern-day car industry is not only difficult but also inefficient.

An early case of this type of cooperation was the Portuguese Autoeuropa plant, settled as a 50/50 joint-venture between Volkswagen and Ford. Set up in 1991, this was an important player in the European production for both matrixes. For years, the cooperation paid off for both participants, but this sort of agreement is flexible enough to allow for exit when the initial interests disappear. Accordingly, Ford left the venture in 1999, and the German group now fully owns and manages the plant.

More recently, Volkswagen developed a car platform together with Ford's European subsidiary, which has mainly been used by the former to produce several of its cars. Daimler has also used Volkswagen-based technologies to produce some of its models, which they both commercialize in different markets. Daimler and Renault, Toyota and General Motors, Peugeot-Citroën and BMW, or General Motors and Peugeot-Citroën are other examples of established or potential (currently at the initial agreement stage) collaborations in the industry. Nevertheless, it is also true that some have ended wrongly, such as General Motors and Fiat not achieving successful results, or Renault and BMW withdrawing at the initial agreement stage.

By mid-2015, Toyota and Mazda had announced an agreement to create a partnership aimed at sharing the production of future car models. In their words, this partnership would "go beyond the traditional framework of cooperation, aiming instead to create a whole new set of values for cars through wide-ranging medium to long term collaboration". However, the pact still does not affect their individuality, as they keep being competitors in the markets. This shows that the configuration of the automotive industry is causing major change with the aim of more efficient competition.

Lately, in the new adoption of electric and hybrid car models, new industries may start to be considered competitors for traditional automakers. For instance, Tesla Motors, a well-known brand that manufactures electric cars has consolidated cooperation with Daimler (within the Mercedes-Benz brand) and Toyota. The expansion of what a competitor means would also reshape the scope of analysis for a coopetition strategy.

Not to mention that some initial cooperation plans ended in the absorption of one of the partners by the other, or in partial control. Nissan and Renault cooperated until the French carmaker bought almost half of Nissan. The Japanese group is still an autonomous player within the Nissan-Renault Alliance (Segrestin, 2005, reviews this partnership). While still independent, they develop some cross investment in line with the interests of the other. They declare economies of scale to be the underlying reason for carrying out such an alliance. Nowadays, this agreement represents about one tenth of worldwide car sales. In 2010, they also joined forces with Daimler in order to enhance these sharing practices.

Hence, on the basis of this developing phenomenon, we not only need to research the outcomes but also the potentials. Managers and policymakers can be assisted by better analysis of coopetition potentials. This is the purpose of the following Section, where an economic approach to this subject is developed.

1.3. Methodology

1.3.1. Potential Coopetition

We introduce some notation and an analytical framework within which to study potential coopetition among plants in the automobile industry composed by I plants, indexed $q = 1, \dots, I$. The output quantity and price vectors of a plant are given by $y = (y_1, \dots, y_{\mathrm{M}}) \in R_{+}^{\mathrm{M}}$ and $p = (p_1, \dots, p_{\mathrm{M}}) \in R_{++}^{M}$, and its input quantity and price vectors by $x = (x_1, \dots, x_N) \in R_{+}^{N}$ and $w = (w_1, \dots, w_{\mathrm{N}}) \in R_{++}^{N}$. Total assets of a plant are expressed by $A \in R_{++}$, which can differ from the input capital depending on its accounting definition. The profit is given by $\pi = R - C = p^T y - w^T x$, where "T" represents the transpose of the vector and, additionally, $w^T x = c^T y$, where $c = (c_1, \dots, c_M) \in R_+^M$ defines the vector of unitary costs. The return on assets (ROA) of a plant is expressed by the ratio of profit to assets, π/A. The set of technologically feasible combinations of output vectors and input vectors is defined by the mathematical programming model known as Data Envelopment Analysis (DEA) introduced by Banker, Charnes and Cooper (1984)

$$T = \left\{(x, y): y \leq \sum_{q=1}^{I} \lambda_q y_q,\ x \geq \sum_{q=1}^{I} \lambda_q x_q,\ \sum_{q=1}^{I} \lambda_q = 1, \lambda > 0.\right\} \tag{1.1}$$

The representation of the technology in terms of its output set is $P(x) = \{y: (y, x) \in T\}$, which is bounded above by the output isoquant. Shephard (1970) introduced the output distance function, which provides a radial measure of the distance from an output vector to the output isoquant. This is defined as $D_o(x, y) = min\{\mu: y/\mu \in P(x)\} \leq 1$. The output distance function is interpreted as a measure of the technical efficiency of a plant. There is efficiency when $D_o(x, y) = 1$. Otherwise, the plant is considered technically inefficient and its degree increases with lower values departing from one.

For simplicity, the exposition that follows is based on the potential coopetition between plants h and l. The methodology can easily be extended to a situation of coopetition between multiple plants.

Coopetition, in contrast with a merger, maintains the independence of the two plants introducing flexibility to the cooperation. A plant can easily switch the cooperation from one plant to another to seek the highest possible return on its investment. This is the economic incentive for coopetition, a behavior that is only possible if the plant maintains control of its own investment as well as the rest of its inputs. Hence, the aggregate assets and the aggregate inputs associated with coopetition between plants h and l are simply the sum of their quantities $(A_h + A_l,\ x_h + x_l)$. We consider this to be feasible when: $(x_h + x_l,\ y_h + y_l) \in T$, being $y_h + y_l$ the aggregation of the output quantities of the two plants. The potential joint product as a result of coopetition is given by y_{h+l}, where $y_{h+l} = (y_h + y_l)/D_o(x_h + x_l,\ y_h + y_l)$. Therefore, the potential joint product is the maximum possible given $x_h + x_l$ or the efficient one associated with the aggregate input quantities. The two firms translate the gains of efficiency from coopetition to a higher amount of output[3]. Thus, all possible complementarities from coopetition are captured when moving from independent to cooperative operations. The potential joint profit is $\pi_{h+l} = p_{h+l}^T y_{h+l} - w_h^{h+lT} x_h - w_l^{h+lT} x_l$ and $R_{h+l} = p_{h+l}^T y_{h+l}$ defines the potential joint revenue, where p_{h+l} is the new vector of prices associated with the potential joint product y_{h+l} and $w_k^{h+l}, k = h, l$ are the prices associated with each plant's quantity of inputs. A variation in the prices of inputs is not expected because the pressure of the plant on suppliers has not changed. The potential return on assets is defined as $ROA_{h+l} = \pi_{h+l}/(A_h + A_l)$.

The present study of potential coopetition between European automobile plants is based on the returns on assets, which is a well-known measure of financial performance[4]. This measure has the virtue of being independent from plant size. This property, which is not shared by other measures of financial performance, such as profit, revenue and cost, makes ROA particularly suitable for the study of potential coopetition between plants, which may be of disparate sizes[5]. We define a situation of potential coopetition as

DEFINITION 1.1

There is a potential economic incentive for coopetition between plants h and l, when $ROA_{h+l} > ROA_k, k = h, l$ and $ROA_{h+l} \geq 0$.

The described situation is only possible when: $\pi_{h+l} > \pi_h + \pi_l$ and $\pi_{h+l} \geq 0$, the potential nonnegative joint profit is higher than the aggregation of profits from the individual plants. It is also interesting to note that potential coopetition implies that each participant receive a positive (but not necessarily equal) share of the gain, i.e., share of the potential joint revenue (R_{h+l}). In fact, if $\alpha_k, k = h, l$ defines the share of the potential joint revenue that plant k earns (where $\sum_k \alpha_k = 1$), the potential coopetition involves: $\frac{\pi_{\alpha_k}^{h+l}}{A_k} > \frac{\pi_k}{A_k}, k = l, h$ where $\pi_{\alpha_k}^{h+l} = \alpha_k(p_{h+l}^T y_{h+l}) - w_k^{h+lT} x_k,\ k = l, h$. In other

[3] The previous definition of potential joint product from coopetition scales each output with $D_O(x_h+x_l, y_h+y_l)$. As we have seen, coopetition may only affect some of the products. In this case, outputs should not be treated symmetrically and scale only some of them. The ones object of coopetition.

[4] See Chapter 8 of Grifell-Tatjé and Lovell (2015) for a comprehensive introduction to this measure of financial performance.

[5] Lozano (2013) takes a DEA-cost approach and seeks to minimize the cost of the planned joint-venture facility.

words, the possibility of a sole player being able to appropriate all of the gains from coopetition is dismissed.

1.3.2. Decomposing ROA Change from Potential Coopetition

It is relevant to study the drivers of this potentially superior return on assets as a result of coopetition. We take a well-established approach in the business literature known as the duPont triangle (Johnson, 1975), whereby the rate of return on assets is expressed as the product of two components, the profit margin and the assets rotation i.e., $ROA = \pi/R \times R/A$. The distinction between a situation of potential coopetition and non-coopetition can be expressed as

$$\frac{ROA_{h+l}}{ROA_k} = \frac{\pi_{h+l}/R_{h+l}}{\pi_k/R_k} \times \frac{R_{h+l}/(A_h + A_l)}{R_k/A_k}, \quad k = h, l. \tag{1.2}$$

The existence of potential coopetition has its origin in a better profit margin (higher profit by unit of revenue) and/or faster asset turnover. The first term on the right side of expression (1.2) takes a higher, equal or lower value than one in which the potential profit margin from coopetition is higher, equal to or lower than a situation of non-coopetition. There are two possible explanations: i) divergence in prices and; ii) different output – input relationship. Higher revenue per unit of assets is the effect that explains a faster asset turnover in the second term on the right side of (1.2). We pay attention to the profit margin component of the duPont triangle. We have

$$\frac{\pi_{h+l}/R_{h+l}}{\pi_k/R_k} = \frac{\pi_k^{h+l}/R_k^{h+l}}{\pi_k/R_k} \times \frac{\pi_{h+l}/R_{h+l}}{\pi_k^{h+l}/R_k^{h+l}}, \quad k = h, l, \tag{1.3}$$

where $R_k^{h+l} = p_k^T y_{h+l}$ expresses potential joint revenue and $\pi_k^{h+l} = p_k^T y_{h+l} - w_k^T x_h - w_k^T x_l$ potential joint profit with the prices of plant $k = h, l$. The two terms on the right side of expression (1.3) have a clear interpretation (Grifell-Tatjé and Lovell 2015, p. 350-51). The first is a productivity effect and measures the potential contribution to the profit margin of changes in the level of productivity from a situation of non-coopetition to one of coopetition. The second is a price recovery effect and quantifies the potential impact of price variation on margin. Both expressions can take higher, equal or lower values than one showing productivity (price recovery) improvement, stagnation or decline. Additionally, Grifell-Tatjé and Lovell (2015) have shown how the productivity effect component in (1.3) can be decomposed; which is the approach that we take.

The potential joint profit with the prices of plant k can be re-expressed as $\pi_k^{h+l} = (p_k - c_k^{h+l})^T y_{h+l}$, where $c_k^{h+lT} y_{h+l} = w_k^T (x_h + x_l)$, $k = h, l$. It allows writing the potential profit margin from a situation of coopetition as

$$\frac{\pi_k^{h+l}}{R_k^{h+l}} = \left[\frac{p_k - c_k^{h+l}}{R_k^{h+l}}\right]^T y_{h+l}, \quad k = h, l$$

$$= \rho_k^{h+lT} y_{h+l}, \quad k = h, l, \tag{1.4}$$

and, in a similar way, the profit margin associated with the situation of non-coopetition can be expressed as $\pi_k / R_k = \rho_k^T y_k$ where $\rho_k = (p_{k1} - c_{k1}, \dots, p_{kM} - c_{kM}) / R_k$, $k = h, l$ defines a unitary margin expressed in prices of k. The productivity component on the right side of expression (1.3) can be rewritten using the previous results as

$$\frac{\pi_k^{h+l} / R_k^{h+l}}{\pi_k / R_k} = \frac{\rho_k^{h+lT} y_{h+l}}{\rho_k^T y_k}, \qquad k = h, l, \tag{1.5}$$

and the direct application on (1.5) of the definition of potential joint production from coopetition: $y_{h+l} = (y_h + y_l) / D_o(x_h + x_l, y_h + y_l)$ enables us to re-express (1.5) as

$$\frac{\pi_k^{h+l} / R_k^{h+l}}{\pi_k / R_k} = \frac{\rho_k^{h+lT} (y_h + y_l)}{\rho_k^T y_k} \times \frac{1}{D_O(x_h + x_l, y_h + y_l)}, \qquad k = h, l \tag{1.6}$$

Figure 1.1 depicts the decomposition of this expression (1.6). It represents the set of technologically feasible combinations of output and input quantities for the case of M=N=1. It also shows the output and input quantities of plants h and l, which are located on the interior of the DEA technology. Hence, *Figure 1.1* illustrates a general situation where an automobile plant can be inefficient, i.e., it is not on the frontier of the technology. It also depicts the aggregation of input and output quantities of the two plants: $x_h + x_l,\ y_h + y_l$, as well as the potential joint product from coopetition (y_{h+l}), which is located on the production frontier. The first term on the right side of expression (1.6) quantifies, in terms of potential profit margin change, the movement from (x_k, y_k) to $(x_h + x_l,\ y_h + y_l)$ in *Figure 1.1*. This can be considered the starting point, and is the result of a passive coopetition. It can take a value higher, equal or lower than one. The second term collects, in fact, the potential fruits from coopetition and measures, in terms of profit margin change, the movement from $(x_h + x_l,\ y_h + y_l)$ to $(x_h + x_l,\ y_{h+l})$ in *Figure 1.1*.

INSERT FIGURE 1.1 ABOUT HERE

The decomposition of profit margin change in expression (1.6) can be linked with the previous work by Bogetoft and Wang (2005), who coined the second term on the right side of expression (1.6) *potential overall gains*. They consider it to comprise a portion of gain that could be achieved individually, before any sort of interaction between the units. That is to say, plants, prior to coopetition, could improve their operations in a way that enables them to achieve the best practices in the technology. They could reach their benchmarks before any sort of achievement from coopetition, i.e., $y_k^* = y_k / D_O(x_k, y_k),\ k = h, l$. In terms of *Figure 1.1*, this involves the movement from (x_k, y_k) to $(x_k, y_k^*),\ k = h, l$. From this point of view, the term that Bogetoft and Wang (2005) called "potential overall gains" should first be adjusted in order to correctly evaluate the potential contribution of coopetition. The main idea is to evaluate only the improvements that cannot be reached individually as potential gains from coopetition, which implies the decomposition of the second term on the right side of expression (1.6) as follows:

$$\frac{\pi_k^{h+l}/R_k^{h+l}}{\pi_k/R_k} = \frac{\rho_k^{h+lT}(y_h + y_l)}{\rho_k^T y_k} \times \frac{D_O(x_h + x_l, y_h^* + y_l^*)}{D_O(x_h + x_l, y_h + y_l)} \times \frac{1}{D_O(x_h + x_l, y_h^* + y_l^*)}, \qquad k = h, l, \tag{1.7}$$

where $y_{h+l} = (y_h^* + y_l^*)/D_O(x_h + x_l, y_h^* + y_l^*)$ and the second term on the right side of expression (1.7) quantifies the part of potential overall gains that can be reached individually, i.e., without any kind of coopetition. This is reflected in *Figure 1.1* by the movement from $(y_h + y_l)$ to $(y_h^* + y_l^*)$. At this point, the third term measures the contribution of all the potential achievements that are merely due to coopetition, as individual improvements prior to interaction are removed. This situation corresponds with the movement from $(y_h^* + y_l^*)$ to (y_{h+l}) in *Figure 1.1*. This expression can be coined as *pure* coopetition effect. Note that this third term can take a value higher, equal to or lower than one. If the third term takes a value lower than one, it means that $(y_h^* + y_l^*) \quad P(x)$, the same as $D_O(x_h + x_l, y_h^* + y_l^*) > 1$. There are no gains associated with coopetition because plants can potentially reach a better level of profit margin alone, with self-adjustments. We refer to this movement as the technical efficiency effect.

As a brief summary, expression (1.7) proposes a decomposition of productivity difference based on three components, which is completed by the price effect in expression (1.3) and the asset turnover in expression (1.2). The product of these five effects gives a complete explanation of potential ROA gains between a situation of coopetition and non-coopetition.

1.4. The Data

It is worth noting that the purpose of this chapter is to study, from an economic perspective, the potential cooperation among independent automobile production plants from 2000 to 2012 inclusive. The automobile sector is one of the main contributors to the economy in the EU, as well as worldwide, and one of the largest providers of employment. Eurostat and the "Association des Constructeurs Européens d'Automobiles" (ACEA) reported that 2.2 million people were directly employed in the EU automobile sector in 2012. This figure rises to more than 3 million people when indirect employment is included. Since important policy measures were undertaken at the EU-level during the 2000–2012 period, the sample is limited to plants that are part of the EU-28. For this group of European countries, the regulatory environment is considered to be more similar and standardized. Not all countries were permanent EU-28 members since the year 2000. However, all of them had been official candidates since at least 1997. Croatia[6] is the only exception, whose candidacy was made official in 2004 and which became a member in 2013.

This study works with plant-level data and the sample is drawn from the European Automobile Manufacturing industry. The main source of information is the Amadeus database, which collects multidimensional accounting information from European automobile manufacturing companies. Specifically, the sample was extracted from the NACE[7] code 2910 titled "*manufacture of motor vehicles*" of the Amadeus database[8]. The long period of this study, 2000-2012, was characterized by major changes in the economic environment, which undoubtedly had some impact on the industry under analysis. The sample contains both private and public production plants although the latter are a small minority.

The Amadeus database provides financial information on individual production plants, our unit of analysis. Plants generate and provide their own accounting records, i.e., balance shit and income statement. In order to study relevant observations, plants whose average number of employees during the period was lower than one hundred were ignored. Furthermore, plants whose data was unreasonable or inconstant during the period of analysis were also dropped[9]. The transition from local general accepted accounting principles (GAAP) to international financial reporting standards (IFRS) was a matter of special attention in producing the dataset. This transition was slightly progressive from 2005 onwards.

The final dataset consists of 160 production plants belonging to 18 European countries and some of these production plants belong to the most important automobile production groups. The dataset takes an unbalanced panel-data configuration. There are plants without available information for one or more years. But also, aside availability and screening mentioned above, a high birth and death rate during the period helps to

[6] Only one plant in the sample is located in Croatia.

[7] “Statistical Classification of Economic Activities in the European Community”, subject to legislation at the EU level, which imposes the use of the classification uniformly across all Member States.

[8] Data download/collection took place twice between 2011 and 2013. Thus, the criteria for unit selection was their main activity (NACE: 2910) available at the time of download.

[9] Some plants were removed from the sample because abnormal trends for some relevant variables were found, e.g., number of employees, amount of assets, compensation per employee, price of capital, among others.

explain the unbalanced panel-data configuration. Offshoring processes carried out in the last decade surely explain a large part of the high birth and death rates observed[10].

The amount of profits in a period of time is given by the accountancy records of the plant. These also account for the investment in assets. In accounting argot, these profits are referred to as "*earnings before taxes*" (EBT). This applied part follows a value added approach because information about the quantity of the intermediate materials is not available or insufficient. What is detailed in the accountancy records is the total cost of the period associated with intermediate materials. Hence, value added is defined by the total revenues minus the total cost of these intermediate materials. In this value added approach, two inputs are considered: labor and capital. This implies that revenues (R) are equal to the value added in the application. We describe and name the relevant variables for inputs (labor and capital) and output (value added) as follows:

i) *Labor quantity* (x_l). The quantity of labor is defined as the average number of employees of the plant during the year. This is computed as the average of the total reported number of employees at the beginning of the accounting period and at the end.

ii) *Labor price* (w_l). This is defined by the ratio between the total labor compensation of the plant and labor quantity. Consequently, the product of labor quantity and its price is equal to the total labor cost for the plant during the period.

iii) *Capital quantity* (x_k). The starting point is the value of the net tangible fixed assets in the plant's accounting records in the year 2000 (x_k^{2000}). To construct the capital stock of the following year (2001), the annual assets depreciation of the year is first subtracted from the capital stock existing at the beginning of the period. This can be expressed as: $x_k^{2000}(1-\delta^{2001})$, where δ^{2001} expresses the depreciation rate for the period. Second, the investment made by the company during the year 2001 (I^{2001}) is identified. Third, this investment is valued at constant 2000 prices by applying the consumer price index of that plant's country as a deflator, i.e., $I^{2001}/(1+d_{2000}^{2001})$ where d_{2000}^{2001} represents the consumer price index of period 2001. Fourth, the stock of capital of period for 2001 is defined by the sum of this deflated investment plus the previously calculated adjusted assets of 2000 $(x_k^{2000}(1-\delta^{2001})+I^{2001}/(1+d_{2000}^{2001}))$. The capital stock for the following year 2002 is calculated in exactly the same way and so on for the remaining

[10] The traditional definition of offshoring includes both the practice of a unit hiring external functions from a third party – outsourcing – and the case of moving to a different location, which explains both the birth and death of plants in the sample.

years. In summary, the capital stock for the year t+1 is calculated as $x_k^{t+1} = (x_k^t(1 - \delta^{t+1}) + I^{t+1}/(1 + d_{2000}^{t+1})), t = 2000, \dots 2011$, where d_{2000}^{t+1} is the cumulative deflator from 2000 to year t+1.

iv) *Capital price* (w_k). This is calculated as the ratio between total capital costs of the plant (interest paid plus depreciation) and the capital stock for the period. Therefore, the product of capital quantity and its price is equal to the plant's total capital costs for the period.

v) *Product quantity* (y). This is expressed as the plant's constant value added. Its value added for the period is deflated by a cumulative manufacturing producer price index for the domestic market (base 2000) where the plant is located. This is expressed at constant 2000 prices.

vi) *Output price* (p) is defined by the ratio between the value added for the period and the product quantity (y). Thus, the output price is the cumulative manufacturing producer price index for the domestic market (base 2000) of the country where the plant is located.

vii) *Total Assets* (A). The amount of total assets is taken from the plant's accountancy statements.

