RETAIL SERVICES EFFICIENCY: IMPACT OF COUNTRY-SPECIFIC FACTORS

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Structured Abstract

Purpose: Efficiency in retailing companies is mandatory for survival. Literature acknowledges external factors impact on efficiency. However, this impact remains understudied, as previous research typically focuses on managerial decisions. This study aims to partially fill this gap by exploring the influence of external factors on retailers' efficiency.

Design/methodology/approach: This research simultaneously measures retail efficiency and evaluates the impact of six potential drivers by applying bootstrap techniques in a sample of twenty-five European Union countries during the period 2006-2015.

Findings: The efficiency of the retail system in the countries under analysis evolves at different paces during the observation period. This evolution can be explained by country population density, average store size within countries, foreign trade ratio, concentration, economic freedom and percentage of urban population.

Research limitations/implications: This research does not account for supply and demand restrictions that might affect retailers' efficiency, as well as other variables that influence their production process.

Practical implications: This paper might help retail managers to comprehend and manage their companies' efficiency. Furthermore, it provides clues to evaluate market attractiveness in retailers' international expansion strategies.

Social implications: Policy makers can facilitate retailers' efficiency through regulations on external variables that influence retailers' performance, namely economic freedom and foreign trade ratio.

Originality/value: For the first time, this study analyses the impact of external factors on retail services efficiency across countries.

Keywords: Efficiency, retailing, cross-national

Research paper

Introduction

Companies are usually under the pressure of increasing their productivity and efficiency, particularly in mature markets. Their survival depends on their ability to improve performance in a context of growing competition and market globalization. Productivity as a business concept should help firms to manage their economic profit (Grönroos and Ojasalo, 2015), and firms from services industries are not an exception. Despite its importance for every type of company, productivity potential gains in services companies are typically lower than in manufacturing firms (Bryson and Daniels, 2015). Besides, to understand productivity in service organizations as a means of managing profit, cost effects and revenue effects of changes in the productions system cannot be separated (Grönroos and Ojasalo, 2015), increasing the challenges of this type of analyses.

Previous research on productivity focuses more on manufacturing than on service firms (Geum *et al.*, 2011). Unfortunately, the advances in productivity management under a goods-dominant approach are not applicable to services (Grönroos and Ojasalo, 2004), thus impeding service firms reaching similar productivity improvements than in manufacturers. This occurs due to service intangibility, heterogeneity, inseparability and perishability.

First, productivity measurement instruments employed in manufacturing processes cannot be applied to services (Grönroos and Ojasalo, 2004), due to intangibility and heterogeneity. Furthermore, services heterogeneity leads to measurement procedures that vary across services industries (McLaughlin and Coffey, 1990). Second, services firms cannot implement some of the techniques that manufacturing companies employ to increase productivity and efficiency, due to services perishability and inseparability (Klassen *et al.*, 1998). For example, both types of firms can reorganize their organizational structure, improve processes and resource utilization, invest

in employees' formation, and focus on very homogeneous customers (Zolnowski *et al.*, 2013; Dobmeier, 2016). In contrast, manufacturing firms can gain productivity by adjusting firm capacity and demand through storage, whereas service firms cannot due to services perishability. Thus, productivity depends more on customer demand in a service context because services are not storable (Grönroos and Ojasalo, 2004; Dobmeier, 2016). Additionally, services inseparability often involves a trade-off between service productivity and service quality, thus threatening future profitability (e.g. Rust and Huang, 2012). In contrast to manufacturers, service firms cannot often reduce costs without reducing service quality. This is especially relevant for labour costs, given the relevance of employees in service delivery (e.g. Yi *et al.*, 2011; Bowen, 2016). For example, simply firing workforce, moving some departments to countries with lower labour costs (like in overseas call-centres), or substituting employees by machines (for example, replacing cashiers by ATMs in supermarkets) are not usually valid options for service companies that do not want to reduce quality levels.

Apart from these services peculiarities that impede applying some productivity enhancement techniques, services companies' performance depends on firms' decisions and on external factors that are out of managerial control (Fried *et al.*, 1999). As both elements might determine success productivity management in services industries requires considering these sector-level particularities.