INSERT TABLE 1.1 ABOUT HERE

Table 1.1 shows the mean values per each variable for the 160 plants in the final dataset. Moreover, it presents two different periods in order to observe changes or some sort of trend in the sample configuration. The start of the global financial crisis (2007–2008) is taken to segment the data into two subsamples: 2000–2007 and 2008–2012. An average plant size of nearly two thousand employees is found. However, the situation changes notably per period: there is a reduction of almost three hundred workers, on average, between the first and second periods. More in depth analysis has shown that the average decline rate per year was over 2.71%, with a more intense drop in the first half. Both capital quantity and product quantity present a somewhat similar pattern. The trend of reduction overlaps with what has been expressed regarding labor quantity, and the decline rates are rather similar for the period (somewhat stronger for product quantity). Total assets, however, present slight growth. Aside from this latter point, it can be argued that there was a tendency to downsize in this industry between 2000 and 2012. As for prices, labor price increased slightly. This may reveal a convergent trend in Europe, as this increase may be motivated by a faster rise in wages in some peripheral countries. Capital price increased slowly with an inverted U-shape throughout the whole period. Profits also decreased, collapsing to half by the second period. It is worth saying that this is mainly due to a global loss in year 2009, when average profit was negative. From 2010 on, plants seem to make an effort to control and adjust their costs, despite the ongoing declines in the markets. Regarding product price, as a deflator is being used, this only shows the accumulated value of the producer price index as stated above.

Finally, return on assets present an average value of 3.7% in our sample, which mimics the typically stated for this industry, between 3 and 5%. However, it is also true that the mean values conceal an inverted U-shape of this magnitude with a clear drop in the period of crisis and only a shy recovery in recent years. In *Table 1.1* also shows median ROA values. Some upcoming tables being shown in median values, we present it here for better understanding. Median values for ROA are somewhat different from mean results. However, they depict a very similar trend, especially in the crisis period.

1.5. Results

1.5.1. Two–Plants Interactions

In this section, potential coopetition between European automobile production plants is evaluated. Our data sample allows for the construction of 45,332 valid interactions throughout the 13-year period[11], during which 160 plants participated in at least one interaction. However, the observations for the analysis were selected in accordance with a set of criteria. The first criterion involved using only those combinations laying inside the technology in the original projection ($y_h+y_l \in P(x)$). Second, according to the definition of potential economic incentive for plants to take part in coopetition, cases were only considered if the coopetition offered an improvement on ROA for both of the plants involved ($\text{ROA}_{h+l} > \text{ROA}_k$, $k = h,l$). That is, coopetition offered an economic improvement to both actors. Third, and as made implicit in the meaning of coopetition, observations were eliminated when the

[11] In the application, as some of the variables were built as mean values between the beginning and the end of the period, the study eventually worked with 12 periods instead of 13.

cooperating plants belonged to the same producer or group, as the study only focused on competing plants.

So, the corpus was narrowed down to 34,080 cases of potential coopetition. All of these offered potential economic gains from a coopetition strategy. It should be noted that, out of the total number of potential cases of coopetition, there were 15,195 cooperations (more than 44% out of 34,080), in which at least one of the plants became viable: it started with a negative ROA and the potential ROA_{h+l} was potentially positive.

However, yet another criterion needed to be met, which is related to the adjustment that plants could make individually, before any interaction. Following expression (1.7) in the methodological section, additional cases were removed when all possible gains could be achieved by individual efforts and the effect of pure cooperation did not contribute, i.e., $(y_h^* + y_l^*) \notin P(x)$. This last step led to a final sample of 12,241 cases[12] of potential coopetition (roughly, more than a fourth of the total initial possible interactions). The analysis that follows is based on these cases.

1.5.2. Exploring Potential Coopetition

In order to gain insight into the configuration of these interactions, the initial financial performance of the plants was first analyzed. Production plants before cooperating could perform with a positive or a negative ROA. So, there were three possibilities of coopetition: cases where both plants had a positive ROA before cooperating, cases where both plants had a negative one and cases where one of them had a positive one whereas the other was negative. *Table 1.2* shows the results for these three possibilities. In *Table 1.2,* the 2000–2012 period has been divided into two sub-periods: 2000–2007 and 2008–2012, which correspond to before and during the economic crisis, respectively. The results are also shown for these two periods of time, including both the percentage and the number of cases. Percentages are shown per row.

INSERT TABLE 1.2 ABOUT HERE

[12] These 14,933 cases are almost equally distributed between two possible periods of time: before and during the economic crisis. This is, from 2000 to 2007 there are 7,736 possible cases of coopetition and from 2008 to 2012 there are 7,197 (51.8% and 48.2%, respectively)

As can be observed, there is a tendency of change between the two periods. In both periods, cooperations between both plants presenting an initially positive ROA dominate (63% and almost 50%, respectively per period). Potential cases in which plants could enter with a different status are also relevant: almost one third in the first period and roughly 42% in the second half.

This change is a consequence of the economic environment in the second half. Cases of potential coopetition in which both plants start with negative ROA represent a minor portion, but it is also true that it more than doubles in the second half, approaching to a tenth of the cases. As previously pointed out, following the definition in the methodological section, the final outcome of the potential coopetition must be a non-negative ROA.

INSERT TABLE 1.3 ABOUT HERE

Another area of interest focuses on the size of plants involved in coopetition, as shown in *Table 1.3*. Percentage values are calculated out of the total 12,241 potential coopetition cases, so that the sum of percentages in the table corresponding to the ten possible combinations of size amounts to 100%. The classification of sizes was carried out in accordance with quartile values of the number of employees per year[13]. *Table 1.3* shows that potential coopetition occurs more between different-sized plants. By adding up the diagonal in the table, where cooperating plants are categorized with the same size, the number is less than a quarter of the total number of cases. If the last two columns are observed, it can be seen how the percentages amount up to more than 90%, showing that a large proportion of the potential cooperations corresponds to small and medium–small plants. More interestingly, this fraction is already 70% if only the last column referring to small plants is considered. In a later table, these results will be considered in light of the study.

[13] Number of employees ranges from 100 to 14,890. Quartiles for size distribution, calculated per year, vary slightly from year to year. Thus, mean intervals for the distribution are (100; 245), (245; 627), (627; 2,844) and over 2,844 for ‘small’, ‘medium-small’, ‘medium-big’ and ‘big’, respectively.

1.5.3. ROA Gains and Drivers

In this section, potential change in ROA is analyzed as well as the main drivers of this change. *Table 1.4* shows both the median value for ROA gains and its decomposition. It presents median values, instead of mean ones, due to the frequent generation of extreme results. These are motivated by the fact that some plants have a very low starting ROA, so that a moderate potential ROA would produce an extreme ROA change. In this situation the median is more informative. Recall that equations (1.2), (1.3) and (1.7) do not hold in the *Tables 1.4* and *1.5* because of this median approach. Columns three and four in *Table 1.4* show a ROA decomposition based on equation (1.2), in which a faster asset turnover or/and a better profit margin explains a higher ROA from coopetition. Computed as (ROA_{h+l} / ROA_k) in equation (1.2), the ROA would potentially improve nearly five times and profit margin and assets turnover seem to contribute in equal rather terms. However, there is some difference when analyzing per period. A considerable reduction in the potential ROA gains of one and a half points can be observed. This drop has its origin in a reduction in the profit margin that is not compensated by the assets turnover for the 2008/12 period. A deeper look at the results show a quite constant assets turnover change all over the years, whereas the profit margin change is less stable and present lower values in the second half. Again, the results are clueing that the plant's results have been affected by the so-called economic crisis in Europe and profit margins have fallen, even when they are described in potential terms.

INSERT TABLE 1.4 ABOUT HERE

Columns five and six in *Table 1.4* are based on equation (1.3), showing whether changes in the profit margin originate from changes in prices or productivity. The result in column five indicates that prices are practically neutral, it thus being the productivity effect that actually drives the change. Therefore, all the potential profit margin changes moving from individual to joint production come from productivity gains. Hence, it can be argued that the potential reduction in profit margin change between periods is caused by lower potential productivity gains.

The productivity effect is further decomposed into three other drivers expressed in equation (1.7). Columns seven to nine in *Table 1.4* show these results. The main finding to be highlighted is that the productivity effect, and therefore the profit margin change, is highly determined by the so-called technical efficiency effect. This is, higher profits per unit of revenue are likely to be achievable with individual efforts, if plants are able to imitate better practices in the industry. This effect was expected, and remarkable values of technical inefficiency for some of the plants in the original sample were found. Consequently, such a result is yet not surprising as some literature has already found the automobile industry to be traditionally shaped by some 'mediocre survivors' (Holweg and Oliver, 2016).

Passive coopetition shows a non-trivial contribution to ROA gains. Column nine depicts the effect on productivity of pure coopetition, in terms of profit margin changes. It shows a relevant positive impact too, vaguely superior in the second half. Being less important than the technical efficiency change, the natural question that arises is whether plants can achieve an impressive improvement in the level of efficiency (column eight) by themselves without coopetition. If this is not the case, the technical efficiency change must fairly be considered one of the outcomes of coopetition. They need a cooperation agreement as an incentive for their own reorganization although coopetition produces a reduced additional joint product. In this case, the technical efficiency change might be considered together with the passive coopetition effect.

The idea signaled in *Table 1.3* is further developed in *Table 1.5*. Following the same definition of size as before, ROA gains, as well as their drivers, are shown for different categories of plant size.

INSERT TABLE 1.5 ABOUT HERE

The table offers a result that we may analyze in two steps. Initially, we see that the smaller the plant the lower the potential ROA gains. While bigger plants would potentially increase their ROA 5.4 times, smaller ones would increase it 4.5 times. For bigger plants, ROA gains are accelerated by higher profit margin changes whereas smaller ones achieve potentially faster assets rotation. In all cases, this is fully driven by productivity gains and, as in the general case, the main source is the technical efficiency change. As for passive coopetition, we find it to offer rather divergent results. Biggest group of plants get the most from this stage, but smallest ones find an unfavorable result, as a value lower than one would potentially cause ROA losses. This is justified by the fact that bigger plants present lower values of starting ROA than smaller plants. However, if we have a look at pure coopetition effect, we conversely find that the smaller the plant the higher the effect on ROA gains. Both results together tell us that smaller plants must play an active role in coopetition to eventually obtain some gains. A passive interaction is for them detrimental.

Another peculiarity is found concerning periods. All categories worsen from 2008 onwards. However, the smaller the plant is, the higher the reduction in the potential ROA gains in the second half. For the smaller ones, this due to lower productivity gains, which makes the profit margin changes lower as well. The pure coopetition effect remains quite stable between the periods, keeping the same raking as in the general case[14].

1.6. Conclussion

There is little literature covering the concept of coopetition, or cooperation among competitors, from an economic perspective. This chapter contributes to the field through the introduction of a non-parametric method to explore the potential economic gains from coopetition. Coopetition, rather than merging, offers many advantages, flexibility being an important one of those. In fact, the plant maintains not only control of its own investment, but also the rest of productive factors. Furthermore, while merging would imply a permanent engagement between the plants, coopetition only happens when incentives pay off. In this context, the parties can terminate the cooperation if the conditions of the initial agreement are not upheld.

The chapter proposes a definition of potential economic incentives for coopetition between independent plants based on the rate of return on assets, a well-known measure of financial performance. The methodological approach has its roots in the previous work by Bogetoft and Wang (2005) and by Grifell-Tatjé and Lovell (2015) and enables comparison between situations of non-coopetition and coopetition. The

[14] We have also carried out the same analysis per each of the ten types of interactions according to plant size (big to big, big to medium-big, etc.). Results emphasize the effect of size, as in Table 5. Passive coopetition only pays off for bigger plants whenever they interact with smaller partners. And pure coopetition effect is higher the smaller the plants taking part of the agreement, being small-small the best possible scenario.

methodology was applied to the study of potential competition within the European automotive industry. The main results are based on the analysis of a generated sample of over forty-five thousand cases of potential cooperation. Out of that sample, roughly twelve thousand of the cases (about 27%) showed potential ROA gains from coopetition.

The main findings reveal that faster asset turnover and better productivity explain higher potential ROA from coopetition. It makes a clear contribution to productivity gains, but the most important driver is technical efficiency. In theory, the plant can reach a higher level of efficiency by itself, without any kind of cooperation. However, the question is whether it needs a cooperation agreement as an incentive for its own reorganization. If that is the case, technical efficiency change should be considered to be an outcome of coopetition.

The results also show that medium–small and small plants have the strongest economic incentive for coopetition. However these groups of plants must play an active role in coopetition to get the potential gains. Passive coopetition would only be fruitful for bigger plants (they present lower ROA values) whereas smaller plants find it disadvantageous. This result seems natural, but empirical literature supporting this claim has not been found, which may be due to the legal framework in which coopetition is placed.

Results in the two periods defined as before and after the crisis are also significantly different. The period of financial distress, 2008–2012, presents lower ROA values and lower potential gains. That effect is more pervasive for smaller actors. It is also true that in the last years of this period appears an overall path to recovery.

Platform-sharing being a suitable method of coopetition in this industry, it has often been configured as a joint-venture between competing producers. In most cases, this arrangement is treated by law as a merger. When coopetition has a European dimension or is a full-function joint venture[15], the EU regulation on mergers is applied. In other cases, special standards (Article 101), as well as EU or national competition

[15] Joint-ventures are regulated both by the EC Merger Regulation and Article 101 of The Treaty on European Union and the Treaty on the Functioning of the European Union. Joint ventures are virtually treated as merger-like operations. This link provides a summary of the assessment and treatment of joint-ventures under European Regulation: http://uk.practicallaw.com/1-107-3702# (last accessed February 2016).

authorities, must approve this type of agreements. Regardless, platform-sharing between plants must overcome many legal restrictions before finally being approved to operate.

Our results suggest that a specific regulation on coopetition needs to be issued at the EU level. Coopetition cannot be treated as a merger and it should be promoted instead of penalized. Policy makers should better understand the virtues of coopetition, removing the worry of hidden collusion. Actually, the new regulation should offer clear incentives for coopetition rather than preventing it, especially to medium and small plants. The potential gains from coopetition found are a good reason for this regulatory re-design, which can be achieved by issuing a specific legal framework.

Some limitations of this study make research extensions relevant in the applied side. For instance, as we discuss with regard to potentiality, many costs associated to the development of the coopetition strategy might reduce the gains to be captured. Further applications should consider some type of structure-, distance-, bargaining- or opportunity-related costs. The conclusions are based on the assumption that plants share gains, but this may not always be the case. The distribution may favor stronger plants, so smaller ones may not actually find such a favorable scenario in reality. Natural, potential extensions for future research on coopetition could also involve analyses about the effect on the consumers, market pricing, product range, product quality or overall surplus.

Figures and Tables

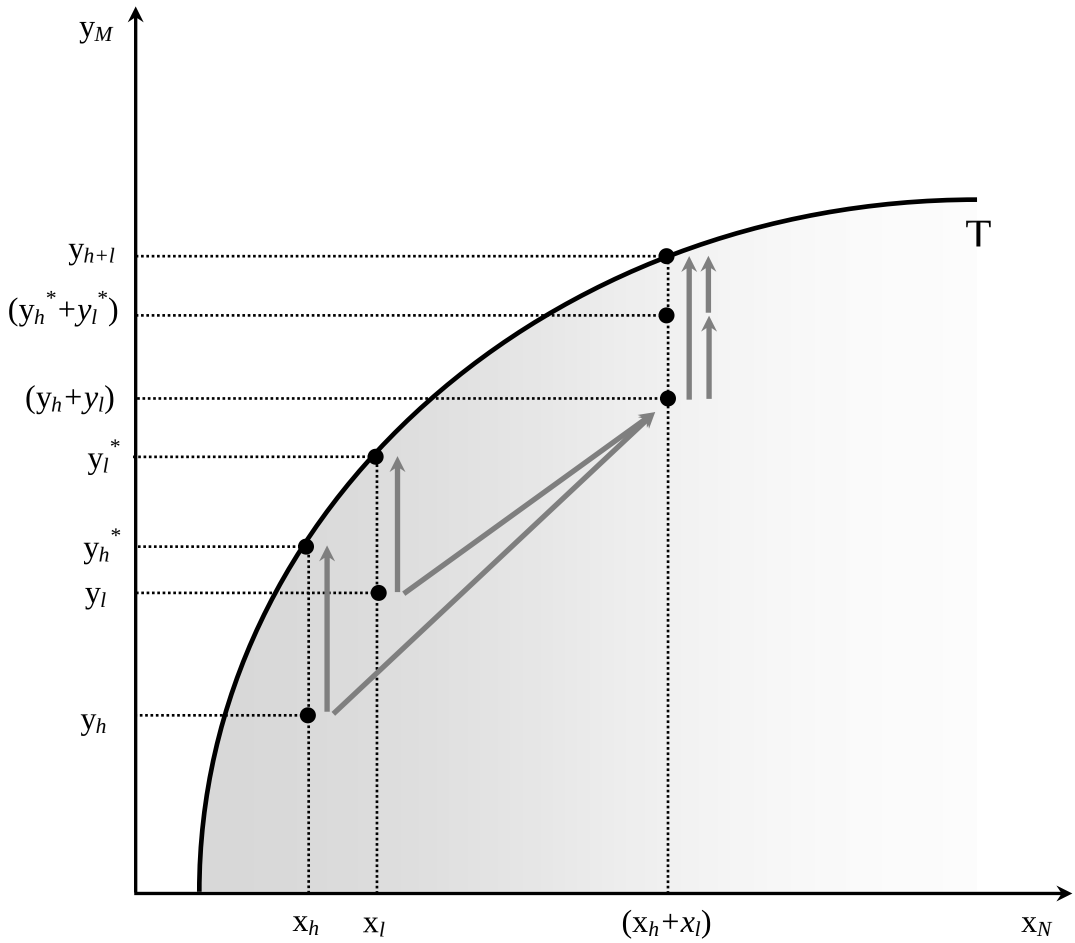

Figure 1.1. Decomposition of coopetition effects.

Table 1.1. Summary statistics by variable. Mean values

Period	x_l Labor Quantity (#)	w_l Labor Price (Current €)	x_k Capital Quantity (€2000)	w_k Capital Price (Current €)	y Product Quantity (€2000)	p Product Price Index	Profit (Current €)	A Total Assets (€2000)	ROA (%)	ROA Median (%)
2000/12	1,961	40,013	155,935,690	0.3631	118,201,157	114.62	13,261,665	478,149,989	3.70	3.17
2000/07	2,078	39,039	170,120,065	0.3476	133,597,155	106.92	16,720,242	476,261,088	4.58	3.32
2008/12	1,819	41,207	139,978,268	0.3809	96,750,919	126.95	8,549,003	480,724,670	2.50	2.85

Table 1.2. Distribution of cases according to initial ROA status of plants.

Period/Status	Both positive	One positive one negative	Both negative	Total
2000/12	57.60% *(7,051)*	36.20% *(4,431)*	6.20% *(759)*	100% *(12,241)*
2000/07	63.54% *(4,544)*	32.14% *(2,298)*	4.32% *(309)*	100% *(7,151)*
2008/12	49.25% *(2,507)*	41.91% *(2,133)*	8.84% *(450)*	100% *(5,090)*

Table 1.3. Distribution of coopetition cases according to size of plants. Number of cases in brackets.

size	Big	Medium–big	Medium–small	Small
Big	0.20% *(24)*	4.77% *(584)*	4.20% *(514)*	14.93% *(1,828)*
Medium–big		4.57% *(560)*	8.37% *(1,025)*	18.50% *(2,264)*
Medium–small			7.52% *(921)*	24.88% *(3,046)*
Small				12.05% *(1,475)*
Total	0.20% *(24)*	9.35% *(1,144)*	20.10% *(2,460)*	70.36% *(8,613)*

Table 1.4. Decomposition of potential ROA gains. Median values

			ROA Gains			Profit Margin Change			Productivity Effect				
Period	ROA Gains	=	Assets Rotation Change	x	Profit Margin Change	Price Recovery Effect	x	Productivity Effect	*Passive* Coopetition Effect	x	Technical Efficiency Change	x	*Pure* Coopetition Effect
[1]	[2]		[3]		[4]	[5]		[6]	[7]		[8]		[9]
2000/12	4.796		2.215		2.340	1.005		2.180	1.062		2.053		1.051
2000/07	5.518		2.257		2.489	1.005		2.320	1.040		2.100		1.047
2008/12	3.968		2.151		2.146	1.005		2.018	1.087		1.999		1.057

Table 1.5. Decomposition of potential ROA gains, per plant size. Median values.

Period	Plant Size	# Obs	ROA Gains	=	ROA Gains: Assets Rotation Change	x	ROA Gains: Profit Margin Change	Profit Margin Change: Price Recovery Effect	x	Profit Margin Change: Productivity Effect	Productivity Effect: *Passive* Coopetition Effect	x	Productivity Effect: Technical Efficiency Change	x	Productivity Effect: *Pure* Coopetition Effect
[1]	[2]	[3]	[4]		[5]		[6]	[7]		[8]	[9]		[10]		[11]
2000/12	B	2,974	5.445		2.069		2.611	1.001		2.578	1.430		2.030		1.010
	MB	4,993	5.062		2.191		2.334	1.001		2.239	1.040		2.110		1.036
	MS	6,427	4.752		2.292		2.200	1.037		2.015	1.030		2.055		1.091
	S	10,088	4.534		2.254		2.364	0.997		2.257	0.952		2.032		1.092
2000/07	B	2,163	5.646		2.039		2.644	1.002		2.615	1.360		1.975		1.012
	MB	2,886	5.476		2.284		2.417	1.000		2.333	0.995		2.192		1.036
	MS	3,721	5.254		2.313		2.262	1.039		2.036	1.076		2.077		1.088
	S	5,532	5.601		2.384		2.537	0.992		2.444	0.889		2.120		1.096
2008/12	B	811	4.429		2.179		2.407	0.999		2.163	1.558		2.140		1.005
	MB	2,107	4.647		2.045		2.258	1.001		2.111	1.098		2.002		1.037
	MS	2,706	3.715		2.261		2.017	1.034		1.809	0.970		2.027		1.094
	S	4,556	3.670		2.103		2.125	1.007		1.963	1.028		1.953		1.087

B: big; MB: medium–big; MS: medium–small; S: small

CHAPTER 2

Organizational Downsizing and Financial Performance

Abstract

In order to define and measure downsizing, mainstream business literature has naturally adopted changes in labor. This study proposes a novel methodology to define and measure organizational downsizing, which integrates not only labor but also all the inputs in an organizational unit. The definition of *organizational downsizing* is used to assess the downsizing effect on productivity changes, which can be directly linked to a measure of financial performance, namely *return on assets* (ROA). A natural extension of that definition is presented for *labor downsizing*. This methodology illustrated with the European automobile production sector from 2000 to 2012. The period presents strong downsizing behaviors among automobile production plants. Organizational downsizing was found to have no effect on the financial results of the plants. In contrast, the remaining effects led to productivity decline and a poorer financial performance.

Chapter 2

Organizational Downsizing and Financial Performance

2.1. Introduction

Competitive pressures drive firms to answer markets with actions designed to improve their performance. Downsizing has naturally been understood and accepted as a competitive upholding mechanism. It has been described as a way of organizational restructuring, making organizations more competitive while aiming to preserve or improve their financial performance. The phenomenon boomed in the 80s and the literature started to pay empirical attention to it in the early 90s. Datta *et al*. (2010) and Gandolfi and Hansson (2011) are two recent literature reviews of the topic. From those revisions, we can draw the conclusion that downsizing has been massively understood to mean labor lay-offs. Studies have merely analyzed the distinct consequences of workforce reductions on performance, without reaching a consensus on the outcomes. This labor approach to the concept of organizational downsizing has been criticized, as it is based on a partial measure. For instance, Cascio (1998) considers that a reduction in the number of employees may not be sufficient in itself, unless it goes in tandem with changes in other assets. In the same vein, Sheaffer *et al*. (2009) suggest that labor reductions may lead to different outcomes depending on the interactions with simultaneous changes in other assets.

The need for a broader definition of downsizing is a shared concern in the literature that is critical of studies based on labor reductions. The analysis should consider more than just labor. Such an approach appeared in early downsizing literature. Freeman and Cameron (1993, p. 12) proposed a managerial definition describing organizational downsizing as "*a set of activities, undertaken on the part of the management of an organization, designed to improve organizational efficiency, productivity, and/or competitiveness*". Cameron (1994), in his study of the identification of successful downsizing strategies implemented in the US automotive industry, proposes a whole range of processes that need to be redesigned for successful labor downsizing. He emphasizes how workforce reductions are not enough, but other involved inputs must be adjusted as well. DeWitt (1998) also points out how the narrowly defined concept of labor downsizing has been unhelpful as a strategy research construct. He views downsizing from a broader perspective, proposing different combinations of reductions in physical, financial, organizational and human resources. Robbins and Pierce (1992) early stress this concern by stating that "*methodologies employed in the empirical studies have failed to operationalize retrenchment as an integral component in organizational turnarounds [...]*". Although all these approaches advocate a broader definition of downsizing, to our knowledge, only a few studies have attempted to broaden the measure of downsizing. Cascio, Young and Morris (1997), Morris, Cascio and Young (1999) and Cascio and Young (2003) compare different combinations of simultaneous changes to labor and assets. Similarly, Sheaffer *et al*. (2009) test how variations in physical assets together with labor reductions may affect financial performance differently. However, their results suggest no clear direction of effects.

This study contributes to the literature with a new definition of organizational downsizing. It proposes the consideration of all production factors in the measurement of downsizing. Moreover, there is still a need for a more direct or exact type of analysis, linking downsizing to a measure of financial performance. The literature has traditionally studied the relationship between labor downsizing and financial performance via non-exact approaches. The common methodology is based on a regression analysis, in which labor downsizing is an explanatory variable of a measure of financial performance (Cascio *et al*., 1997; Love and Nohria, 2005 or Goesaert, Heinz and Vanormelingen, 2015, among others[16]). This study explores a different direction built on the economics of financial performance (Grifell-Tatjé and Lovell, 2015). Under this approach, we define an inclusive measure of organizational downsizing that establishes an exact relationship with a well-known measure of financial performance. As follow-up, we naturally extend the definition of organizational downsizing to the case of labor downsizing, whereby traditionally extended labor downsizing is a component of the inclusive definition of organizational downsizing.

[16] Similar approaches can be found, for example, in De Meuse, Vanderheiden and Bergmann (1994); Bruton, Keels and Shook (1996); Suárez-González (2001); Baumol, Blinder and Wolf (2003); Cascio and Young (2003); Saïd, Louarn and Tremblay (2007); Muñoz-Bullón and Sánchez-Bueno (2010); Chhinzer and Currie (2014).

The study illustrates the methodology in the European automobile production industry. At plant level, this industry presents a good opportunity for such analysis, as it underwent an intense downsizing process in the 2000's decade. We analyze the financial consequences of downsizing at plant-level for more than a decade (2000-2012). To date, there have been very few studies of this effect at plant level (Baily, Bartelsman and Haltiwanger, 1996; Collins and Harris, 1999; Baily, Bartelsman and Haltiwanger, 2001), and they have mainly been devoted to the effects on productivity rather than financial outcomes. Here we defend the importance of linking organizational downsizing and financial performance in a multi-plant setting.

The rest of the paper starts with a section on the methodological context, where a financial measure of performance change, the return on assets, is presented and decomposed. In order to retrieve the early definitions of organizational downsizing, Section 3 proposes an inclusive measure of downsizing in which all inputs in an organization can be included. The section also proposes an extension of labor downsizing, which allows for a direct comparison with the natural measure adopted by the literature. The organizational downsizing measure introduced here can be directly related to changes in financial performance, which is explained in Section 4. The application is presented in Section 5 through the automobile production industry in Europe, at plant level. Section 6 then shows the results of the analyses for that industry. We conclude in Section 7, where implications of the results are suggested.

2.2. The Methodological Context

This section describes the main concepts that enable the development of our concept of organizational downsizing. We start by defining $p = (p_1, \dots, p_{\mathrm{M}}) \in \mathrm{R}^{\mathrm{M}}_{++}$ and $y = (y_1, \dots, y_{\mathrm{M}}) \in R^{\mathrm{M}}_{+}$ as vectors of output prices and quantities for the case of an organizational unit composed of I units, indexed $q = 1, \dots, I$. To simplify notation, the indexation of the organizational unit is only introduced when it is necessary for reasons of clarity. In the applied part of the paper, the organizational unit takes the form of an automobile plant. In the case of inputs, $\mathrm{w} = (\mathrm{w}_1, \dots, \mathrm{w}_{\mathrm{N}}) \in \mathrm{R}^{\mathrm{N}}_{++}$ represent the vector of prices and $\mathrm{x} = (\mathrm{x}_1, \dots, \mathrm{x}_{\mathrm{N}}) \in \mathrm{R}^{\mathrm{N}}_{+}$ is the vector of quantities. One of these productive factors is labor, which is specifically expressed by x_l. The assets (or invested capital) of the organizational unit are expressed by $A \in R_{++}$, which may differ from the input capital depending on its definition. Given this, the revenues of a plant can be defined as $R = p^T y$ and total cost as $C = w^T x$, where "T" represents the transpose of the vector. The definition of the profit of an organizational unit is hence straightforward as revenues minus costs: $\pi = R - C$, and profitability is defined by the ratio of revenues over costs: $\Pi = R/C$.

The paper proposes a measure of organizational downsizing based on the popular rate of return on assets (ROA). This is expressed by the ratio of profit on assets: π/A, where A is usually defined as total assets, but it can take other definitions following the tradition of financial analysis, such as equity. It can also be easily extended to other financial performance indicators. Bryan (2007) proposes substituting A with x_l, generating a measure of return on labor, A/x_l. Bryan (2007) considers that "*companies focus far too much on measuring returns on invested capital rather than on measuring the contributions made by their talented people* (p. 1)". Also, from this labor perspective, the approach can be applied to the case of labor cooperatives following the literature initiated by Ward (1958) and Domar (1966), in which the cooperative has the *dividend* as objective. This is defined as $D = (\pi + w_l x_l)/x_l$ and the total costs of the cooperative is $C_{-\{l\}}$, which excludes labor expenses[17]. In this cooperative context, the analysis that follows is the same, but the focus is on D instead of on π/A.

The financial performance of an organizational unit is defined by the return on assets. This widely used measure of financial performance can be decomposed as

$$\frac{\pi}{A} = \frac{\pi}{R} \times \frac{R}{A}, \tag{2.1}$$

explaining return on assets by the product of (π/R), which the literature refers to as return on sales, return on revenues or revenue profit margin, and (R/A), usually named asset turnover. The decomposition in (2.1) is well-known as the duPont triangle[18].

[17] See Grifell-Tatjé and Lovell (2004) for an application based on the definition of dividend by Ward (1958) and Domar (1966).
[18] Johnson (1975) provides an interesting historical perspective of its use.

We center attention on the expression that defines the return on sales (π/R), which can be rewritten as $\pi/R = \ ^T y/w^T x$, where the profit margin is expressed in terms of cost, instead of revenues. It is deduced from the previous equality: $\ ^T y = (\pi/R)C$ or, the same, $\ ^T y = \pi/\Pi$, where the modification consists of scaling π by Π. The interpretation of can easily be seen for the case of one output (M = 1). In this situation: $= (p - uc)/\Pi$, where $\Pi = p/uc$ and $uc = w^T x/y$ is the unit cost. Hence, defines a vector of output prices that are scaled unit profits. In the case of multiple outputs (M > 1), there is $\rho^T y = \pi/\Pi \ = \sum((p_i - uc_i)y_i /\Pi)$, where $\rho_i = (p_i - uc_i)/\Pi, i = 1, \dots M$. As in the case of one output, the unit profits are scaled equivalently in the creation of $\rho_i, i = 1, \dots M$. Therefore, plays the role of an output price, defined as a normalized unit profit.

The difficulty of this multi-output setting is the determination of the unit cost of each product, which requires cost allocation and constitutes an important drawback in its empirical application. One way to overcome this difficulty is to define $\rho = (\beta p_1, \dots., \beta p_M)$, where $\beta = (\ \ /\Pi)/R$. The vector of is built by multiplying each output price by the scalar β. It has the interesting property of preserving the relative importance of the output prices, which are the usual weights in an output aggregation process[19]. Additionally, the previous interpretation of is preserved, but it is considered that the profit associated to a product is proportional to its revenue share, i.e., $(p_i - uc_i)y_i = \pi\alpha_i$, where $\alpha_i = (p_i y_i/R)$ and $\sum \alpha_i = 1.\ \ i = 1, \dots, M$[20]. The next expression (2.2) expressed in a multi-output context is developed under this approach.

Downsizing occurs over time. Thus, we need a dynamic context to assess variations in ROA. Accordingly, 0 and 1 are taken as the base and comparison periods. Change in the return on assets from base period to comparison period is expressed in ratio form, using expression (2.1), as

[19] The ratio: $\rho_i/\rho_j = p_i/p_j \ \forall \ i \neq j$.

[20] We have: $\rho^T y = \sum \beta p_i y_i$, from the definition of $\rho = (\beta p_1, \dots., \beta p_M)$.

$= \sum(\pi/\Pi)(p_i y_i/R)$, because $\beta = (\ \ /\Pi)/R$

$= \sum(\pi\alpha_i/\Pi)$, where $\alpha_i = (p_i y_i/R)$ and $\sum \alpha_i = 1.$ (a)

We know from a previous finding: $\rho^T y = \sum((p_i - uc_i)y_i /\Pi)$ (b)

Combining (a) and (b): $\sum((p_i - uc_i)y_i /\Pi) = \sum(\pi\alpha_i/\Pi)$, and yields $(p_i - uc_i)y_i = \pi\alpha_i, i = 1, \dots, M$.

$$\frac{\pi^1/A^1}{\pi^0/A^0} = \frac{\rho^{1T}y^1/w^{1T}x^1}{\rho^{0T}y^0/w^{0T}x^0} \times \frac{R^1/A^1}{R^0/A^0}$$

$$= \left[\frac{p^{0T}y^1/p^{0T}y^0}{w^{0T}x^1/w^{0T}x^0} \times \frac{y^{1T}\rho^1/y^{1T}\rho^0}{x^{1T}w^1/x^{1T}w^0}\right] \times \frac{R^1/A^1}{R^0/A^0}. \tag{2.2}$$

The first row in (2.2) reproduces the equation (2.1) in terms of change using the equality $\pi/R = \ ^{T}y/w^{T}x$. The change in return on assets is equal to the product of the return on sales and the asset turnover change. Thus a positive change in ROA is due to higher profit per unit of sales and/or faster assets turnover (sales per unit of assets). The second row in expression (2.2) decomposes the return on sales change into two components. The first defines productivity change as the ratio of two quantity index numbers. The numerator of the expression is a Laspeyres (1871) output quantity index and the denominator is a Laspeyres input quantity index. The expression compares the variation in output quantities with the variation in input quantities and defines a Laspeyres productivity index. A value higher, equal or lower than one of the Laspeyres productivity index signals productivity growth, stagnation or decline because output growth as measured by the output quantity index exceeds, equals or trails input growth as measured by the input quantity index. The second component of return on sales change has an identical structure, but instead of comparing changes in quantities, it compares changes in prices. The numerator of the expression is a Paasche (1875) output price index and the denominator is a Paasche input price index. This expression compares the growth in   with the growth in *w* and defines a Paasche price recovery margin index number. It describes the ability of the organizational unit to absorb the variations in the prices of the inputs and transform them into higher normalized unit profit gains. It can take values that are higher, equal or lower than one and signals positive or limited capacity of transforming input price variations into normalized unit profit changes[21].

[21] $\frac{y^{1T}\rho^1/y^{1T}\rho^0}{x^{1T}w^1/x^{1T}w^0} = \frac{y^{1T}p^1/y^{1T}p^0}{x^{1T}w^1/x^{1T}w^0} \quad \frac{y^{1T}\rho^1/y^{1T}\rho^0}{y^{1T}p^1/y^{1T}p^0}$ The expression shows that the ability of the organizational unit to undertake a positive transformation depends on two aspects. The first expression on the right hand side defines a Paasche price recovery index: the ratio of a Paasche output price index and a Paasche input price index. This takes values higher, equal or lower than one and signals positive, zero or negative price recovery because output price change measured by the output price index exceeds, equals, or falls short of input price variation as measured by the input price index. This shows the extent to which variations in prices of inputs are compensated by variations in prices of outputs. The second expression on the right hand

This initial decomposition of ROA change is represented in *Exhibit 2.1*, which also shows more of the decomposition proposed in Section 4, where organizational downsizing is presented as a component of productivity change to directly determine its impact on financial performance. In the exhibit, each component is related to its corresponding mathematical expression. Thus far, the first and second rows in expression (2.2) correspond to the second and third columns in *Exhibit 2.1*, respectively.

INSERT EXHIBIT 2.1 ABOUT HERE

The previous exposition was founded on a Laspeyres productivity index and a Passche recovery index. It is possible to perform a similar analysis based on a Paasche productivity index and a Laspeyres recovery index. The geometric mean of these two possible approaches produces an assessment that builds on Fisher (1922) index numbers. This possibility is discussed at the end of the next section.

2.3.Restructuring, Organizational and Labor Downsizing

In this section, an inclusive definition of organizational downsizing is presented. Downsizing is defined as an action affecting all factors in the organization (Freeman and Cameron, 1993). The development of the proposal requires introduction of some central concepts from the theory of production. The set of technologically feasible combinations of output vectors and input vectors is defined by the mathematical programming models in Färe *et al*. (1985), based on Data Envelopment Analysis (DEA), a technique introduced by Charnes *et al*. (1978) and Banker *et al*. (1984). We have

$$T^s = \left\{ (x, y): y \leq \sum_q \sum_{t=1}^{s} \lambda_q^s y_q^s, x \geq \sum_q \sum_{t=1}^{s} \lambda_q^s x_q^s, \sum_q \lambda_q^s = 1, \lambda_q^s > 0 \right\}, \qquad (2.3)$$

side keeps the same structure based on a Paasche price recovery index substituting p with in the numerator and w with p in the denominator of the expression. This provides information about whether the normalized unit profits have changed more, the same or less than the prices of the products and takes values higher, equal or less than one.

where x_q^s is the input vector and y_q^s is the output vector for organizational unit q in period *s*, respectively. The technology is defined in a general context, which is given by variable returns to scale. In this DEA approach, the technology is bounded above by a piecewise linear frontier, over the data formed by the best observations from all the years from the first to the comparison year (expressed by 1) inclusive. Note that the technology is defined in a sequential way, which does not allow for technical regress (Tulkens and Eeckaut, 1995). The representation of the technology in terms of its input set is $L^1(y^1) = \{x^1: (x^1, y^1) \in T^1\}$, which is bounded below by the input isoquant. $c^1(y^1, w^1)$ expresses a cost frontier, the minimum cost to produce y^1 outputs at the input price level w^1, where $c^1(y^1, w^1) = min_x\{w^1 x^1: x^1 \in L^1(y^1)\}$. We have $c^1(y^1, w^1) = w^{1T} x^1(y^1, w^1)$, where $x^1(y^1, w^1) = \{x_1^1(y^1, w^1), \ldots, x_N^1(y^1, w^1)\}$ represents the cost-efficient vector of input quantities and, particularly, $x_l^1(y^1, w^1)$ the cost-efficient level of labor. The total cost $C^1 = w^{1T} x^1$ is bounded below by the cost frontier, which is non-decreasing in *y* and non-decreasing, concave, and homogeneous of degree +1 in w. The introduction of the cost frontier permits the distinction between the vector of actual input quantities x^1 and the vector of cost-efficient input quantities $x^1(y^1, w^1)$, where $w^{1T} x^1(y^1, w^1) \leq w^{1T} x^1$. The difference between the two is attributable to technical and allocative efficiency.

Figure 2.1 portrays a situation of downsizing from a base period 0 to a comparison period 1. This represents the set of technologically feasible combinations of output and input quantities for the case of M=N=1. It shows positive technical change because there is an upward shift in the production frontier. The figure describes the evolution of two organizational units: A and B, which use the same quantity of input and output in the base period. Their behavior over time is different, as the dotted arrows in the figure show, so the quantity of input and output are not equal in the comparison period. Organizational unit A has reduced its quantity of input $(x_A^1 < x_A^0)$ and output $(y_A^1 < y_A^0)$, which is not the case with unit B, as it produces exactly the same quantity. *Figure 2.1* is complemented by *Figure 2.2* which illustrates the same situation in the space of the input set technology for N=2. *Figure 2.2* has additionally been split in two, representing the specific situations of organizational unit A (*Figure 2.2.1*) and B (*Figure 2.2.2*). These figures show $x^1(y^0, w^0)$ and $x^1(y^1, w^0)$, the cost-efficient input quantities with respect to the comparison technology and input prices of the base period. These cost-efficient input quantities have also been reproduced in *Figure 2.1*. Note that both units experiment productivity gains because there is technical change and they are closer to the production frontier in period 1 than 0.