This paper focuses on the grocery retail sector, given its importance in services industries and the pertinence of productivity and efficiency analysis for its companies (Lusch *et al.*, 1995). The pace of retail evolution has increased dramatically (Grewal *et al.*, 2018). Although the ultimate function of commercial distribution remains the same across time –making goods and services available to markets (Kumar *et al.*, 2017) – the sector has undergone notable changes in

recent years, due to challenges such as the growing importance of electronic commerce or increasing competition among retailers. Technological innovations have transformed the retail sector over the past several decades, allowing for dramatic increases in product variety, firm size, labour productivity, and concentration ratios (Basker, 2016). In fact, information technologies represent one of the main sources of productivity and efficiency (Ratchford, 2016). In the current scenario, new technology –from radio-frequency identification (RFID) tags to big data analytics or artificial intelligence – and the presence of an ever-changing competitive market structure requires the business industry to adapt their practices accordingly (Kumar *et al.* 2017). Thus, firms in this sector require measuring and managing their efficiency in order to set the basis for growth and diversification strategies (Sellers and Nicolau, 2011). In this sense, retailers are particularly concerned with strategies such as pricing, product selection, location choice, and store format. Though these strategies can be profitable, the difficulty lies in identifying the source of profitability in the complex retail structure (Kumar *et al.*, 2017). The efficient use of productive resources constitutes a key strategy to guarantee the future viability of companies and their competitiveness. Moreover, in this regard, marketing managers from other companies need reliable metrics to assess the effectiveness of their distribution decisions. These decisions require counterbalancing companies' performance and the performance of their distribution partners, to maintain an adequate commercial relationship (Ailawadi and Farris, 2017).

Previous research already measures the productivity of companies that provide distribution services (e.g. Ratchford and Brown, 1985; Ratchford and Stoops, 1988; Goldman, 1992), and identify determining factors. These drivers include marketing aspects, company characteristics, and environmental issues (e.g. Van Dalen *et al.*, 1990). More recently, literature has focused on estimating the efficiency of distribution channel intermediaries (e.g., Thomas *et*

al., 1998; Donthu and Yoo, 1998; Keh and Chu 2003; Ratchford, 2003; Barros and Alves 2003, 2004; Sellers and Mas, 2009a; Gauri, 2013).

Most of these studies analyse efficiency for the companies that operate in a country, such as the United States (Keh and Chu, 2003; Mostafa, 2009; Gauri, 2013), the United Kingdom (Reynolds *et al.*, 2005), France (Perrigot and Barros, 2008), Spain (Sellers and Mas, 2006, 2009a; De Jorge and Sanz-Triguero, 2011; De Jorge and Rojas, 2015), Portugal (Barros and Alves, 2004), Brazil (Neves *et al.*, 2018), India (Gupta and Mittal, 2012; Gandhi and Shankar, 2014), or China (Yu and Ramanathan, 2009). Such approach is adequate to analyse how company decisions drive efficiency. In contrast, it impedes studying the impact of external country-specific drivers that affect the companies under analysis (e.g. economic wealth or concentration levels).

Despite its interest, this impact of external factors is taken for granted in retail efficiency research, thus remaining understudied. This impedes isolating the efficiency of retailers derived from an appropriate management of the inputs employed from the efficiency of retailers derived from country-specific factors where they develop their activities. The aim of this paper is to partially fill this gap, by exploring the influence of several contextual country-specific variables on retailers' performance. Hence, this study contributes to the comprehension about efficiency drivers by focusing on the influence of structural variables (concentration, average size, external dependence, and business freedom) and market variables (population density and percentage of urban population). This leads to conclusions that are relevant not only for academics and managers but also for policy makers. This research adopts a cross-national perspective. In particular, the paper studies retailers' efficiency within the European Union. In recent years the performance of service industries has come to the forefront of research and policy debate on

Europe's comparative economic performance (O'Mahony, 2015). The context has evolved over the last decade, with some key variables possibly affecting efficiency, thus providing an interesting scenario not only to measure but also to identify contextual drivers of efficiency in retail systems.

The remainder of this manuscript is organized as follows. The second section provides the theoretical framework of our research. Next, we describe the methodology implemented in this study –a stochastic non-parametric model to assess efficiency and the impact of its potential drivers. Subsequently we analyse our results. Finally, we present our conclusions in the final section.

Literature review: productivity and efficiency in the service sector

Given the increasingly importance of the service sector in the last decades, productivity and efficiency have become an important issue within this sector. In this sense, numerous studies have analysed productivity and efficiency of service organizations (Sherman and Zhu, 2006, 2013), including banks (Berger *et al.*, 1993), insurance companies (Jarraya and Bouri, 2014), hotels (Assaf and Josiassen, 2016), real estate agents (Anderson *et al.*, 2000) or health-care organizations (Gupta, 1995), among others.

The interest of analysing these topics relies on the idea that the service sector lacks the same potential to take advantage of technological changes as capital-intensive manufacturing industries (Ratchford and Brown, 1985). Thus, increasing productivity and efficiency in the service sector can be difficult to achieve. In fact, Van Biema and Greenwald (1997) pointed out that productivity has not grown as fast in the service sector as in the manufacturing sector, and services are produced with excess resources and at unnecessarily high costs. The characteristics of services (i.e., intangibility, heterogeneity, simultaneity, and perishability) make the

measurement of service productivity a challenging task (McLaughlin and Coffey, 1990). In the same line, Klassen *et al.* (1998) stated that measuring performance in high contact services has proven difficult largely since production and sales occur simultaneously and because the services provided are heterogeneous. Besides, developing meaningful performance indicators for services has been hampered because of the difficulty in defining and categorising the appropriate inputs and outputs (Klassen *et al.*, 1998).

One of the main problems faced by the service sector is that the underlying assumptions of the models and concepts applied in the manufacturing industry do not hold in services processes (Grönroos and Ojasalo, 2004), and productivity represents a more complex construct in service industries than in manufacturing (Calabrese, 2012). In fact, the different nature and diversity of service industries has meant that each field has developed its own productivity measures which have often not been widely disseminated (McLaughlin and Coffey, 1990).

Particularly, our interest is focused on the retailing industry. Thus, the next sub-section reviews previous works aimed at analysing productivity and efficiency in retailing reviewing the different methods and variables employed to analyse efficiency within this sector.

Productivity and efficiency in the retail sector

The relevance of evaluating productivity and efficiency has been widely supported in the context of the retailing sector. Thus, previous studies have focused on examining retailers' productivity (e.g. Ratchford and Brown, 1985; Ratchford and Stoops, 1988; Goldman, 1992) and efficiency (e.g. Thomas *et al.*, 1998; Donthu and Yoo, 1998; Keh and Chu 2003; Ratchford, 2003; Barros and Alves 2003, 2004; Sellers and Mas, 2009a; Gauri, 2013). These studies differ mainly in the variables included as inputs and outputs, the methodology used to estimate efficiency and the sample employed in the empirical application.

Regarding the variables used, Barros and Alves (2003) and Sellers and Mas (2009a) stated that the selection of variables is usually driven by the availability of information, previous literature and researcher criteria. Recently, Yu and Ramanathan (2016) reviewed the inputs and outputs included in previous retailing efficiency studies. Among the inputs, physical variables such as the number of employees (e.g., Thomas *et al.*, 1998; Barros and Alves, 2003; Sellers and Mas, 2006; Gupta and Mittal, 2010) and the size of the outlets (Donthu and Yoo, 1998; Keh and Chu, 2003) are usually employed. Furthermore, several authors have included financial variables, such as wages paid (e.g., Barros and Alves, 2003) and capital (e.g., Barros and Perrigot, 2008). Among the outputs, financial variables such as total revenues, sales or profits are the most commonly employed variables (e.g., Donthu and Yoo, 1998, Barros, 2006). In this sense, it is worth mentioning that the consideration of monetary variables could bias the results as they might be affected by a price effect. Although the inclusion of monetary variables could be justified by the extent and depth of the assortment in retailing, it should be taken into account that the non-zero capacity of retailers when setting their prices might lead to some confusion between efficiency and market power. In fact, a high level of monetary output (which could be interpreted as a high level of efficiency) could also be a consequence of higher prices derived from the traditional hypothesis of market power (Sellers and Mas, 2009b). Therefore, it is important to isolate the price effect when estimating efficiency with monetary variables. Alternatively, Donthu and Yoo (1988) considered traditional marketing outputs like customer satisfaction, while Ratchford (2003) considered conventional physical outputs and assortment.