INSERT FIGURE 2.1 ABOUT HERE

INSERT FIGURES 2.2.1 AND 2.2.2 ABOUT HERE

It is of interest to highlight that both cases, A and B, would be classified as downsizers by the literature, where downsizing has been associated with the reduction in the observed quantity of input(s). Nevertheless, they express completely different situations. The case of organizational unit B presents a situation where $L^1(y^0) = L^1(y^1)$ in *Figure 2.2.2* and, as a direct consequence, the cost-efficient input quantities $x_B^1(y^0, w^0)$ and $x_B^1(y^1, w^0)$ are equal. In contrast, organizational unit A displays a situation in *Figure 2.2.1*, where $L^1(y^1) \quad L^1(y^0)$ generating $x_A^1(y^1, w^0) < x_A^1(y^0, w^0)$. Recall that the movement from $(x^1(y^0, w^0), y^0)$ to $(x^1(y^1, w^0), y^1)$ in *Figure 2.1* and *Figure 2.2.1* corresponds to the change in the size of the organization net of cost inefficiency. The described situations have inspired the following definition:

DEFINITION 2.1

An organizational unit experiments restructuring when $x^1(y^0, w^0) \neq x^1(y^1, w^0)$ *and organizational downsizing occurs when* $x^1(y^1, w^0) < x^1(y^0, w^0)$.

These definitions of *organizational restructuring* and *organizational downsizing* impose inequality in all the cost-efficient input quantities in the former and strictly lower cost-efficient input quantities in the latter. One option is to define weaker definitions of organizational restructuring and organizational downsizing allowing for equality in some cost-efficiency input quantities. In contraposition with the definition of organizational downsizing, *organizational upsizing* can be defined as $x^1(y^1, w^0) > x^1(y^0, w^0)$, where all the cost-efficient input quantities are higher instead of lower. Hence, and similar to the case of organizational downsizing, organizational upsizing defines a specific way of growing. An intermediate situation is possible in which some cost-efficient input quantities increase and others decrease, but this situation should be infrequent because it requires a non-neutral displacement of the same technology (i.e., from $L^1(y^0)$ to $L^1(y^1)$). The literature has widely documented non-neutral technical change and proposed ways of measuring it (Färe *et al*., 1997), but non-neutral shifts of the same technology as responses to changes in output quantities are much less documented. *Definition 2.1* of organizational downsizing can easily be extended to a particular input. This feature is especially relevant for the case of labor, because most of the literature on downsizing has defined it on the basis of this input.

DEFINITION 2.2

An organizational unit experiments labor downsizing when $x_l^1(y^1, w^0) < x_l^1(y^0, w^0)$.

where $x_l^1(y^1, w^0)$ and $x_l^1(y^0, w^0)$ express cost-efficient labor quantities with respect to the comparison technology and input prices of base period. Note that when a unit is classified as a downsizer based on *Definition 2.1*, it must necessarily obtain the same classification with the application of *Definition 2.2*. However, this is not the case in the reverse direction, from *Definition 2.2* to *Definition 2.1*. This result is a direct consequence of the observations that show intermediate situations in which some cost-efficient input quantities increase and others decrease. Therefore, the definition of organizational downsizing is more restrictive than the definition of labor downsizing. The former must define the same or a subset of observations of the latter. This situation of labor downsizing can be extended to the already introduced case of upsizing.

2.4.Measuring Financial Performance of Organizational Restructuring

The second row in expression (2.2) defines productivity change as the ratio of two Laspeyres quantity index numbers. The Laspeyres input quantity index, in the denominator of the expression, can be rewritten as

$$\frac{w^{0T}x^1}{w^{0T}x^0} = \frac{w^{0T}x^1(y^1, w^0)}{w^{0T}x^1(y^0, w^0)} \times \frac{w^{0T}x^1/c^1(y^1, w^0)}{w^{0T}x^0/c^1(y^0, w^0)}, \tag{2.4}$$

where the first component on the right hand side quantifies organizational restructuring in terms of costs. The second expression collects the remaining effects that explain cost change: efficiency and technical change (Grifell-Tatjé and Lovell, 2015). The use of (2.4) in the denominator of the expression that defines productivity change in (2.2) allows for the introduction of the following proposition:

PROPOSITION 2.1: *The contribution of productivity change to ROA change can be decomposed as*

$$\frac{p^{0T}y^1/p^{0T}y^0}{w^{0T}x^1/w^{0T}x^0} = \frac{p^{0T}y^1/p^{0T}y^0}{w^{0T}x^1(y^1,w^0)/w^{0T}x^1(y^0,w^0)} \times \frac{w^{0T}x^0/c^1(y^0,w^0)}{w^{0T}x^1/c^1(y^1,w^0)}, \qquad (2.5)$$

where the first term on the right hand side of expression (2.5) is discussed in detail below. It is anticipated that it measures the contribution of *organizational restructuring* to ROA change. The second expression measures the contribution of cost efficiency change and technical change to ROA, via productivity change. We introduce a simplification to the terminology and denominate this second term in (2.5), *manufactured productivity change*. Consequently, a positive ROA change, via productivity gains, is due to the positive contribution of organizational downsizing and/or the positive contribution of the manufactured productivity change. The decomposition in (2.5) is shown in the last column of *Exhibit 2.1*. What follows extends the notion of organizational restructuring.

PROPOSITION 2.2: *An index number that measures the contribution of organizational restructuring to ROA change is given by*

$$O^0(p^0,y^1,y^0,w^0) = \frac{p^{0T}y^1/p^{0T}y^0}{w^{0T}x^1(y^1,w^0)/w^{0T}x^1(y^0,w^0)}, \qquad (2.6)$$

where $O^0(p^0,y^1,y^0,w^0) \gtreqless 1$. This index has interesting structural properties that permit its interpretation as a measure of organizational restructuring. A necessary property is that when the organizational unit is not restructured, the index number takes a value equal to 1. The following proposition summarizes this idea:

PROPOSITION 2.3: *When* $x^1(y^1, w^0) = x^1(y^0, w^0)$, *according to Definition 2.1, the unit does not have organizational restructuring, then* $O^0(p^0, y^1, y^0, w^0) = 1$.

PROOF: $x^1(y^1, w^0) = x^1(y^0, w^0)$ for $y^1 = y^0$, then $O^0(p^0, y^1, y^0, w^0) = 1$ because both the numerator and denominator of (2.6) are equal to one.

In fact, *Proposition 2.3* shows that $O^0(p^0, y^1, y^0, w^0)$ has the identity property. The index number provides an evaluation of the restructuring policy of the organization and takes a value higher, equal or lower than one with identical contribution to productivity change, and hence return on assets change. It is interesting to investigate the situation of organizational downsizing. The next proposition summarizes a central finding:

PROPOSITION 2.4: When organizational downsizing occurs: $x^1(y^1, w^0) < x^1(y^0, w^0)$, then $O^0(p^0, y^1, y^0, w^0) \gtreqless 1$ showing the financial impact of a successful, effect-less or unsuccessful downsizing.

PROOF: We have $w^{0T}x^1(y^1, w^0) \leq w^{0T}x^1(y^0, w^0)$ for $0 \leq y^1 \leq y^0$ from the property of weak monotonicity of a cost function, so the denominator of (2.6) is: $w^{0T}x^1(y^1, w^0)/w^{0T}x^1(y^0, w^0) \leq 1$. As $p^{0T}y^1 \leq p^{0T}y^0$ the numerator of (2.6) is also $p^{0T}y^1/p^{0T}y^0 \leq 1$. As the numerator and denominator of (2.6) take values lower and equal than one, then $O^0(p^0, y^1, y^0, w^0) \gtreqless 1$.

Proposition 2.4 can be extended in a similar manner to the context of *organizational upsizing*: $x^1(y^1, w^0) > x^1(y^0, w^0)$. It is easy to show that, in this situation, the expression of organizational restructuring: $O^0(p^0, y^1, y^0, w^0) \gtreqless 1$, as upsizing improves ROA, remains unchanged or declines. Additionally, it is relevant to mention that (2.6) is defined by the ratio of two Laspeyres quantity indexes, so $O^0(p^0, y^1, y^0, w^0)$ has the properties of a Laspeyres index number (Balk, 2008; Diewert, 1981).

A similar analysis can be performed following a Paasche instead of Laspeyres approach. The starting point is equation (2.2), which can be rewritten as

$$\frac{\pi^1/A^1}{\pi^0/A^0} = \left[\frac{p^{1T}y^1/p^{1T}y^0}{w^{1T}x^1/w^{1T}x^0} \times \frac{y^{0T}\rho^1/y^{0T}\rho^0}{x^{0T}w^1/x^{0T}w^0}\right] \times \frac{R^1/A^1}{R^0/A^0}. \tag{2.7}$$

The difference between expressions (2.2) and (2.7) resides in the weights. The first expression on the right hand side of (2.7) defines a Paasche productivity index because it uses the prices of outputs and inputs of the comparison period as weights. Similarly, the second expression is a Laspeyres recovery index because the weights are given by the quantities of the base period. Subsequent analysis proceeds as in Sections 3 and 4, replacing the base period weights (p^0, w^0) with comparison period weights (p^1, w^1) in expressions (2.4) – (2.6), and cost-efficient input quantities $x^1(y^0, w^0)$ and $x^1(y^1, w^0)$ with the cost-efficient input quantities with respect to the base technology and input prices of comparison period $x^0(y^0, w^1)$ and $x^0(y^1, w^1)$ in *Definitions 2.1* and *2.2*, as well as in expressions (2.4), (2.5) and (2.6). It is possible to develop a Fisher (1922) approach that simply calculates the geometric mean of the Laspeyres and equivalent Paasche approach of expressions (2.4) – (2.6). The translation of the Fisher approach to *Definition 2.1* requires the fulfillment of both conditions: $x^1(y^0, w^0) \neq x^1(y^1, w^0)$ and $x^0(y^0, w^1) \neq x^0(y^1, w^1)$ for the case of restructuring and the fulfillment of $x^1(y^1, w^0) < x^1(y^0, w^0)$ and $x^0(y^1, w^1) < x^0(y^0, w^1)$ for the case of downsizing. *Definition 2.2* is adapted in an identical way. In the applied part of the paper, we follow a Fisher approach because the literature considers it superior to a Laspeyres or Paasche one (Diewert, 1981; 1992).

2.5. Illustration on the Automobile Industry

According to Eurostat and the "Association des Constructeurs Européens d'Automobiles" (ACEA), the automobile production sector in Europe directly provides 2.2 million jobs. Indirectly, more than 3 million are reported. Our sample entails the EU-28 between 2000 and 2012. Within this framework, the policy environment can be considered rather similar.

Using the Amadeus database as the main source, our sample collects financial information at the level of the production plant. It reports multidimensional accounting data for all European automobile manufacturing plants, namely those whose NACE[22] code was 2910: *"manufacture of motor vehicles"*, in the database[23]. Both private and public producers were included in the sample (the latter represent less than 2%). In data selection, plants whose average number of employees was under one hundred for the period were dropped. Neither did we include plants with unreasonable or inconsistent data during the period[24]. Finally, in the analyzed decade, companies slowly transitioned from local general accepted accounting principles (GAAP) to international financial reporting standards (IFRS). The study has paid special attention to these changes to make the sample comparable.

From this sample of 160 production plants we further drop observations that report a negative profit for the period. As we use a ROA approach, negative profits need to be excluded to avoid meaningless results. So, our final sample is an unbalanced panel of 607 observations collected from 125 plants which pertain to 16 different European countries. Most of the plants belong to some of the most relevant European and non-European automobile production groups. A high rate of birth and death is found along the analyzed years, which also helps to explain such an imbalance. It is also relevant to mention that offshoring processes were carried out in this period, partially explaining the observed rate of birth and deaths[25].

The amount of profits in a period of time is given by the accounting records of the plant. They also account for the investment in assets. In accounting argot, these profits are called "*earnings before taxes*" (EBT). This applied part follows a value added approach because information about the quantity of the intermediate materials is not available or insufficient. What is detailed in the accounting records is the total cost of intermediate

[22] "Statistical Classification of Economic Activities in the European Community", subject to legislation at the EU level, which imposes the use of the classification uniformly in all the Member States.

[23] Data download/collection took place twice between 2011 and 2013. Thus, the criteria for unit selection was its main activity (NACE: 2910) available at the moment of the download.

[24] Some plants were removed from the sample because abnormal trends for some relevant variables were found, e.g., number of employees, amount of assets, compensation per employee, price of capital, among others.

[25] The traditional definition of offshoring includes both the practice of a unit hiring external functions with a third – outsourcing – and the case of moving to a different location itself. This explains both the birth and death of plants in the sample.

materials for the associated period. Hence, value added is defined by the total revenue minus the total cost of these intermediate materials. In this value added approach, two inputs are considered: labor and capital. We describe and name the relevant variables for inputs (labor and capital) and output (value added) as follows:

i) *Labor quantity* (x_l). Average of the number of employees at the beginning and end of the accounting period.

ii) *Labor price* (w_l). Total labor compensation per employee.

iii) *Capital quantity* (x_k). The sum of the depreciated amount of tangible fixed assets at the beginning of the period and the deflated investment (country's cumulative consumer price index, base 2000) of the plant during the period.

iv) *Capital price* (w_k). Interest paid plus depreciation per unit of stock of capital.

v) *Product quantity* (y). Average of constant sales (deflated by the country's cumulative manufacturing producer price index, base 2000) of the plant at the beginning and end of the accuonting period.

vi) The *output price* (p). The ratio between the value added of the period and the product quantity (y): amount of value added per unit of real sales.

vii) *Total Assets* (A). The amount of total assets in the accounting statements that includes both current and non-current assets.

INSERT TABLE 2.1 ABOUT HERE

Table 2.1 shows the mean values and tenth and ninetieth percentiles[26] per variable. A final sample of 226 organizational downsizing observations[27] is obtained for the 2000/12 period. The average plant size is 2,647 employees. Although the information is not reported in the table, the average number of employees in the sample experienced a 3%

[26] The sample is fairly heterogeneous in size and characteristics. Thus, we show quantiles instead of standard deviation to present a more visual idea of the range.

[27] To identify and select the sample of organizational downsizers, we use Definition 1 under its Fisher approach. Thus, Laspeyres and Paasche conditions must be satisfied. More, we also allow for a range of acceptace, i.e., per approach, if cost-efficient quantities of labor and capital change in opposite directions and one of them shows a variation below 2% while the other is higher in the opposite direction, then the unit is classified according to the latter.

decrease per year, with a more intense drop in the first half of the period. Both capital quantity and product quantity overlap this pattern, as do total assets, with similar decline rates. Consequently, it can be argued that this industry reduced its average plant size between 2000 and 2012. Input prices increased showing a converging trend of peripheral countries. Finally, the table shows the average level of profits and ROA. A further analysis that is not expressed in the table has shown an inverted U-shape in the ROA trend for this period. It is relevant to mention that the starting ROA of the sample of organizational downsizers was found to be, on average, two points lower than the industry level.

Table 2.2 shows the results for ROA change and further decomposition as proposed in the methodological section (namely, expressions 2.5 and 2.7, under its Fisher approach). More, the results in the table are now shown in geometric mean terms for the equalities in the row decomposition to hold. In general terms, values under one mean a decline or negative effect on financial performance, and *vice versa*.

INSERT TABLE 2.2 ABOUT HERE

Organizational downsizers had considerably poorer ROA levels (0.824) in the 2000/12 period. In a literature where no conclusion is reached on the effect of downsizing, our result is in line with such studies as De Meuse, Vanderheiden and Bergmann (1994) or Muñoz-Bullón and Sánchez-Bueno (2010). Nonetheless, it is should be noted that before the crisis downsizing plants kept their ROA somewhat stable, whereas they fell significantly after 2008.

The main driver is the return on sales, which we decompose into price recovery margin (column 6) and productivity change (column 7). The poorer return on sales (0.868) is equally due to lower ability to recover via changes in prices and declines in productivity. As for productivity, the change is decomposed into organizational downsizing and the manufactured productivity change (columns 8 and 9). To clarify, organizational downsizing in *Table 2.2* refers to the contribution of organizational restructuring to ROA, $O^0(p^0, y^1, y^0, w^0)$ (expression 2.6, under its Fisher approach), for the organizational downsizing plants. In productivity terms, reducing the organizational size in the automobile industry did not pay off (0.914) and plants suffered declines in productivity.

This result confronts a main body of literatre but agrees with some other studies based on labor-related measures of downsizing (Gittell *et al*., 2006; Reynaud, 2013; Chhinzer and Currie, 2014 or Goesaert, Heinz and Vanormelingen, 2015).

Organizational downsizing particularly (0.981), shows that the contribution of reducing organizational size to the change in ROA was slightly detrimental[28]. Simultaneously, organizational downsizers were not able to take advantage of any other kinds of effects while restructuring. The manufatured productivity change, which collects technical change and cost efficiency effects, makes a rather unfavorable contribution to financial performance (0.932).

2.6.Conclusion

Early literature defining downsizing considered a proccess whereby the whole set of production factors employed is reduced. However, even assuming this perspective, empirical approaches have failed to operationalize a reduction in all factors simultaneously. A common choice in manufacturing environments, where labor is a relevant asset, has been to use a reduction in the number of employees as a measure (and definition) of downsizing. Thus, the motivation of this work lies in the need to recover the traditional characterization of downsizing.

We propose and define a measure of *organizational restructuring* and, accordingly, *organizational downsizing*. The definition is inclusive, as it can consider all factors at once and not only labor. In addition, it provides a direct measure of the impact of downsizing on (financial) performance of a production unit. A non-parametric, DEA-based approach enables the decomposition of changes into a measure of financial performance. We take a different approach to the mainstream literature, where isolated measures are used to assess the effects of downsizing.

The methodology was illustrated using the automobile production industry in Europe, between 2000 and 2012. We found an important downturn in the average financial performance of organizational downsizing production plants. A lower return on sales is

[28] This result was found to be non-significantly different to 1 (mean test p-value > 0.1).

found, due to declines in productiviy. The organizational downsizing effect in itself made a moderate negative contribution to financial performance.

From our illustration, we can draw a direct managerial implication. On average, organizational downsizers seem to lack the ability to conduct downsizing properly. Although organizational downsizing has a moderate negative impact on financial performance, it was found that organizations failed to adapt the plant to its new size. No common feature was found among plants that succeeded at organizational downsizing, which emphasizes the importance of the process itself: organizational downsizing *per se* does not contribute to improvement but rather to carrying it out adequately. Further research is needed to find some patterns that characterize those successful and unsuccessful organizational downsizers.

Theoretically, this paper contributes to a wider conception of what downsizing stands for as part of the restructuring process, as well as to a better isolation of the actual effect on the financial performance of an organizational unit.