Concerning the methodology, previous papers have employed both the non-parametric technique of Data Envelopment Analysis –DEA– (e.g., Thomas *et al.*, 1998; Sellers and Mas, 2006; De Jorge, 2010) and parametric stochastic frontiers (e.g. Sellers and Mas 2009a; Gauri,

2013). The main difference between these methodologies is that non-parametric techniques do not assume a functional relationship between the inputs and outputs while parametric techniques specify a functional relationship (e.g. Cobb-Douglas or Translog). Gong and Sickles (1992) evidenced that neither technique uniformly dominated the other. Besides, some studies adopted a static perspective (e.g. Thomas *et al.*, 1998; Ratchford, 2003; Donthu and Yoo, 1998; Keh and Chu, 2003; Barros and Alves, 2003), whereas several papers adopted a dynamic perspective (e.g. Barros and Alves, 2004; Sellers and Mas, 2009a; De Jorge, 2010) allowing frontier shifts and technical change.

With regard to the sample, most of these studies have analysed efficiency for the companies that operate in a country, such as the United States (Keh and Chu, 2003; Mostafa, 2009; Gauri, 2013), the United Kingdom (Reynolds *et al.*, 2005), France (Perrigot and Barros, 2008), Spain (Sellers and Mas, 2006, 2009a; De Jorge and Sanz-Triguero, 2011; De Jorge and Rojas, 2015), Portugal (Barros and Alves, 2004), India (Gupta and Mittal, 2012; Gandhi and Shankar, 2014), or China (Yu and Ramanathan, 2009). Despite its interest, the research that compares the efficiency of distributors from different countries is scarce (e.g., De Jorge, 2010; Assaf *et al.*, 2012). For example, De Jorge (2010) analysed the efficiency of a sample of distributors from six European countries (Belgium, Czech Republic, France, Italy, Spain and Sweden). This author observed important differences in the evolution of productivity and efficiency between countries. Assaf *et al.* (2012) used a sample of distributors from different countries to examine the effects of distributors' internationalization on efficiency. They observed a U-shaped relationship between both variables and found that the date of entry into the country, mergers and acquisitions as well as the country of origin moderated this relationship.

Finally, although many papers have only focused on estimating retailers' efficiency, a more recent stream of research has gone further and tried to identify the efficiency drivers by means of different variables (e.g., Yu and Ramanathan, 2016). These variables might include marketing aspects (e.g. store location), firm characteristics (e.g. type of store), or environmental factors (e.g. population). Despite marketing and firm characteristics variables are relevant, environmental external factors could even be more important determinants of retailers' performance; nevertheless, the latter have surprisingly been less studied.

In this context, the aim of this paper is to analyse retailers' efficiency and to extend the research on the impact of external variables on retailers' efficiency at a country level. Thus, the contribution of the study is twofold. First, this paper provides a comparative analysis of the efficiency of European retail systems. Second, it examines the influence of business environments on efficiency and in particular, the impact of market variables (population density and percentage of urban population) and structural variables (concentration, average size, external dependence, and business freedom) on efficiency. As stated above, these variables can directly influence company results, even more so than managerial decisions. Therefore, an adequate analysis of retailers' efficiency requires considering these variables to identify the source of such efficiency –the ability of companies to manage their resources on external conditions.