Exhibits, Figures and Tables

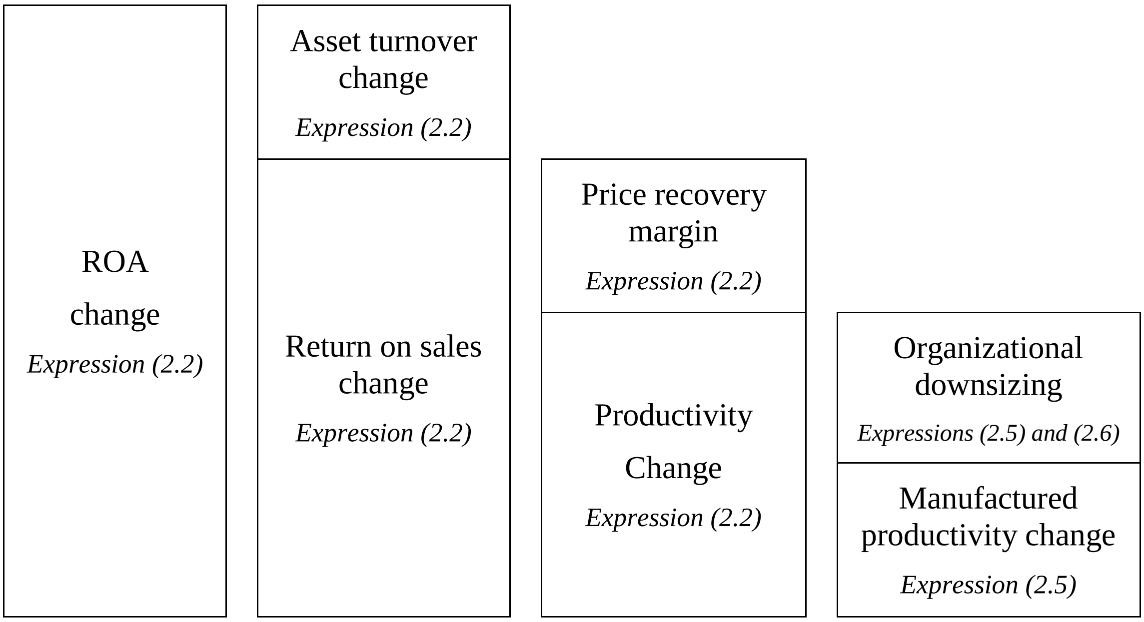

Exhibit 2.1. Representation of ROA change decomposition

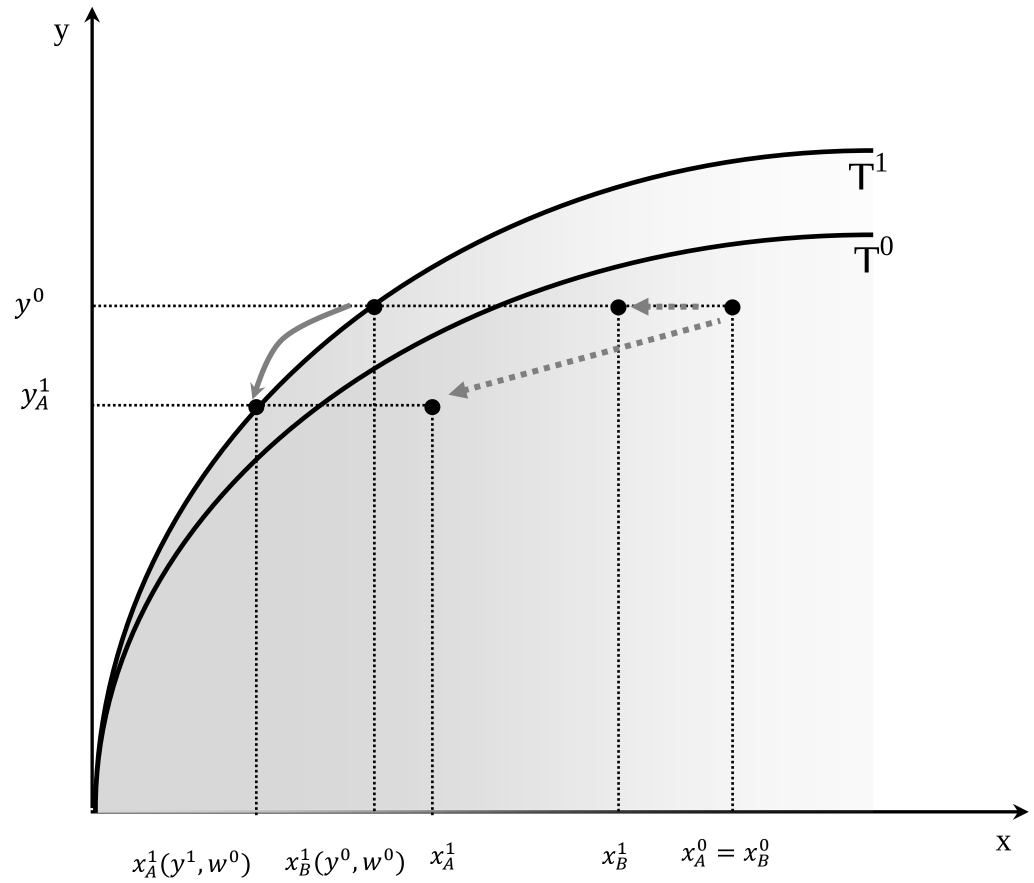

Figure 2.1. Organizational Downsizing. M=N=1.

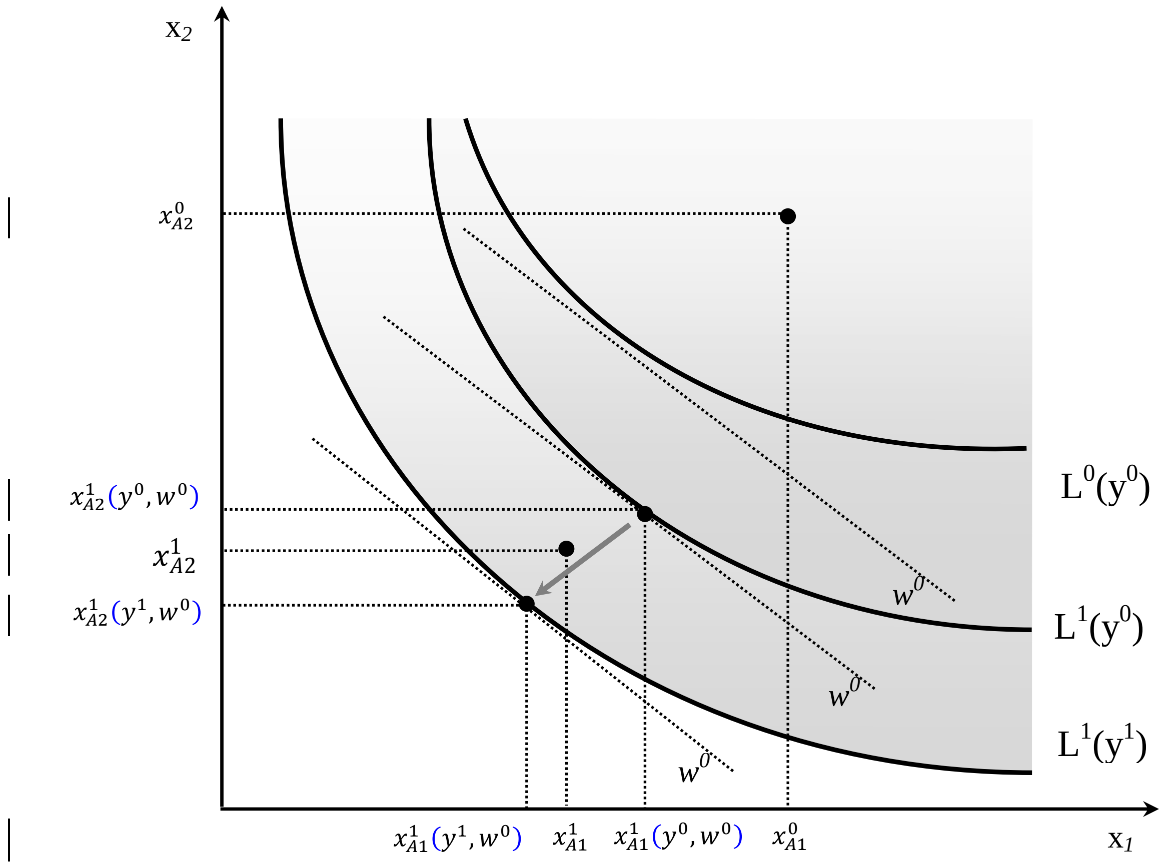

Figure 2.2.1. Organizational downsizing for organizational unit A. N=2

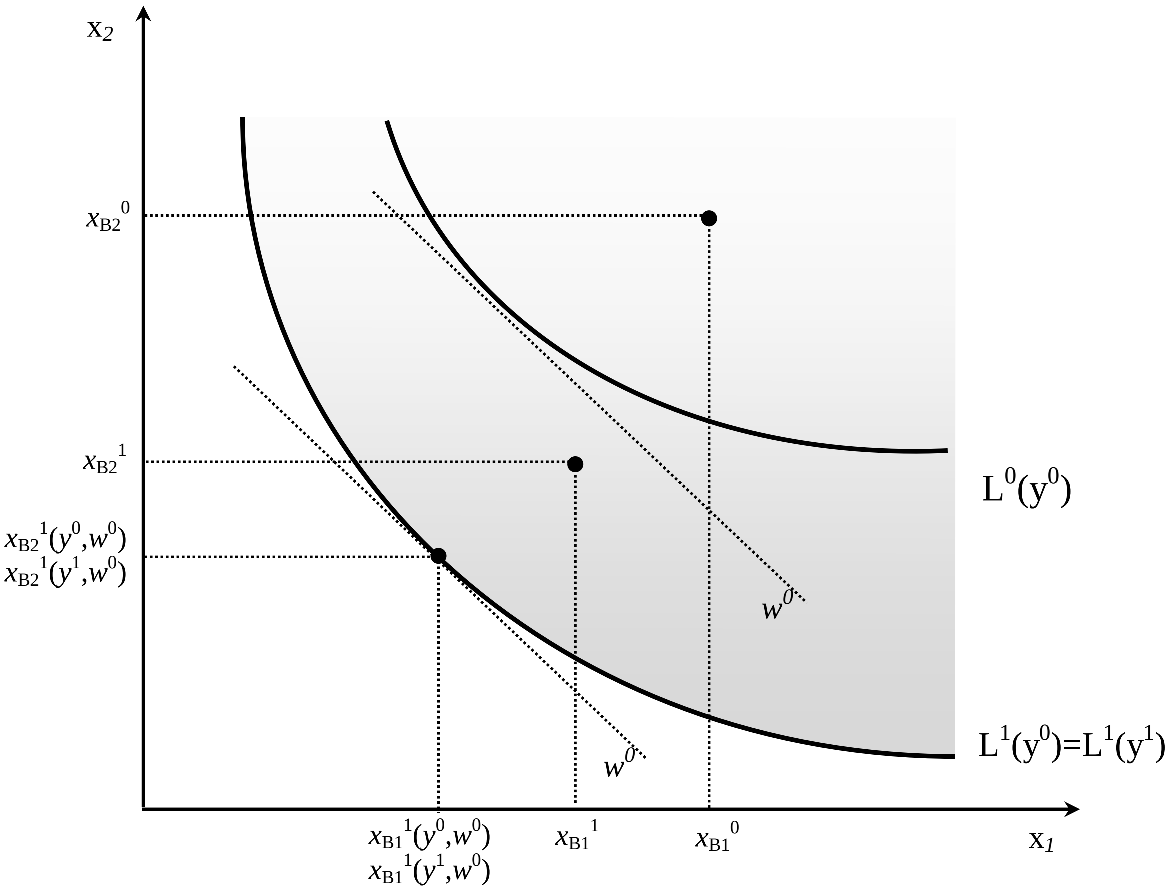

Figure 2.2.2. Non organizational downsizing for organizational unit B.

Table 2.1. Summary statistics per variable for organizational downsizers. Mean values.

Period	# Obs.	x_l Labor quantity (#)	w_l Labor price (current €)	x_k Capital quantity (th.€2000)	w_k Capital price (current €)	y Product quantity (th.€2000)	p Product price (€2000)	π Profit (th.current €)	A Total assets (th.current €)	ROA
2001/12	226	2,647	41,266	195,556	0.371	1,117,176	0.250	35,520	598,372	0.066
(percentile10)		*199*	*19,323*	*3,054*	*0.138*	*34,174*	*0.092*	*997*	*35,712*	*0.009*
(percentile 90)		*6,603*	*60,218*	*517,556*	*0.538*	*3,428,319*	*0.537*	*76,192*	*1,607,134*	*0.129*

Table 2.2. ROA change and drivers decomposition. Geometric mean values

				ROA change			Return on Sales change			Productivity change		
Period	# Obs	ROA change	=	Asset Turnover change	x	Return on Sales change	Price recovery margin	x	Productivity change	Organizational Downsizing	x	Manufactured Productivity change
[1]	[2]	[3]		[4]		[5]	[6]		[7]	[8]		[9]
2001/12	226	0.824		0.949		0.868	0.950		0.914	0.981		0.932
		1.746		*0.249*		*1.317*	*1.398*		*0.137*	*0.154*		*0.138*

CHAPTER 3

Organizational Restructuring: Upsizing vs. Downsizing among European Automobile Production Plants

Abstract

This study defines organizational downsizing and organizational upsizing in order to compare the financial consequences of these two types of restructuring strategies. Specifically, it assesses the contribution of productivity changes to financial performance, as well as its drivers. European automobile production plants are used to test several hypotheses that directly compare downsizers to upsizers. Results clearly suggest that the outcomes of organizational restructuring found in this industry for downsizers and upsizers are significantly different: organizational downsizing contributed to worsening financial performance whereas organizational upsizing contributed to improving it. More specifically, organizational downsizers yield important efficiency losses, driving productivity changes that worsen their financial performance. Reductions achieved in input prices did not compensate for the detrimental change in productivity. Downsizing goals were not met and there is no convergence between the two groups.

Chapter 3

Organizational Restructuring: Upsizing vs. Downsizing among European Automobile Production Plants

3.1.Introduction

The empirical literature lacks a consensus on the outcomes of restructuring processes. The findings are quite divided so the conclusions and implications of different studies usually rely upon idiosyncratic variables of the samples analyzed or the comparison counterparts (i.e., a non-downsizing sample). Many authors (e.g., Wayhan and Werner, 2000) acknowledge that these mixed results are partly due to differences in the variables used and the methodological approaches. Thus, our aim in this study is to contribute to better understanding the impact of restructuring processes on the financial performance of an organizational unit. We use the European automobile industry, at the plant level, and assess it between 2000 and 2012.

The downsizing literature has followed two main analytical approaches. The first more common one has been to analyze the impact of downsizing on the performance of an organizational unit. Financial and productivity outcomes (mainly labor-related ones) are the focus of this branch. The second and scarcer one compares downsizers with samples of non-downsizers. In this vein, there are two alternatives: comparing performance levels between samples and/or comparing changes in performance. In this study we start by separately presenting financial performance levels of two opposing samples of downsizers and upsizers. Then, a follow-up decomposition of changes in performance allows us to test whether restructuring lead to some type of convergence. Do downsizers perform better than upsizers? Do downsizers earn higher financial gains from restructuring than upsizers? By answering the latter question, we contribute to the branch of the literature analyzing changes.

It is worth mentioning at this point that the literature has used the concept of upsizing vaguely. Downsizing has traditionally been defined as reductions in labor (in either amount or percentage). Other approaches are based on similar variables such as announced layoffs. However, upsizing has been naturally blended with the idea of growth. Thus, many studies label an organization which does not downsize in their terms as a non-downsizer. A company making no changes in its inputs could be included in that group. In this chapter, we expand upon the methodology introduced in Chapter Two. This chapter defined organizational restructuring, namely downsizing and upsizing, as the situation where all the cost-efficient input quantities change simultaneously. We take those definitions to split and analyze the automobile industry.

Labor-based definitions of downsizing as a way to understand restructuring are not sufficient. To our knowledge, few studies have proposed ways to incorporate more than labor into the analysis (Cascio *et al*., 1997; Morris, Cascio and Young, 1999; Cascio and Young, 2003; and Sheaffer *et al*., 2009). However, their scheme is to combine simultaneous changes in different assets. We instead build an integrate measure of organizational restructuring that encompasses all organizational inputs.

Organizational downsizing and upsizing is then understood as two different strategies from the management viewpoint. Restructuring an organization entails a clear shift, in one direction or the other. In our specific case, an automobile plant may try to improve its competitiveness via organizational downsizing or organizational upsizing. We eventually want to test whether these two strategies were equally fruitful in this industry during the period studied and to ascertain the drivers behind the success or failure of each strategy. Furthermore, our longitudinal dataset enables two different scenarios to be identified: before the so-called economic recession (from 2000 to 2007) and during the recession (from 2008 to 2012). We refer to these periods as market expansion and contraction, respectively. A strategy that works in market expansion may work or not whenever there is a decline (contraction in demand, restricted financial access, outside competition and the like). We test whether the drivers of change in financial performance remain the same under the two different market conditions. Downsizing in expansion and upsizing in contraction seem less obvious but can still lead to major advantages. To our knowledge, these aspects have not yet been clearly explored in the literature.

Last but not least, the number of studies analyzing downsizing effects with non-parametric techniques is also very scant. Our upcoming revision generally relies on regression models or simple mean tests to identify the effects of restructuring. We only found Badunenko (2010) using DEA techniques to analyze the downsizing trend in the German chemical industry between 1992 and 2004. We adopt an approach based on the theory of index numbers that allows for the easy accommodation of a non-parametric approach. It directly links a measure of organizational restructuring to a measure of financial performance (namely, the return on assets, ROA).

With this study we want to better explain the impact of organizational restructuring on the financial performance of an organization. Specifically, we analyze the outcomes of the downsizing and upsizing strategies in European automobile production plants. At this point, our contribution to the empirical literature is twofold. First, after acknowledging the differences in financial performance between downsizers and upsizers, we test their financial consequences when restructuring. We test which type of restructuring contributed more to improving that performance in this industry. Furthermore, we highlight the productivity drivers behind that change. Secondly, we investigate how the market circumstances can shape the outcome of each type of restructuring or not.

The rest of the study is organized as follows. In Section 2 we present a survey of restructuring outcomes. It is based mainly on downsizing and labor-related approaches, as the literature has predominantly adopted these approaches. We outline several hypotheses arguing whether separate samples of downsizers and upsizers yield different effects on financial performance. In Section 3 we present the methodology, which is taken from and expands upon Chapter Two. We end this section by explaining the way we test our hypothesis. Sections 4 and 5 present the sample and the results of this study on European automobile production plants. We conclude in Section 6 with some implications of our results.

3.2.Effects of Restructuring

Within this section, we outline several hypotheses that directly compare the outcomes of organizational downsizing with the outcomes of organizational upsizing. As stated, the literature regularly defines downsizing via labor reductions. Likewise, the most common approach has been to study samples of downsizers separately. Therefore, we start by presenting some findings on the outcomes of labor downsizing. We continue by adding some literature that compares downsizers to non-downsizers to show the effects on financial performance. We build our first hypothesis in this vein. Next, we develop three additional hypotheses on the differences between groups regarding productivity drivers' contribution to changing financial performance. We finish with a section on the evolution of input price changes at restructuring.

As stated, we maintain the definition of organizational restructuring proposed in Chapter Two. An organizational restructurer is an organizational unit whose bundle of all cost-efficient input quantities changes between two periods. This definition improves the one traditionally used in the literature by allowing for a more refined split of a sample of restructurers. For instance, a non-downsizer is sometimes implicitly defined as any organization which does not downsize, which could include units not making any change at all in their input quantities. Our definition of an organizational upsizer clearly states that the organization increases its amount of inputs. Thus, our definition of upsizing is clearly discernible from the idea of non-downsizing. This approach isolates the cases that carry out no restructuring: they can be considered neither downsizers nor upsizers.

3.2.1. Labor Downsizing Outcomes

One conclusion that can be drawn from revising the empirical findings of the literature on downsizing is the lack of consensus on outcomes. Organizational performance is equally prone to improving and suffering in either the short or long run (Chadwick, 2004). Reviews by Davis *et al*. (2003), Gandolfi (2008), Datta *et al*. (2010) and Gandolfi and Hansson (2011) present both positive and negative effects of downsizing on different productivity and/or profitability measures. Findings are still very inconclusive. However, our revision suggests that studies more commonly find positive impacts on productivity and negative impacts on profitability (regardless the performance definitions used). In *Table 3.1.1* we summarize a selection of the empirical research revised. It shows articles where samples of downsizing observations were assessed in isolation. All articles in the table define downsizing exclusively via labor[29].

INSERT TABLE 3.1.1 ABOUT HERE

INSERT TABLE 3.1.2 ABOUT HERE

[29] Among those papers, we report either the main finding or the one that is more aligned with the analyses that we perform in this study, as some authors who more deeply assess the consequences of downsizing may find other specific results

Predictably, job cuts will help labor productivity. The efficient reduction of redundant labor alone will improve labor productivity if the company is able to keep the output levels. Therefore, financial performance would improve as it is directly affected by productivity gains. From the table we see that recurrent measures of productivity are sales per employee or value added per employee. We find that labor productivity is predominantly favored by labor downsizing (see Yu and Park, 2006, among others) although a minor portion finds it to worsen (e.g., Reynaud, 2013). As for the financial outcomes, the results are more disperse. Profitability measures either improve or worsen after labor downsizing, and many times studies attribute these effects to the units' ability to carry out the downsizing adequately. That is to say, to translate the productivity gains obtained into financial gains.

Knowing that about downsizing, we now start our comparison between downsizers and non-downsizers. Our main findings are shown in *Table 3.1.2* (some perform this analysis after assessing downsizing outcomes, so they were added in *Table 3.1.1* as well).

3.2.2. Restructuring and Financial Outcomes

The main objective of this study is to analyze the financial consequences of restructuring processes by comparing organizational downsizers to organizational upsizers. Within the literature revision we refer to the latter as non-downsizers. Both strategies are meant to improve the profitability level, but there is scarce, yet inconclusive, research on the differences (see *Table 3.1.2*). Productivity gains via input reductions make downsizers seem more prone to outperforming non-downsizers in profitability gains. However, other affecting factors may alter this reasoning. We build our profitability hypothesis to test which restructuring alternative leads to higher financial gains.

Among the reasons to downsize, authors commonly cite market declines (Greenberg, 1990; Baumol, Blinder and Wolff, 2003; Reynaud, 2013; Kawai, 2015) or restructuring plans (Chen *et al.*, 2001). However, the main reason is justified on poor financial performance prior to downsizing (Iqbal and Shetty, 1995; Budros, 1997; Yu and Park, 2006; Gandolfi and Hansson, 2011; Freeman and Ehrhardt, 2012; Goyer, Clark and Bhankaraully, 2016). Aiming to improve operating efficiency makes downsizing an approved move. A business reduces its inputs in order to preserve or improve its productivity levels via efficiency gains, so that it can obtain higher positive effects in its financial performance. Theoretically, layoffs would improve financial performance whenever efficient cost cutting comes with a stable level of revenues. However, results show that the objective is diluted in the process and the goal of improvement is not achieved. Many times, profitability motives vanish and downsizing continues because it is ideologically correct (Mone, McKinley and Barke, 1998). This justifies the literature reporting lower labor costs but also lower ROA and inconsistent profit margins (Datta *et al*., 2010; Gandolfi and Hanssen, 2011). The profitability consequences of downsizing in *Tables 3.1.1* and *3.1.2* (mainly, ROA) do not seem consistent. It can improve or fade and/or the effect can be better or worse in downsizers than their counterparts.

Inclusive restructuring measures are also lacking. Whenever different inputs may change in different directions, the results can be mixed. In our revision, only several articles included more than labor in the analysis of downsizing. Cascio *et al*. (1997), Morris, Cascio and Young (1999) and Cascio and Young (2003) propose different combinations of labor changes together with changes in physical assets to examine the performance consequences. When analyzing ROA trends of different groups during several periods after restructuring, none of them obtained significant improvements. Firms did not find any gain via either labor or assets, or their combination, regardless of the type of restructuring. Sheaffer *et al*. (2009) also propose combinations of changes in different assets. In their results, all groups reported negative effects on long-term profitability (profit margins). Particularly, labor downsizing in tandem with asset downsizing shows very poor results. In short, these studies do not allow us to draw clear conclusions on restructuring outcomes.

Thus, previous findings do not help determine solid conclusions on outcomes. The previous studies do not concur with each other, nor are the methodologies broad enough to measure organizational restructuring. Therefore, within the automobile industry, we directly compare the differences in the financial change of downsizing and upsizing production plants. Relying on a theoretical perspective, we propose the first hypothesis to test whether downsizers got better financial outcomes than upsizers.

Hypothesis 1 *(H1): organizational downsizers obtain higher ROA gains than organizational upsizers.*

At this point, there is an interest in whether this hypothesis holds for different market conditions: namely expansion and contraction. The literature has made some advances on the potential effect of the market circumstances. An expansion can be interpreted as an opportunity for businesses to thrive. According to Budros (1999), in a competitive market, a plant can find incentives to cut its size in order to improve its position in relation to its rivals. His findings support this hypothesis. In market peaks firms are also pushed to remain competitive. Plants anticipate that the expansion is just a cycle and they reduce their level of inputs to gain competitiveness before it ends. As for contraction periods, while downsizing may seem like a justifiable move, Luan, Tien and Chi (2013) found that Taiwanese companies suffered financially after downsizing, between 2005 and 2009. Likewise, expanding the level of inputs during expansion or contraction responds to opportunity factors aiming to increase performance. Thus, we propose two mutually exclusive contexts as extensions to our hypothesis: before and after 2008. Eventually, we test whether our prediction holds under these different circumstances. In the applied section, we refer to these extensions as *a* and *b*.

3.2.3. Restructuring and the Drivers of Productivity Change

Productivity change is a main component of financial performance change. The literature has explored its outcomes after restructuring (mostly with downsizing). We started Subsection 2.1 stating that lowering the input level while keeping the output constant will theoretically raise productivity. Contrarily, more inputs would necessarily need a higher increase in the output. If we compare downsizers to non-downsizers, that reasoning may hold. In this subsection, we argue about the drivers of productivity change: technical change, efficiency change and the contribution of organizational restructuring. Those drivers are further explained in the methodological part. Hypotheses at this point will help to understand better how each driver contributes per group. We start by revising the literature on these effects.

One drawback found among the studies is that they are geared more toward labor productivity instead of productivity[30]. Early on, Baily *et al*. (1996) pointed out that "the focus on labor productivity rather than total factor productivity affects the interpretation of our results. The role of capital deepening and biased technical change cannot be thoroughly understood by the behavior of labor productivity alone: for example, investments in labor saving equipment which increase labor productivity may not be successful from a TFP point of view". Their results suggest that plants engaged in downsizing experienced skill-based technical change, as they keep more productive labor. Siegel (1999) finds the same pattern, stating that technological changes are closely associated with downsizing. There is a shift in labor composition in favor of workers with higher educational levels.

A plant that efficiently downsizes would keep more skilled workers and more advanced assets, yielding positive technical change. That efficient cut that allows for technical change can go in tandem with efficiency gains. In the applied part of this chapter, these efficiency gains are measured through cost reductions (via cost efficiency). Both technical change and efficiency gains would contribute to improving financial performance. The following two hypotheses compare the contribution of these drivers between the two groups of restructurers. In the applied part, tests are also carried out by type of market.

Hypothesis 2 *(H2): organizational downsizers obtain better contribution from technical change to financial performance than organizational upsizers.*

Hypothesis 3 *(H3): organizational downsizers obtain better contribution from efficiency change to financial performance than organizational upsizers.*

Together with technical change and efficiency change, our methodology taken from Chapter Two and briefly presented in Section 3 isolates the contribution of restructuring itself. It measures the direct effect of organizational restructuring on financial performance of the plant, via productivity changes. To our knowledge, this aspect has not previously been compared for downsizers and counterparts in the literature. Mimicking the previous hypotheses, we propose the following:

[30] We use productivity to refer to total factor productivity (TFP)

Hypothesis 4 *(H4): organizational downsizers obtain better contribution from restructuring to financial performance than organizational upsizers.*

3.2.4. Restructuring and Productivity Change

The joint effects of technical change, efficiency change and organizational restructuring contributions will determine productivity change. The main measurement of productivity in the literature has been output per employee (see *Tables 3.1.1* and *3.1.2*). Here we revise some of the main findings from this body of works.

Little research has been done in this vein a plant-level. Baily *et al*. (1996) analyze the causes behind labor productivity gains among plants in the US manufacturing sector for a period of economic growth (1977-87). They classify plants as downsizers/non-downsizers depending on their changes in labor, and successful/unsuccessful depending on the labor productivity change. Four categories are thus created (e.g., a successful downsizer is a plant where labor productivity increased after layoffs). Their findings show that downsizing can lead to both labor productivity gains and losses. Likewise, non-downsizers contributed to overall productivity growth in the 1980s almost as much as downsizers did. This suggests that regardless of the type of restructuring, plants must be able to successfully accomplish it.

Using the same classification as in Baily *et al*. (1996), Collins and Harris (1999) also compare downsizers versus non-downsizers, for different economic phases. They make use of plant-level data as well, in the British automobile production sector. The findings of their study show that successful downsizers outperformed the other three categories on average, especially in a period of economic stability (1985-89). Only plants that successfully increased their inputs were able to surpass them in a period of economic downturn (1979-85). However, it is also true that successful downsizers were not always able to translate labor productivity gains into profits, whereas successful non-downsizers regularly did. Interestingly, unsuccessful downsizers had the worst productivity records of all the groups. Finally, Baily *et al*. (2001) describe how the labor productivity of persistent downsizers outperforms the productivity of the other groups. However, they also show how an adverse market shock significantly affects the productivity of downsizers more.

Most of the comparison studies in *Table 3.1.2* merely present the mean level of productivity measures of downsizers and non-downsizers pre- and post- restructuring. To our knowledge, only Chen *et al*. (2001) compare productivity changes of both groups at once. This allows us to infer to what extent the effects are greater for one group. They find that labor downsizers achieve higher productivity gains. However, they only refer to labor-related productivity (i.e., sales per employee) not productivity. Some studies overcome this drawback by using broader measures of productivity. The same rationale as before says that a downsizing organization that reduces all its inputs will get productivity gains as long as it is able to maintain a somewhat stable level of output. However, the results are still related to labor-based definitions of downsizing. Baumol *et al*. (2003), find no effect of labor downsizing on productivity.

Whether or not downsizers are able to obtain higher productivity gains than upsizers needs empirical assessment. It will heavily depend on their ability to carry out the restructuring process. Many uncontrollable factors may appear while in the process (Cascio, 2010). With hypothesis 5, we test for differences between groups in the contribution of productivity changes to financial performance. We propose that downsizers will obtain a higher contribution from productivity, which contrasts with the main body of results but agrees with some dynamic results (Chen *et al*., 2001). The hypothesis summarizes the three previous ones and it is stated as:

Hypothesis 5 *(H5): organizational downsizers obtain better contribution from productivity change to financial performance than organizational upsizers.*

3.2.5. Restructuring and Input Prices

Together with productivity changes, variations in input prices drive financial performance change. That is, financial performance will be determined by the joint evolution of changes in productivity and input prices. It will improve whenever productivity gains go hand in hand with a reduction in input costs. Likewise, it will hold if the reduction in input prices surpasses productivity losses or if the productivity gains cover the growth in input prices. Otherwise, financial performance will be worse off when productivity losses go hand in hand with an increase in input prices. Yet this also happens if productivity gains are not able to offset price increases or if productivity losses surpass price reductions. A business facing a contraction in demand while being price-taker in the inputs market can merely reduce the amount of labor (Cappelli, 2000). Thus, productivity gains and a simultaneous reduction in input prices are hard to find. Chen *et al*. (2001) provide evidence on financial performance improvement via operating income (driven by both labor productivity gains and margins).

In a case where restructuring would not affect productivity, the firm can still be inefficient. If input prices decrease, the firm would potentially obtain profitability gains (Cappelli, 2000). Labor contract revisions are a necessary step after downsizing for corporate survival (Chen *et al*., 2001). Downsizing would push wages down, as the firm may put pressure on the remaining workers under the threat of layoffs. Thus, downsizing tends to depress wages and worker compensation. Baumol *et al*. (2003) show no effect on productivity but improved profitability. They argue about the reduction in unit costs driven by input price reductions (p. 228). Finally, in the face of productivity loses, if the firm is able to reduce input prices but still it does not compensate sufficiently, profitability loses would appear (Dong and Xu, 2008).

There is a counterargument that justifies wage increases after downsizing. As suggested above, an organization aims to cut less efficient inputs, and that produces a skill-biased technical change. If we assume that more efficient inputs are paid better, downsizing will raise the average price of inputs. Baily *et al*. (1996) found that largest increase in wages occurs among plants that suffered higher rates of employment decline. An increase of input prices in upsizing could be also justified by an increase in the demand of those inputs.

Thus, arguments and findings are opposed. Additionally, the main finding and reasoning is usually based on labor prices, which is more affected by restructuring. To improve this, we build an input price index for all the inputs in the production plant. We test how the prices of the inputs change and how different that change is by group. Based on some previous findings explained above, we presume that organizational downsizers are able to lower the prices of inputs and that the reduction they obtain is larger than in their upsizing counterparts.

Hypothesis 6 *(H6): organizational downsizers obtain larger reductions in input prices than organizational upsizers.*

This hypothesis only tests the evolution of input prices. However, we develop a measure of price recovery margin. Thus, once we understand better how input prices change, we are able to argue whether production plants translated those changes into their margins or not. In the next section, we outline our methodology and connect it with the hypotheses proposed here.

3.3.Methodology

In this section, we briefly present the methodology based on the definitions proposed in Chapter Two. We already mentioned our specific sample of automobile production plants. Consider $p = (p_1, \dots, p_{\mathrm{M}}) \in \mathrm{R}^{\mathrm{M}}_{++}$ and $y = (y_1, \dots, y_{\mathrm{M}}) \in R^{\mathrm{M}}_{+}$ as vectors of output prices and quantities for the case of a production plant. We consider Iunits indexed $q = 1, \dots, I$. As for the inputs, $w = (w_1, \dots, w_{\mathrm{N}}) \in \mathrm{R}^{\mathrm{N}}_{++}$ represents the vector of prices and $x = (x_1, \dots, x_{\mathrm{N}}) \in \mathrm{R}^{\mathrm{N}}_{+}$ is the vector of quantities. $A \in R_{++}$ represent the assets of a production plant, which may be different than the capital input quantity. Easily, revenues of a specific production plant are denoted as $R = p^T y$ and total cost as $C = w^T x$, where "T" represents the transpose of the vector. A plant's profits are then calculated as $\pi = R - C$ and the profitability as $\Pi = R/C$.

We take advantage here of our novel definition of organizational downsizing based on return on assets (ROA):π/A. The reader may notice that A can be not only assets but also any other financial measure for the indicator needed by the analyst. Financial performance of a plant, return on assets, can be explained by the product of profit margin or return on sales and asset turnover, as follows:

$$\frac{\pi}{A} = \frac{\pi}{R} \times \frac{R}{A} \tag{3.1}$$

The decomposition in (3.1) is well-known as the duPont triangle[31]. Return on sales (π/R) in expression (3.1) can be re-expressed in terms of costs as $\pi/R = \ ^T y/w^T x$. Instead of revenues, we consider total cost. Thus, $\ ^T y = (\pi/R)C = \pi/\Pi$. For the case of a single output (M = 1), $\ = (p - uc)/\Pi$, where $\Pi = p/uc$ and $uc = w^T x/y$ is the

[31] Johnson (1975) provides an interesting historical perspective on its use.

unit cost. So, represents a vector of output prices that are scaled unit profits. For the case of multi-output (M > 1) profits are scaled the same to create $\rho_i, i = 1, \dots M$. To overcome the difficulty of cost allocation per product we define $\rho = (\beta p_1, \dots, \beta p_M)$, where $\beta = (\ /\Pi)/R$. The interpretation of is preserved, but it is considered that the profit associated with a one product is proportional to its revenue share i.e., $(p_i - uc_i)y_i = \pi\alpha_i$, where $\alpha_i = (p_i y_i/R)$ and $\sum \alpha_i = 1$. $i = 1, \dots, M$[32]. We follow this in expression (3.2).

Variations in ROA need a dynamic approach, so we define 0 and 1 as the base and comparison periods, respectively. ROA change from the base to the comparison period is computed as in this next expression, departing from (3.1):

$$\frac{\pi^1/A^1}{\pi^0/A^0} = \frac{\rho^{1T}y^1/w^{1T}x^1}{\rho^{0T}y^0/w^{0T}x^0} \times \frac{R^1/A^1}{R^0/A^0}$$

$$= \left[\frac{p^{0T}y^1/p^{0T}y^0}{w^{0T}x^1/w^{0T}x^0} \times \frac{p^{1T}y^1/p^{1T}y^0}{w^{1T}x^1/w^{1T}x^0}\right]^{1/2} \times \left[\frac{y^{0T}\rho^1/y^{0T}\rho^0}{x^{0T}w^1/x^{0T}w^0} \times \frac{y^{1T}\rho^1/y^{1T}\rho^0}{x^{1T}w^1/x^{1T}w^0}\right]^{1/2} \quad (3.2)$$

$$\times \frac{R^1/A^1}{R^0/A^0}.$$

The first row defines the change in the return on assets as the product of changes in the return on sales and changes in the assets turnover. By using that ROA change, we test our first hypothesis (H1) about financial performance, both for downsizers and upsizers. Then, the change in return on sales is subdivided into two other components on the second and third rows. The first one can be considered a Fisher productivity index (geometric mean of Laspeyres and Paasche productivity indexes). We use this component to test hypothesis 5 (H5), which compares productivity change contributions to financial performance between restructuring groups. The second component of the second row is a Fisher price recovery margin index number (geometric mean of Laspeyres and Paasche price recovery indexes). The first one reports on the productivity gains that a production plant can achieve, whereas the second signals its ability to

[32] We have: $\rho^T y = \sum \beta p_i y_i$, from the definition of $\rho = (\beta p_1, \dots, \beta p_M)$.
$= \sum(\pi/\Pi)(p_i y_i/R)$, because $\beta = (\ /\Pi)/R$
$= \sum(\pi\alpha_i/\Pi)$, where $\alpha_i = (p_i y_i/R)$ and $\sum \alpha_i = 1$. (a)
We know from a previous finding: $\rho^T y = \sum((p_i - uc_i)y_i/\Pi)$ (b)
Combining (a) and (b): $\sum((p_i - uc_i)y_i/\Pi) = \sum(\pi\alpha_i/\Pi)$, and yields $(p_i - uc_i)y_i = \pi\alpha_i, i = 1, \dots, M$.

transform input prices variations into normalized unit profit gains. Denominators of the components used for the Fisher price recovery index are expressions for input price indexes ($x^{0T}w^1/x^{0T}w^0$ and $x^{1T}w^1/x^{1T}w^0$). Its geometric mean represents the Fisher input price index, which we use to test hypothesis 6 and its extensions (H6).

For clarity, the decomposition shown in this section is presented in *Exhibit 3.1*. In the exhibit, each component of the decomposition is linked to its corresponding mathematical expression. Likewise, we show which component is used to test each of the hypotheses presented above. So far, expression (3.2) is represented between the first and third columns in *Exhibit 3.1*.

INSERT EXHIBIT 3.1 ABOUT HERE

Our definition of restructuring encompasses all factors in an automobile production plant. We start now by presenting the input-output combinations that define the technologically feasible set based on Data Envelopment Analysis (Charnes *et al.*, 1978; Banker *et al.*, 1984; Färe *et al.*, 1985). We work with a sequential frontier to avoid technical regress, such that

$$T^1 = \left\{(x,y): y \leq \sum_q \sum_{s \leq 1} \lambda_q^s y_q^s \,,\; x \geq \sum_q \sum_{s \leq 1} \lambda_q^s x_q^s,\; \sum_q \lambda_q^s = 1, \lambda_q^s > 0\right\}, \tag{3.3}$$

where x_q^s is the input vector and y_q^s is the output vector for plant q in period s, respectively. The technology is built under variable returns to scale and the frontier is the above enveloping line formed by best performers in all the years. The technology in terms of its input set is $L^1(y^1) = \{x^1 : (x^1, y^1) \in T^1\}$ and it is bounded below by the input isoquant. $c^1(y^1, w^1) = min_x\{w^1x^1 : x^1 \in L^1(y^1)\}$ represents a cost frontier, the minimum cost to produce y^1 outputs at the input price level w^1. Defined $c^1(y^1, w^1)$, it is equivalent to $w^{1T}x^1(y^1, w^1)$ where $x^1(y^1, w^1) = \{x_1^1(y^1, w^1), \dots, x_N^1(y^1, w^1)\}$ is the cost-efficient vector of input quantities. The total cost $C^1 = w^{1T}x^1$ is bounded below by the cost frontier, which is non-decreasing in y and non-decreasing, concave, and homogeneous of degree +1 in w. The cost frontier enables us to compute the cost-efficient input quantities such that $w^{1T}x^1(y^1,w^1) \leq w^{1T}x^1$. The difference between the two is attributable to technical and allocative efficiency and our definition of restructuring is based on those cost-efficient quantities. In Chapter Two organizational restructuring was defined and consequently so were organizational downsizing and upsizing. For simplicity, we used a Laspeyres perspective. Under a Fisher approach, all cost-efficient input quantities are strictly lower or higher for downsizers and upsizers, respectively, both for Laspeyres and Paasche.

DEFINITION 3.1

An organizational unit experiences restructuring when $x^1(y^0,w^0) \neq x^1(y^1,w^0)$ *plus* $x^0(y^0,w^1) \neq x^0(y^1,w^1)$. *Organizational downsizing occurs when* $x^1(y^1,w^0) < x^1(y^0,w^0)$ *plus* $x^0(y^1,w^1) < x^0(y^0,w^1)$ *and, conversely, organizational upsizing occurs when* $x^1(y^1,w^0) > x^1(y^0,w^0)$ *plus* $x^0(y^1,w^1) > x^0(y^0,w^1)$.

3.3.1. Measuring Financial Performance of Organizational Restructuring

The denominator in the Laspeyres and Paasche productivity indexes in the second row of expression (3.2) can be rewritten as

$$\frac{w^{0T}x^1}{w^{0T}x^0} = \frac{w^{0T}x^1(y^1,w^0)}{w^{0T}x^1(y^0,w^0)} \times \frac{w^{0T}x^1/c^1(y^1,w^0)}{w^{0T}x^0/c^1(y^0,w^0)} \quad \text{and}$$

$$\frac{w^{1T}x^1}{w^{1T}x^0} = \frac{w^{1T}x^0(y^1,w^1)}{w^{0T}x^0(y^0,w^1)} \times \frac{w^{1T}x^1/c^0(y^1,w^1)}{w^{1T}x^0/c^0(y^0,w^1)} \tag{3.4}$$

The Laspeyres/Paasche input quantity is then decomposed to isolate the effect of restructuring. Combining expressions (3.2) and (3.4) yields this definition of the Fisher productivity index

$$\left[\frac{p^{0T}y^1/p^{0T}y^0}{w^{0T}x^1/w^{0T}x^0} \times \frac{p^{1T}y^1/p^{1T}y^0}{w^{1T}x^1/w^{1T}x^0}\right]^{1/2} =$$

$$\left[\frac{p^{0T}y^1/p^{0T}y^0}{w^{0T}x^1(y^1,w^0)/w^{0T}x^1(y^0,w^0)} \times \frac{p^{0T}y^1/p^{0T}y^0}{w^{1T}x^0(y^1,w^1)/w^{1T}x^0(y^0,w^1)}\right]^{1/2} \quad (3.5)$$

$$\times \left[\frac{w^{0T}x^0/c^1(y^0,w^0)}{w^{0T}x^1/c^1(y^1,w^0)} \times \frac{w^{1T}x^0/c^0(y^0,w^1)}{w^{1T}x^1/c^0(y^1,w^1)}\right]^{1/2}.$$

The second row in (3.5) expresses the contribution of *organizational restructuring* to ROA change. The component in the third row in (3.5) was introduced in Chapter Two as *manufactured productivity change*. As stated, the Fisher productivity index is used in hypothesis 5, and the contribution of the organizational restructuring is used for hypothesis 4 (H4). Both the hypothesis and its corresponding component testing it are illustrated in *Exhibit 3.1*. Now, this last term in (3.5) can be decomposed as:

$$\left[\frac{w^{0T}x^0/c^1(y^0,w^0)}{w^{0T}x^1/c^1(y^1,w^0)} \times \frac{w^{1T}x^0/c^0(y^0,w^1)}{w^{1T}x^1/c^0(y^1,w^1)}\right]^{1/2} =$$

$$\left[\frac{c^0(y^0,w^0)}{c^1(y^0,w^0)} \times \frac{c^0(y^1,w^1)}{c^1(y^1,w^1)}\right]^{1/2} \times \left[\frac{w^{0T}x^0/c^0(y^0,w^0)}{w^{0T}x^1/c^1(y^1,w^0)} \times \frac{w^{1T}x^0/c^0(y^0,w^1)}{w^{1T}x^1/c^1(y^1,w^1)}\right]^{1/2} \quad (3.6)$$

The manufactured productivity change is decomposed into technical change and cost efficiency change (Crifell-Tatjé and Lovell, 2015). From a cost perspective, the first and second components of the second row in (2.6) express the contribution of technical change and cost efficiency change to ROA change, respectively. Both are defined under a Fisher perspective. In our sequential technology approach, we prevent from technical regress so that the expression can only take values equal to or higher than one. Consequently, it will contribute to enhancing financial performance. We test hypotheses 2 and 3 (H2 and H3) with those two components. These hypotheses together with their corresponding components testing them are illustrated in *Exhibit 3.1*.