Methodology, sample and data

Methodology: efficiency estimation

The concepts productivity and efficiency are often used interchangeably despite the fact they are not exactly synonyms. On the one hand, productivity can be defined as the ratio between the output obtained from a production process and the input(s) required to produce it. In this sense, a

higher ratio can be directly interpreted as higher productivity. This ratio represents an estimation of performance and could be used as an external benchmarking for managers, who could compare productivity ratios among firms or industries. The main shortfall of productivity is that it represents an absolute measure of performance. It is estimated by inserting numbers into the predetermined formulas or ratios without considering the performance of other firms or other environmental circumstances (Donthu and Yoo, 1998).

On the other hand, efficiency is related to the concept of a production possibility frontier. In this sense, a frontier production function defines the relationship between inputs and outputs by depicting the maximum output attainable from a given set of inputs. Thus, the efficiency of a firm is a comparative measure of how well it employs inputs to achieve its outputs, as compared to its maximum potential for doing so, which is represented by its production possibility frontier. Firms operating on the production frontier are labelled as efficient (they obtain the maximum possible output level from a given set of inputs), and firms operating beneath the production frontier are labelled as inefficient (they are expected to increase their output by simply increasing their efficiency, without absorbing further resources).

To estimate efficiency, both parametric and non-parametric models have been proposed in the literature. The basic difference between them is that the parametric models specify a functional relationship between the inputs employed and the outputs obtained, while in the non-parametric models no functional relationship is considered. Gong and Sickles (1992) show that neither technique uniformly dominates the other.

This paper assesses retailers' efficiency and evaluates the impact of its potential drivers according to Simar and Wilson (2007, 2011). These authors proposed to estimate efficiency and its determining factors simultaneously via a stochastic two-stage process. The first stage assesses

efficiency using the non-parametric technique of Data Envelopment Analysis (hereafter, DEA). Charnes *et al.* (1978) originally proposed the DEA methodology. Management literature widely uses DEA to assess efficiency. It relies on linear programming techniques. DEA estimates the efficiency of the units under analysis. In this study, these units are the retailing systems of the European countries. In the second stage, a regression model is used to explain the influence of environmental variables on the estimates of efficiency. Specifically, a regression model is estimated for the initial estimates of efficiency ($\hat{\delta}_i$) with the external variables (Z_i) as regressors: $\hat{\delta}_i = f(Z_i, \beta_i) + \varepsilon_i$, where ε_i is a random variable that follows a normal distribution $N(0, \sigma_i)$.

The estimation of the $\hat{\beta}_i$ parameters allows identifying the effect of external variables on efficiency. This procedure, however, can produce biased estimates: this is because the error terms are correlated, as the computation of efficiency indicators ($\hat{\delta}_i$) involves several observations from each country (Simar and Wilson, 2007). To avoid this bias problem, a semi-parametric methodology is used, enabling to obtain consistent and unbiased estimates through a double bootstrap resampling procedure. Thus, this methodology decomposes efficiency into two components: the first one reflects the efficiency deriving from the units' own performance included in the analysis, while the second component captures a systematic factor which is explained by the Z_i variables. We provide details of the estimation algorithm in the appendix.

The validity of the two-stage method employed in this research requires verifying that the environmental variables do not affect the production possibilities. However, if the environmental variable affected the production function itself a different model would be needed, and the second stage regression would not be appropriate. We test this separability condition using Daraio *et al.* (2015) proposal. Finally, to take into account the dynamic nature of the data we have employed an intertemporal frontier (Tulkens and Vanden Eeckaut, 1995). Furthermore, we

have included several year dummy variables in the second stage to consider year-specific factors not included in the model.

Sample and Data

Retail distribution in the European Union provides a unique research context for the purpose of this research. European retailers have advanced in the last decades towards an integrated market (Eurostat, 2017), where the main European retailers operate simultaneously in several countries, reaching significant market shares. These companies mainly come from Germany, France and the United Kingdom. These international expansions across Europe imply that the European Union countries are comparable in terms of the competitors that operate in them. Nevertheless, each state maintains its own peculiarities in terms of external factors that might affect efficiency.

Hence, it can be expected relatively homogenous decision-making processes within the European Union, as decisions are made by the same companies. At the same time, this research context ensures enough variability in terms of potential external drivers of efficiency. Consequently, the European Union constitutes an adequate contextual setting to isolate and assess the impact on external factors on efficiency.

Regarding the variables' selection, there is an ongoing debate in the literature on retail efficiency as to the nature of the considered as inputs, outputs and efficiency drivers (Alderson, 1948; Beckman and Buzzell, 1958; Sellers and Mas, 2009a). Despite abundant discussion, no agreement has yet been reached as to which variables need to be taken into account when measuring retail efficiency and evaluating the potential impact of its drivers. Barros and Alves (2003) or Sellers and Mas (2009), among others, proposed to select these variables based on previous literature, information availability and researcher judgment. Considering these three aspects, this paper included the variables shown in Figure 1. Regarding the productive process,

this paper considers the following four inputs: (1) number of distribution companies; (2) number of points of sale, which acts as a proxy of the market coverage (Sellers and Mas, 2006); (3) number of employees, an input representing the labour factor (Bucklin, 1978; Pilling et al., 1995; Thomas et al., 1998); (4) investment in tangible assets, which considers other resources destined for investments that are not covered by previous inputs. Two variables are included as outputs: (1) total sales (Bucklin, 1978; Ratchford and Stoops, 1988; Donthu and Yoo, 1998; Thomas et al., 1998; Barros and Alves, 2003, 2004); (2) gross value added. Although there could be some overlap between total sales and value added, the latter variable allows controlling the influence of other types of costs not considered as inputs. Furthermore, apart from sales volumes, retailers pay special attention to value added as it guarantees the viability of the company and its ability to maintain a competitive advantage. The output variables are estimated in physical terms by dividing them by the price level of each country (index of price levels of food and non-alcoholic beverages –EU index = 100). This eliminated possible measurement errors deriving from differences in consumer income and in the level of services added due to distribution across countries. Regarding efficiency drivers, this paper explores the effects of the following variables: (1) average store size (in square meters), which represents average retailers chain size (Lusch and Moon, 1984; Donthu and Yoo, 1998), (2) population density (inhabitants per square kilometre), (3) retail concentration, measured through the Herfindahl-Hirschman index (Aalto-Setälä, 2002; Sellers and Mas, 2009b), (4) foreign trade ratio (food imports/total food sales), which can determine grocery goods costs, (5) economic freedom, measured through the Economic Freedom Index (Miller *et al.*, 2015), (6) urban population (percentage of population living in urban areas), which can influence logistic costs and hence determine efficiency.

INSERT FIGURE 1 AROUND HERE

Data are obtained from Eurostat (<https://ec.europa.eu/eurostat/data/database>), Euromonitor (<https://www.euromonitor.com>), The Heritage Foundation (<https://www.heritage.org/index>) and the World Bank (<https://data.worldbank.org>). The data includes information for the aforementioned inputs, outputs and efficiency determinants in the period 2006-2015 for 25 EU countries: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Holland, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the United Kingdom (see Table 1 for the descriptive statistics and Table 2 for correlation indexes).

INSERT TABLES 1 AND 2 AROUND HERE

Results

Table 3 shows the results regarding estimations of efficiency, i.e. average efficiency estimate based on the standard DEA model (Efic.), the average efficiency estimate based on the stochastic DEA model (Efic-BC), the bias of the standard DEA model and the confidence intervals for the bias corrected efficiency estimates. Average efficiency was 0.817 and 0.774 based on the non-stochastic and the stochastic models respectively. This implies that the countries in our sample could reach the same output using on average respectively 18.3% and 22.6% less of productive resources. The analysis also revealed that efficiency varied across countries. Three groups can be distinguished. First, one group of countries had high efficiency indexes (>0.90) (Finland, Slovenia, France, Belgium, Germany, United Kingdom and Sweden). A second group of

countries had low levels of efficiency (<0.70) (Latvia, Lithuania, Slovakia, Croatia, Portugal, Czech Republic, Romania and Bulgaria). Finally, a third group of countries had medium levels of efficiency (Spain, Austria, Estonia, Holland, Denmark, Ireland, Hungary, Greece, Poland and Italy). The differences between the mean indices of these three groups are significant (ANOVA test: $F=216.83$, $p=0.000$).