3.3.2. Hypotheses Contrast

In order to test whether means from different groups are equal or not, we run Welch's two-sample t-test (Welch, 1947). Unlike Student's t-test, Welch's does not assume equal variances. By modifying the degrees of freedom, the test is more robust for samples with unequal variance. Thus, Welch's is meant to be more reliable than Student's t-test for unequal variances and sample sizes, which is the case in our applied part for the automobile industry.

All hypotheses from Section 2 are tested and interpreted on a similar basis. All hypotheses, from 1 to 6, and their extensions, *a* and *b*, are expressed as a null hypothesis (Hi_0) and an alternative one (Hi_1), as in:

$$Hi_0: \bar{\mu}_{downsizers} - \bar{\mu}_{upsizers} = 0, \qquad i: 1, 2, 3, 4, 5 \textit{ and } 6$$

$$Hi_1: \bar{\mu}_{downsizers} - \bar{\mu}_{upsizers} \neq 0, \qquad i: 1, 2, 3, 4, 5 \textit{ and } 6$$

We generalize $\bar{\mu}$ for the average value of any of the variables being analyzed (e.g., ROA change). The null hypothesis proposes that the difference in means equals zero, and the alternative hypothesis expresses that this difference is not equal to zero. We work with a 95 percent confidence level. If the null hypothesis is rejected (*p-value* > 0.05), we can interpret that organizational downsizers and upsizers obtain a different mean value for the variable being tested. At this point the result of the Welch's *t* statistic tells us the direction of the difference, and it is computed as:

$$t = \frac{\bar{\mu}_{downsizers} - \bar{\mu}_{upsizers}}{\sqrt{\frac{s^2_{downsizers}}{N_{downsizers}} + \frac{s^2_{upsizers}}{N_{upsizers}}}}$$

A negative (positive) value indicates that downsizers' (upsizers') mean is lower. So, first, by rejecting the null hypothesis we accept that the means are different. Then, we can find support for the hypotheses proposed in Section 2 whenever Welch's *t* statistic takes a positive value. This reasoning works for hypotheses 1 to 5, where the mean of downsizers is expected to be higher than the mean of upsizers. Hypothesis 6, however, says that input price reductions are larger among downsizers. Measured via index numbers, we must reverse the reasoning so only a negative value would support the hypothesis. Operatively, we built the t-test with the logarithms of the original values, as we did a mean test for geometric means. Before running the test for each of the hypotheses, we tested and found that all the independent samples were normally distributed, which is one of their main assumptions[33].

3.4. The Data

The 'Association des Constructueurs Européens d'Automobiles' (ACEA) and Eurostat, tell the automobile production sector to directly provide 2.2 million jobs (more than 3 million when indirect jobs are considered). Under these numbers, this sector is doubtlessly a prime actor in the European economy. The sample for this study initially considers the EU-28, assuming important policy measures issued at the EU level from 2000 to 2012. In other words, the regulatory context can be considered rather similar. After 2000, some countries from this group whose candidacy had been proposed at least since 1997 joined the Union. Only Croatia[34] made its candidacy official in 2004, becoming a member in 2013. The decade considered is characterized by economic shocks and this industry was undoubtedly affected.

At plant level, our dimension of analysis, we gather information from the European automobile manufacturing industry. Amadeus database provides multidimiensional, accounting information for all European automobile production plants. Specifically, our initial selection was based upon the NACE[35] activity code 2910, namely, *"manufacture of motor vehicles"*[36]. Both private and public plants were included in the final sample that we are about to describe, although public ones comprised a negligible irrelevant percentage (under 2%).

Our main database, Amadeus, provides financial figures per production plant. Nonetheless, some units were initially dropped from the sample. As some very small

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[33] Mann-Whitney test was also run as an alternative non-parametric test of differences. The conclusions exactly mimic the ones obtained from Welch's test.

[34] Only one plant in the sample is located in Croatia.

[35] "Statistical Classification of Economic Activities in the European Community", subject to legislation at the EU level, which imposes the use of the classification uniformly within all the Member States.

[36] Data download/collection took place twice between 2011 and 2013. Thus, the criteria for unit selection was its main activity (NACE: 2910) available at the moment of the download.

plants may show very inconsistent trends, if the average number of employees for the period was lower than one hundred, we decided to exclude the plant. More importantly, we discarded those with unreasonable or inconsistent data during the period[37]. It is important to note that for the period analyzed, companies started adopting international financial reporting standards (IFRS), moving away from local general accepted accounting principles (GAAP). In the study, we paid attention to this change in order to make the sample comparable.

At this point, we have 160 production plants. A further step, as we are working under a ROA approach, was to rule out observations that report negative profits for the year. Under our methodology, a negative result can yield meaningless results. Thus, the final sample we work with is an imbalanced data panel containing observations from 125 production plants from 16 different countries in the EU-28. A high proportion of these plants is a part of one of the main production groups, European or otherwise. We noticed high birth/death rates, which helps explain the aforementioned imbalance. It is also relevant to highlight that during this period some manufacturers developed offshoring processes, which also explains the birth/death events[38].

The accounting statements of the plant show the profits for a given period of time. Furthermore, the investment in assets are also reported. In accounting terms, these profits are called "*earnings before taxes*" (EBT). In the applied part below, we follow a value added approach because of unavailable or incomplete information on the quantity of intermediate materials. In the accounting records, only the total cost of the intermediate materials is provided. Therefore, the value added is the calculated as total revenues minus total cost of intermediate materials. In our approach, we use labor and capital as these intermediate materials. We shall now name and describe the variables used in our analysis: inputs (labor and capital) and output (value added based figure):

i) *Labor quantity* (x_l). The labor is defined as the average number of employees at the plant during the year. It is computed as the average between the total reported number of employees at the beginning and end of the accounting period.

[37] Some plants were removed from the sample because abnormal trends were found for relevant variables e.g., number of employees, amount of assets, compensation per employee, price of capital, among others.

[38] The traditional definition for offshoring includes both the practice of a unit contracting external functions with a third party– outsourcing – and moving to a different location itself. This explains both the birth and death of plants in the sample.

ii) *Labor price* (w_l). It is defined by the ratio between the total labor compensation of the plant and labor quantity. Consequently, the product of labor quantity and its price is equal to the total labor cost for the plant during the period.

iii) *Capital quantity* (x_k). The value of the net tangible assets in the accounting records of the plant (x_k^{2000}) in 2000 is taken as starting point. To construct the capital stock of the next year (2001), the annual assets depreciation of the year is first subtracted from the capital stock existing at the beginning of the period. This can be expressed as: $x_k^{2000}(1-\delta^{2001})$, where δ^{2001} expresses the depreciation rate of the period. Second, the investment made by the plant in 2001 (I^{2001}) is identified. Third, this investment is valued at constant 2000 prices by applying the consumer price index of the country that the plant belongs to as a deflator, i.e., $I^{2001}/(1+d_{2000}^{2001})$ where d_{2000}^{2001} represents the consumer price index of period 2001. Fourth, capital stock of 2001 is defined by the sum of this deflated investment plus the adjusted assets from 2000 as calculated previously $(x_k^{2000}(1-\delta^{2001})+I^{2001}/(1+d_{2000}^{2001}))$. The stock of capital of the following year 2002 is calculated in exactly the same way, and so on for the rest of the years. In summary, the stock of capital of the year *t*+1 is calculated as $x_k^{t+1} = (x_k^t(1-\delta^{t+1})+I^{t+1}/(1+d_{2000}^{t+1})), t = 2000, \dots 2011$, where d_{2000}^{t+1} is the cumulative deflator from 2000 to year *t*+1.

iv) *Capital price* (w_k). It is calculated as the ratio between total capital costs of the plant (interest paid plus depreciation) and the stock of capital of the period. Therefore, the product of capital quantity and price is equal to the plant's total capital costs for the period.

v) *Product quantity* (y). This is expressed as the plant's constant sales. The plant's sales for the period is deflated by a cumulative manufacturing producer price index for the domestic market (base 2000) where the plant is located. Thus, it is expressed at constant 2000 prices. Then an average is computed between the magnitude at the beginning and and of the accounting period.

vi) *Output price* (p) is defined by the ratio between the value added of the period and the product quantity (y). This price expresses the amount of value added per unit of real sales.

vii) *Total Assets* (A). The amount of total assets is taken from the plant's accounting statements, the balance sheet. It includes both current and fixed assets.

INSERT TABLE 3.2 ABOUT HERE

Table 3.2 shows the mean values for each variable for the 125 plants in our sample. These plants generate a total of 607 observations for the period 2000/2012, which can be classified as organizational downsizers, organizational upsizers, or non-restructured, according to our definitions. Moreover, we split the sample considering 2007-2008, as the macroeconomic context in Europe showed major changes, and we also test our hypotheses in line with those different conditions. These subperiods are reported in the table to analyze the differences as well. Average plant size in our sample is more than two thousand employees. Among the groups, downsizers are generally bigger than upsizers. Badunenko (2010) found that larger firms were more technically efficient for several years during the 1990's on average. However, these firms still downsized often in that period because of scale inefficiency, so our results point in the same vein. An average size of the full sample under the averages of each group is due to the fact that non-restructured plants are small or very small (average number of employees around 300). There is a reduction of nearly four hundred workers, on average, from the first period to the second. Although the information is not reported in the table, a deeper analysis reveals that the average decline in the number of employees was approximately 3% per year, with a more intense drop in the first subperiod. Both capital quantity and product quantity show a quite similar pattern, as do total assets. This downsizing overlaps with what has been expressed regarding labor quantity, and the decline rates are rather similar for the period. Consequently, it can be argued that there is a downsizing trend in this industry between 2000 and 2012. By group, we find that average values among downsizers are much smaller in the second period, so we could argue that the average intensity of downsizing was higher than the intensity of upsizing. As for prices, the labor price increased slightly. This may show a convergent trend in Europe, as this increase may be motivated by a faster rise in wages in some peripheral countries, as well as a rise in capital prices. Both increased around 2% per yerar, on average. However, whereas labor prices were rather similar between downsizers and upsizers, capital prices were cheaper for upsizers. Profits also show a decline, but the amount is significantly smaller if we compare it to the average fall in product quantity. We do not report total costs in the table, but we observed major reductions in their average magnitude throughout the entire period (4% per year). This means that production plants made a considerable effort to keep profits somehow stable, despite the declines in the markets. Upsizers's profits were higher, especially in the crisis subperiod. Finally, ROA levels show an average close to 9%, with a decline in the second subperiod. Intuitively, downsizers report poorer financial performance in all periods. Finally, the table shows the split in the sample that would correspond to traditional definitions where only a change in labor quantity is considered.

3.5.Results

From *Table 3.2* we already know that organizational upsizers outperform downsizers in terms of ROA. Furthermore, average decline in ROA after the crisis is similar for both groups. So far, this is a static analysis that compares one group to another, but we are more interested in the dynamic approach analyzing changes when restructuring. *Figure 3.1* is presented as an introductory note to the results. It shows all observations sorted by the contribution of the organizational restructuring they achieve. In three parts, we show first only downsizers, then only upsizers and finally both groups together. For downsizers, a poor contribution from the organizational restructuring usually goes hand in hand with a poor contribution from the productivity change, and *vice versa*. For upsizers, the story is reversed. A poor contribution from the organizational restructuring is commonly found with a positive contribution from productivity changes, and *vice versa*. This interesting result suggests that downsizers may benefit from the restructuring in itself but they do not adjust their inputs adequately, so they eventually get productivity losses. Upsizers get a positive contribution from restructuring, different from downsizers, and they are also able to obtain productivity gains. The third graph also suggests that no contribution from restructuring in any direction (organizational restructuring close to 1) is also associated with slight contributions from productivity change for both groups. *Tables 3.3* and *3.4* offer further insights, analyzing these differences by group.

INSERT FIGURE 3.1 ABOUT HERE

Hypothesis 1, based on expression (3.2), is tested in *Table 3.3.1*. For the period 2001-12, organizations that upsized got important ROA gains (1.084), whereas the financial performance of organizational downsizers worsened considerably (0.824). $H1_0$

is rejected, and the difference is highly significant. We can already argue that reducing the organization did not pay off at all in the automobile industry in terms of financial performance. The idea that downsizing could be used to be more competitive does not hold, nor do our results show any convergence between downsizers and upsizers. The initial difference in terms of ROA became larger after restructuring. For clarity, we do not show this in the tables, but the decline in the return on sales was the main driver of the drop in the financial performance of organizational downsizers, as it was in the ROA gains of upsizers. We find support for Hypothesis 1 (H1) in reverse terms: organizational upsizers obtain higher ROA gains than organizational downsizers.

INSERT TABLE 3.3 ABOUT HERE

Hypotheses 2 and 3, based on expression (3.6), are tested in *Tables 3.3.2* and *3.3.3*, respectively. $H2_0$ cannot be rejected, meaning that we found no significant difference between the contributions of the technical change of the two groups, even though the contribution is positive. Hypothesis $H3_0$ is rejected, so the mean contribution of efficiency changes (measured as cost efficiency) to ROA change is significantly different by group. Organizational downsizers did not adjust their input quantities properly and the cost efficiency contribution is very detrimental to their financial performance (0.893). Conversely, organizational upsizers find no impact of cost efficiency change on productivity (result roughly 1). Together, these results suggest that downsizing hardly favors inputs adjustment. Hypotheses 2 and 3 (H2 and H3) are also supported in reverse terms.

Hypothesis 4, based on expression (3.5), is tested in *Table 3.3.4*. One main contribution of this study is to assess the direct impact of organizational restructuring on financial performance, via productivity changes. In line with the findings above, as already discussed for *Figure 3.1*, organizational upsizing contributed to improving financial performance, but organizational downsizing did not (1.029 versus 0.981). Those means are statistically different, so $H4_0$ is rejected. Based on the negative result of the statistic, Hypothesis 4 (H4) can also be inversely supported.

One interesting aspect to examine at this point is whether being part of a big group affects the impact of organizational restructuring on financial performance. We do not report the results, but interestingly we found that the parent company matters.

Plants belonging to the ten biggest producers in Europe were selected. The remaining plants were put in another group. Results show that organizational downsizing only contributes positively when the plant belongs to a main group. Alternatively, organizational upsizing only contributes whenever plants are not part of a big matrix. This productivity driver was found to cause the biggest divergence between the plants that are part of a major group and those that are not. However, the ROA change of both groups is not significantly different. Further analysis of these differences could be topic of future research.

Hypothesis 5, based on expression (3.2), is tested in *Table 3.3.5.* The poorer return on sales found for organizational downsizers was mainly driven by severe productivity losses (0.914). This effect is very strong and is the main cause behind the lower financial performance explained in Hypothesis 1. Productivity change contributed to worsening the performance of organizational downsizers due to both efficiency losses and the unfavorable effect of the restructuring itself. Contrarily, the upsizers were able to get important productivity gains (1.094), and the difference with downsizers is significant, so we reject $H5_0$. Likewise, the negative value of the statistic leads to the reverse the Hypothesis 5 (H5): organizational upsizers get a higher contribution from productivity change to financial performance than organizational downsizers. Prices also had an effect, as we will discuss below.

Hypothesis 6, based on expression (3.2), is tested in *Table 3.3.6*. We reject the null hypothesis ($H6_0$), meaning that changes in prices are different. However, a negative value means that we found support for Hypothesis 6 (H6) that the reduction of input prices for organizational downsizers was larger than for organizational upsizers. Whilst organizational downsizing resulted in a reduction in the prices of inputs (input price index 0.988), organizational upsizing increased them (input price index 1.032). That suggests that, after downsizing, production plants are able to pressure the inputs downward (e.g., pressure on workers to cut wages). Furthermore, the results are omitted, but an analysis of expression (3.2) for the Fisher price recovery index reveals that plants were unable to translate the prices of the inputs into higher normalized unit profits.

INSERT TABLE 3.4 ABOUT HERE

Tables 3.4.1 to *3.4.6* show the t-test results for the hypotheses' extensions on different types of market conditions. As seen, our first five main hypotheses are reversely supported. That is, the downsizing purposes generally justifying the decision did not result as good as the upsizing outcomes. Furthermore, organizational downsizers in the automobile industry in Europe worsened noticeably. They were only able to lower input prices to compensate for important declines in productivity. Ultimately, organizational downsizers got much worse outcomes from restructuring than their upsizing counterparts. The extensions essentially test whether those conclusions can be extended to any type of economic context: expansion and/or contraction. For both situations, the conclusions hold in the sense that organizational downsizers obtain poorer contributions to the financial performance from restructuring than upsizers. However, in the context of expansion (2001-07), ROA change and organizational restructuring differences are not statistically significant at 5%. From these tables, we also learn that financial performance change dropped between the two periods, especially for organizational downsizers (from 1.003 to 0.693 in *Table 3.4.1*). In the crisis period (2008-12), organizational downsizers worsened the contribution of productivity change to financial performance but upsizers improved it slightly, which is the same result obtained for the organizational restructuring effect. That is, the contribution from restructuring to financial performance did not appear for downsizers but was relevant for upsizers. Lastly, the efficiency change contribution improved for both groups, showing that adjustment processes were faster during the crisis period. However, only upsizers were able to obtain positive contributions from it.

On price changes per period, the result holds but the strength of the effects found previously is lower. Differences are still significant at 5%.We found that before the crisis, changes in input prices changes were translated into better margins. For organizational downsizers, input price reductions were unable to compensate for productivity losses, which eventually led to deterioration in financial performance. On the contrary, upsizers got input price increases but the productivity gains were important enough to improve their ROA.

3.6. Conclusion

In spite of the widespread attention to downsizing has been paid in the management literature, its outcomes are still inconclusive. Moreover, the comparison between downsizing and other types of restructuring has been studied quite thoroughly and requires more research. One drawback in the literature in this field is its dependence on labor-related definitions and measures of restructuring (especially downsizing). Using a wider definition of restructuring in this study, we want to contribute to a better understanding of the consequences of restructuring processes. Ultimately, we could test whether there is some type of convergence between different sorts of restructuring strategies. The analysis is performed for the European automobile production industry, at the level of the production plant.

We start by adopting the concept of organizational restructuring introduced in Chapter Two, which considers changes in all the inputs of the organization. We then define organizational downsizing and organizational upsizing as decreasing or increasing that level cost-efficient input quantities. Our methodology allocates organizations to a specific group. That is, changes in the level of inputs clearly go in one direction or the other. With our specific view of organizational upsizing, we contribute to refining what the literature has commonly labeled non-downsizing, which could include organizations that make no change in their inputs.

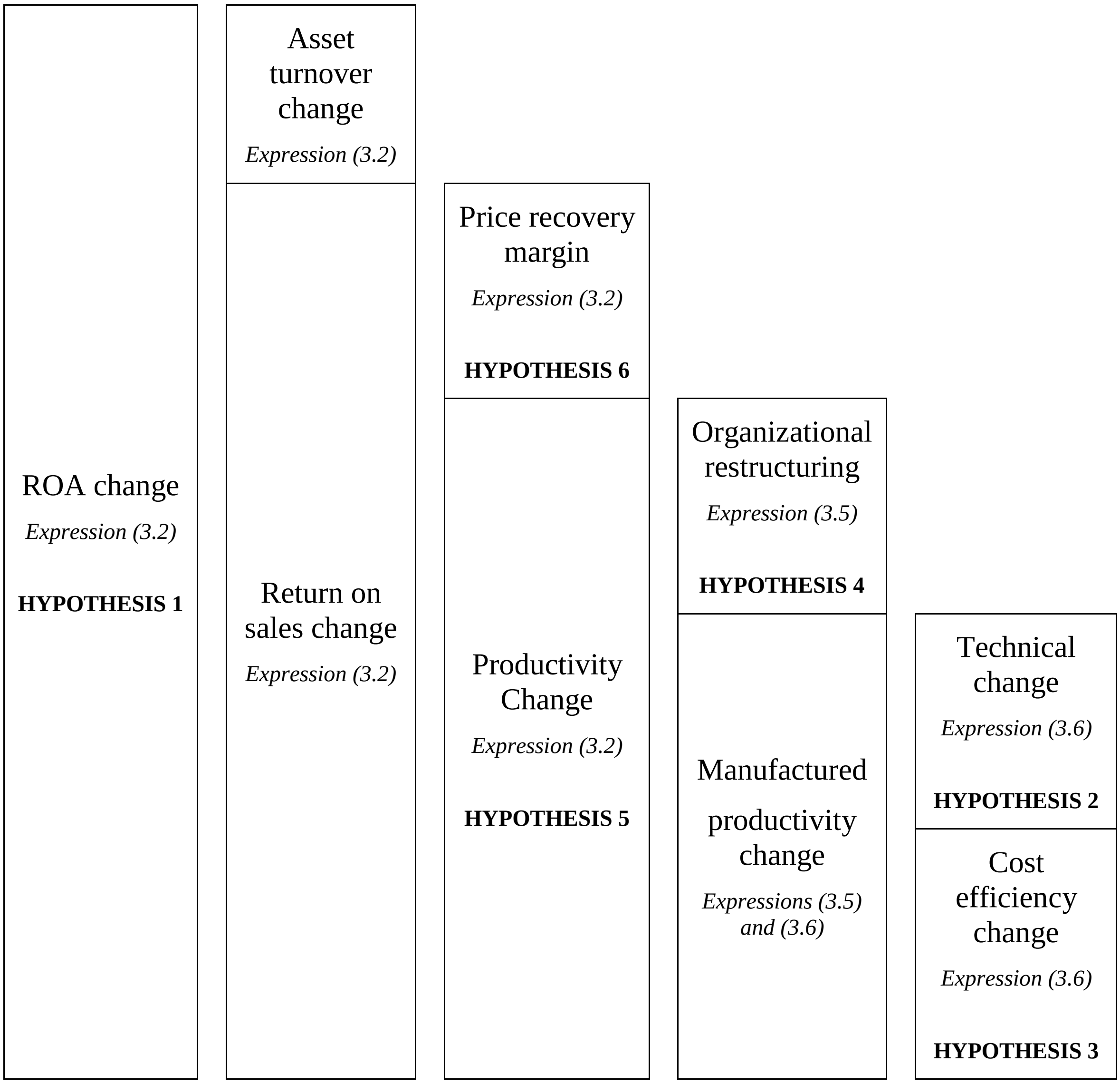
Base on the literature, we develop several hypotheses to compare different types of restructuring. Specifically, we assess the differences in outcomes between organizational downsizers and organizational upsizers. With poor financial performance generally endorsing downsizing processes, we hypothesize that organizational downsizers obtain better results than upsizers. Thus, organizational downsizers would potentially yield better financial performance. Likewise, we could expect a higher contribution to financial performance from productivity changes, driven by higher contributions of technical change, efficiency change, organizational restructuring. Lastly, this group would benefit from larger input price reductions.

Our results strongly suggest that organizational downsizing was very harmful for the financial performance of the automobile production plants in Europe between 2001 and 2012. Conversely, organizational upsizers considerably improved their ROA. The two strategies were very divergent in their outcomes. Regarding the drivers behind those differences we find important productivity gains for upsizers and significant productivity losses for downsizers. Especially, downsizers seem to have problems adjusting their input level properly when restructuring, so they obtain efficiency losses. As for the specific contribution to financial performance from the organizational restructuring itself to financial performance, the results hold and downsizers do not benefit from it, whereas upsizers do. All of these results together lead us to support the reverse of our hypotheses, meaning that organizational downsizers in general found very poor outcomes from restructuring. As for the changes in input prices, downsizers got slight reductions but they were unable to translate them into better margins. Finally, we can argue that for downsizers originally showing worse financial performance than upsizers, restructuring processes only contributed to further worsening this performance.

One important implication derived of this study is that the organizational downsizing goals were not achieved. This suggests a failure in managing the restructuring. Our results support some authors' idea that downsizing adequately is the key to success. Future research could seek to better understand reasons behind this failure or success at restructuring, such as the size of the organization or belonging to a main parent company, among others.

Exhibits, Figures and Tables

Exhibit 3.1. Representation of ROA change decomposition and hypotheses



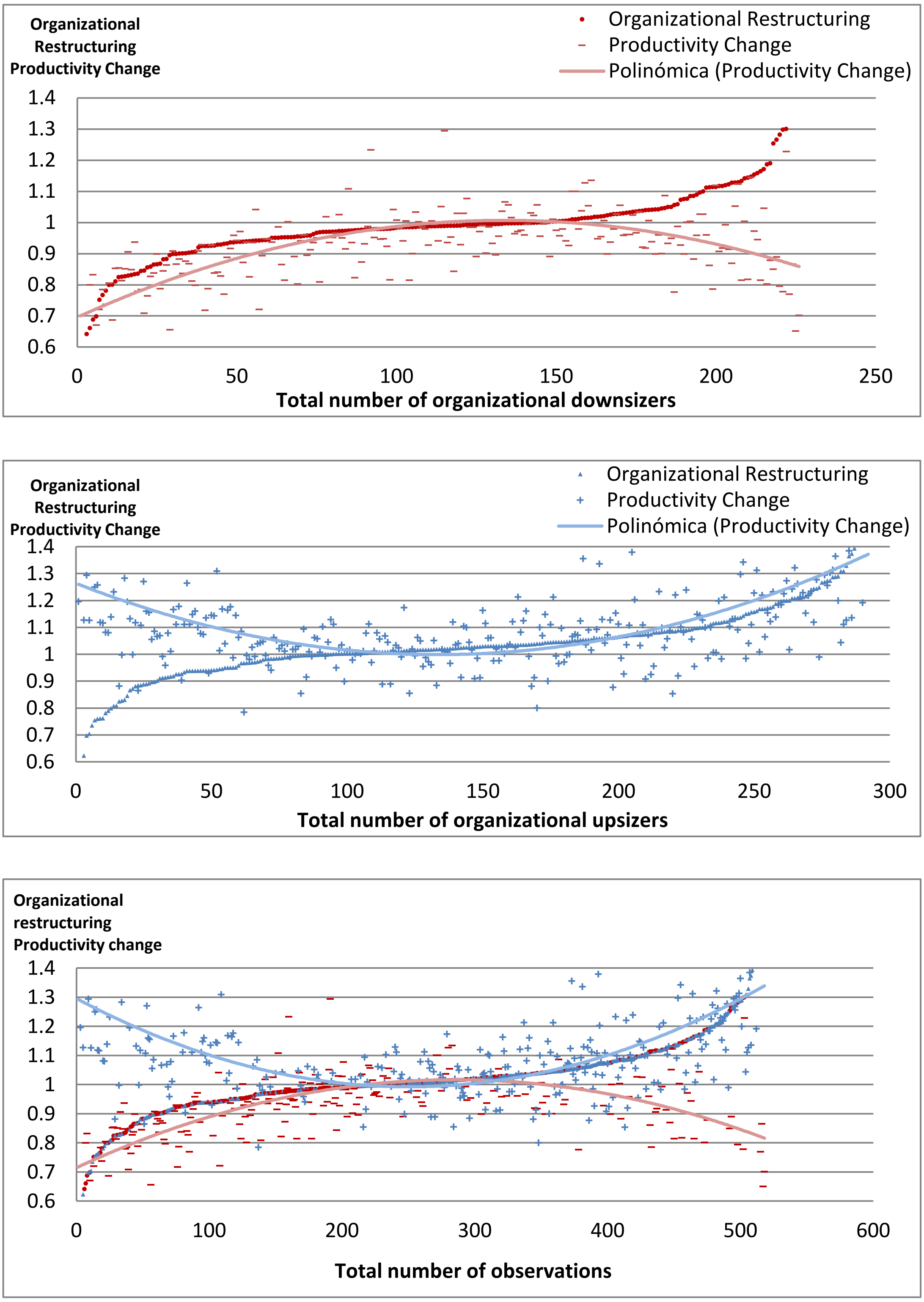


Figure 3.1. Sorted Organizational Restructuring and Productivity Change. First, organizational downsizers. Second, organizational upsizers. Third, both groups together.

Table 3.1.1. Articles selected on productivity and profitability outcomes of labor downsizing

Author	Year	Sample	Scope	Downsizing measure	Productivity	Profitability
De Meuse, Vanderheiden and Bergman	1994	17 downsizers	USA	percentage of layoffs over total employees		(-) ROA (-) profit margin (-) ROE (-) assets turnover (+) market-to-book ratio
Mentzer	1996	122 downsizing firms	Canada	changes in employees		(+/-) Net income
Chen, Mehrotra, Sivakumar and Wayne	2001	349 layoff announcements	USA	changes in employees	(+) sales per employee	(+) ROA (+) return on sales (-) costs of goods sold over sales (-) capital expenditure per employee
Chalos and Chen	2002	downsizers in the Fortune 500	USA	changes in employees	(+) sales per employee	(+) ROA (+) operating cash flow per employee (+) costs of goods sold per employee (+) debt solvency
Baumol, Blinder and Wolff	2003	267 downsizing establishments	USA	percentage of downsizing	(=) TFP growth	(+) Profitability
Carswell	2005	155 downsizing firms	New Zealand	changes in employees	(+) sales per employee	(+) ROA (+) ROE (+) profit margin
Gittell, Cameron, Lim and Rivas	2006	airline companies	USA	percentage of downsizing	(-) output per employee	
Yu and Park	2006	164 downsizing firms	Korea	change in employment as a dummy variable (D vs. ND)	(+) sales per employee (+) VA per employee (+) operating income per employee	(+) ROA (+) asset turnover
Hillier, Marshall, McColgan and Werema	2007	322 layoff announcements	UK	percentage change in the number of employees (1%)	(+) operating profit per employee (+) sales per employee	(=) ROA (+) Debt
Guthrie and Datta	2008	122 downsizing firms	USA	percentage change in the number of employees (5%)		(-) ROA
Muñoz-Bullón and Sánchez-Bueno	2010	709 downsizing announcements	Spain	changes in employees		(-) ROA (-) return on sales
Iverson and Zatzick	2011	115 downsizing organizations	Canada	changes in employees	(+) sales per employee	

Reynaud	2013	13,837 listed and non-listed companies	France	changes in employees	(-) value added per hours worked	(+) ROA (-) ROE (-) profit margin (-) sales turnover (+) labor costs
Brauer and Laamanen	2014	73 downsizing	Europe	percentage change in the number of employees (5%)		(U) ROA
Chhinzer and Currie	2014	178 downsizing announcements	Canada	announced downsizing as changes in labor	(=) sales per employee (-) operating income per employee	(=) ROA (-) ROE (=) profit margin (=) asset turnover
Goesaert, Heinz and Vanormelingen	2015	92 downsizing firms	Germany	percentage change in the number of employees (3%)	(-) TFP (-) value added per employee	(-) EBITDA (-) profit margins (+) wages
Carriger	2016	149 downsizers	USA	percentage change in the number of employees (5%)	(+) revenue per employee	(+) ROA (-) ROE (+) ROI (+) Asset turnover

For downsizing samples, (+) and (-) stand for positive and negative impacts, respectively. (=) is used when no effect is found. (U) represents a U-shape relationship
The sign of the impact is based on the main result of the article or the result aligned with our purposes. Further findings usually depend on additional control variables.

Table 3.1.2. Articles selected on productivity and profitability outcomes of labor downsizing vs. non-downsizing

Author	Year	Sample	Scope	Downsizing measure	Productivity	Profitability
De Meuse, Vanderheiden and Bergman	1994	17 downsizers vs. 35 non-downsizers	USA	percentage of layoff over total employees		(-) ROA (-) profit margin (-) ROE (-) assets turnover (-) market-to-book ratio
Chen, Mehrotra, Sivakumar and Wayne	2001	349 layoff announcements vs. matching non-layoff	USA	changes in employees	(+) sales per employee	(-) ROA (-) return on sales
De Meuse, Bergman, Vanderheiden and Roraff	2004	78 downsizing firms vs. 14 non-downsizing	USA	percentage of announced layoff over total employees		(-) ROA (-) profit margin (-) ROE (-) assets turnover (-) market-to-book ratio
Yu and Park	2006	164 downsizing vs. 94 non-downsizing	Korea	change in employment as a dummy variable (D vs. ND)	(-) sales per employee (-) VA per employee (-) operating income per employee	(-) ROA (-) asset turnover
Saïd, Le Louarn and Tremblay	2007	140 downsizers vs. 99 non-downsizers	USA	percentage change in the number of employees (5%)	(=) sales per employee	(-) Operational indebtedness
Marques, González, Cruz and Ferreira	2011	553 downsizers vs. 804 non-downsizers	Portugal	percentage change in the number of employees (5%)		(-) ROA (-) profit margin
Muñoz-Bullón and Sánchez-Bueno	2011	1,054 downsizers vs. 1,449 non-downsizers	Spain	changes in employees	(+) value added per employee	(-) ROA (-) return on sales
De Meuse and Dai	2013	123 downsizers vs. 608 non-downsizers	USA	percentage change in the number of employees (5%)		(-) ROA (-) profit margin (-) earnings per share (-) revenue growth (-) market capitalization
Carriger	2016	149 downsizers vs. 265 non-downsizers	USA	percentage change in the number of employees (5%)	(-) revenue per employee	(+) ROA (-) ROE (-) ROI (=) Asset turnover

For comparison analyses, (+) and (-) mean lower or higher, respectively, level or effect on downsizers compared to non-downsizers.
The sign of the impact is based on the main result of the article or the result aligned with our purposes. Further findings usually depend on additional control variables.

Table 3.2. Summary statistics by variable. Mean values

Period	# Obs	x_l Labor quantity (#)	w_l Labor price (current €)	x_k Capital quantity (th.€2000)	w_k Capital price (current €)	y Product quantity (th.€2000)	p Product price (€2000)	π Profit (th.current €)	A Total assets (th.current €)	ROA Return on Assets
Full sample										
2001/12	607	2,065	39,721	159,217	0.322	922,333	0.264	35,713	511,402	0.089
2001/07	352	2,219	39,155	169,831	0.313	1,031,237	0.255	38,252	541,775	0.093
2008/12	255	1,853	40,502	144,566	0.334	772,005	0.277	32,210	469,477	0.084
Organizational Downsizers										
2001/12	226	2,647	41,266	195,556	0.371	1,117,176	0.250	32,520	598,372	0.066
2001/07	106	3,300	41,984	231,735	0.381	1,475,887	0.239	38,228	711,187	0.071
2008/12	120	2,071	40,632	163,597	0.362	800,314	0.260	27,477	498,719	0.062
Organizational Upsizers										
2001/12	292	2,150	40,509	176,653	0.281	1,035,661	0.228	47,954	587,981	0.098
2001/07	186	2,201	39,222	185,221	0.287	1,087,783	0.222	49,439	605,101	0.102
2008/12	106	2,059	42,767	161,617	0.271	944,201	0.237	45,349	557,938	0.089
Non-restructured										
2001/12	89	308	33,213	9,737	0.330	55,748	0.420	3,662	39,311	0.119
Traditional labor downsizer										
2001/12	249	2,551	40,798	193,322	0.376	1,113,820	0.248	38,036	611,976	0.064
Traditional labor upsizer										
2001/12	323	1,833	40,706	143,303	0.291	851,352	0.263	36,184	473,043	0.101

Table 3.3. Test of hypotheses

Table 3.3.1. Test of Hypothesis 1, the ROA gains

H1: organizational downsizers obtain higher ROA gains than organizational upsizers

	ROA change 2001/12
Downsizers	0.824
Upsizers	1.084
Welch's statistic t	-3.212
p-value	0.001
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	rejected

Table 3.3.2. Test of Hypothesis 2, the technical change effect

H2: organizational downsizers obtain better contribution from technical change to financial performance than organizational upsizers.

	Technical change 2001/12
Downsizers	1.044
Upsizers	1.056
Welch's statistic t	-1.114
p-value	0.266
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	non-rejected

Table 3.3.3. Test of Hypothesis 3, the efficiency change effect

H3: organizational downsizers obtain better contribution from efficiency change to financial performance than organizational upsizers.

	Cost efficiency change 2001/12
Downsizers	0.893
Upsizers	1.007
Welch's statistic t	-6.440
p-value	0.000
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	rejected

Table 3.3.4. Test of Hypothesis 4, the restructuring effect

H4: organizational downsizers obtain better contribution from restructuring to financial performance than organizational upsizers.

	Organizational restructuring 2001/12
Downsizers	0.981
Upsizers	1.029
Welch's statistic t	-3.406
p-value	0.001
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	rejected

Table 3.3.5. Test of Hypothesis 5, the productivity change effect

H5: organizational downsizers obtain better contribution from productivity change to financial performance than organizational upsizers	
	Productivity change 2001/12
Downsizers	0.914
Upsizers	1.094
Welch's statistic t	-12.236
p-value	0.000
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	rejected

Table 3.3.6. Test of Hypothesis 6, the input prices effect

H6: organizational downsizers obtain larger reductions in input prices than organizational upsizers.	
	Input price index 2001/12
Downsizers	0.988
Upsizers	1.032
Welch's statistic t	-4.137
p-value	0.000
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	rejected

Table 3.4. Test of hypotheses' extensions

Table 3.4.1. Test of extensions 1a and 1b

H1a: under market expansion, organizational downsizers obtain higher ROA gains than organizational upsizers.

	ROA change 2001/07
Downsizers	1.003
Upsizers	1.188
Welch's statistic t	-1.704
p-value	0.090
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	non-rejected

H1b: under market contraction, organizational downsizers obtain higher ROA gains than organizational upsizers.

	ROA change 2008/12
Downsizers	0.693
Upsizers	0.924
Welch's statistic t	-2.026
p-value	0.044
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	rejected

Table 3.4.2. Test of extensions 2a and 2b

H2a: under market expansion, organizational downsizers obtain better contribution from technical change to financial performance than organizational upsizers.

	Technical change 2001/07
Downsizers	1.087
Upsizers	1.086
Welch's statistic t	0.083
p-value	0.934
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	non-rejected

H2b: under market contraction, organizational downsizers obtain better contribution from technical change to financial performance than organizational upsizers.

	Technical change 2008/12
Downsizers	1.006
Upsizers	1.007
Welch's statistic t	-0.275
p-value	0.784
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	non-rejected

Table 3.4.3. Test of extensions 3a and 3b

H3a: under market expansion, organizational downsizers obtain better contribution from efficiency change to financial performance than organizational upsizers	
	Cost efficiency change 2001/07
Downsizers	0.871
Upsizers	0.980
Welch's statistic t	-4.404
p-value	0.000
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	rejected

H3b: under market contraction, organizational downsizers obtain better contribution from efficiency change to financial performance than organizational upsizers	
	Cost efficiency change 2008/12
Downsizers	0.913
Upsizers	1.054
Welch's statistic t	-6.188
p-value	0.000
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	rejected

Table 3.4.4. Test of extensions 4a and 4b

H4a: under market expansion, organizational downsizers obtain better contribution from restructuring to financial performance than organizational upsizers.

	Organizational restructuring 2001/07
Downsizers	1.001
Upsizers	1.025
Welch's statistic t	-1.918
p-value	0.056
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	non-rejected

H4b: under market contraction, organizational downsizers obtain better contribution from restructuring to financial performance than organizational upsizers.

	Organizational restructuring 2008/12
Downsizers	0.963
Upsizers	1.034
Welch's statistic t	-2.937
p-value	0.004
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	rejected

Table 3.4.5. Test of extensions 5a and 5b

H5a: under market expansion, organizational downsizers obtain better contribution from productivity change to financial performance than organizational upsizers.

	Productivity change 2001/07
Downsizers	0.948
Upsizers	1.091
Welch's statistic t	-9.411
p-value	0.000
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	rejected

H5b: under market contraction, organizational downsizers obtain better contribution from productivity change to financial performance than organizational upsizers.

	Productivity change 2008/12
Downsizers	0.885
Upsizers	1.098
Welch's statistic t	-9.144
p-value	0.000
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	rejected

Table 3.4.6. Test of extensions 6a and 6b

H6a: under market expansion, organizational downsizers obtain larger reductions in input prices than organizational upsizers

	Input prices index 2001/07
Downsizers	0.987
Upsizers	1.038
Welch's statistic t	-3.895
p-value	0.000
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	rejected

H6b: under market contraction, organizational downsizers obtain larger reductions in input prices than organizational upsizers.

	Input prices index 2008/12
Downsizers	0.989
Upsizers	1.022
Welch's statistic t	-2.000
p-value	0.047
H_0: $\mu_{downsizers} - \mu_{upsizers} = 0$	rejected

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