INSERT FIGURE 2 AROUND HERE

INSERT TABLE 3 AROUND HERE

On average, the retail efficiency in the EU countries increased over time (Figure 3). There were, however, some differences across countries (Table 4). Some countries improved their retail efficiency (e.g. Austria, Ireland or Sweden), while others did not (e.g. the Netherlands or Slovakia).

INSERT FIGURE 3 AROUND HERE

INSERT TABLE 4 AROUND HERE

Table 5 shows the estimation results of the regression models based on efficiency and external variables. In order to evaluate model sensitiveness to collinearity, several alternative models are estimated. The results were consistent across specifications and thus supported the reliability of the results. Furthermore, the Daraio *et al.* (2015) proposal was employed to test separability. The joint test ($p=0.474$) indicated that there was no evidence against separability,

thus supporting the validity of the two-stage process used in this research. The dependent variable in the regression models was the mode of inefficiency. Therefore, a positive sign in the parameters of the environmental variables implied a negative impact on efficiency and vice versa.

INSERT TABLE 5 AROUND HERE

First, population density had a positive influence on efficiency. Therefore, the greater the population density was, the greater the efficiency. This positive effect on efficiency may be due to the fact that transport costs are among the biggest to be associated with distribution activities (Betancourt, 2005). Indeed, as the population density increases, companies can achieve economies of scale because they need a lower number of stores to meet the needs of the same population. This reduces retailer transportation costs as well as required investments in tangible assets.

Second, foreign trade ratio had a negative impact on efficiency. The greater the foreign trade ratio, the lower efficiency was.

Third, average store size had a positive impact on efficiency. Thus, the greater the average store size in a retail system, the greater the efficiency was. This result is consistent with literature on retail productivity about scale economies, which considers that store size positively influences labour productivity (e.g. Lusch and Moon, 1984) and efficiency (Keh and Chu, 2003). When average store size increases, companies can achieve scale economies, because the resources devoted to build and operate a new store are distributed among a broader and deeper assortment (Sellers and Mas, 2009). For example, a bigger assortment in non-perishable products

implies a greater amount of products offered to customers. This allows to better satisfy customers' needs (Lusch and Moon, 1984), leading to a higher sales volume per purchase trip.

Fourth, the retail concentration index positively influences efficiency. The higher the concentration, the greater the efficiency was. Retail concentration can lead to economies of scale. Lower costs can have positive consequences for customers, if the gain in efficiency is reflected in lower prices.

Fifth, urban population had a positive effect on efficiency: the greater the urban population in a country, the greater the efficiency of its retailing system. Transportation costs could explain this effect. Rural areas usually have worst transportation infrastructures implying that transportation costs to access customers are greater in rural areas than in urban areas.

Finally, economic freedom had a positive and significant effect on efficiency. This result is consistent with previous research findings, which showed a positive relationship between lesser regulation and increases in total factor productivity (Nicoletti and Scarpetta, 2003; Crafts, 2006; Griffith and Harmgart, 2008; De Jorge, 2008; Escribá-Pérez and Murgui-García, 2018). One of the main effects of regulation is its ability to change incentives for investment and innovation. Thus, if regulation reduces the net returns of investment and innovation activities, it has a negative effect on productivity (Crafts, 2006). Additionally, retailing regulations can slow down the development and implementation of new technologies as well as organizational changes that act as precursors of productive growth (McGuckin *et al.*, 2005). These regulations include restrictions on opening hours, labour legislation and laws on land use among others.

Conclusions

This paper analyses the efficiency of retail systems of EU countries over the period 2006-2015 and the impact of external variables on such efficiency. A double-bootstrap DEA stochastic

model is employed to measure retail efficiency and to assess the impact of its drivers. Retail efficiency is estimated in physical terms, hence eliminating the impact of prices on efficiency measurement. The results show that the average efficiency of European distribution increased between 2006 and 2015, partially due to external variables. This phenomenon was found to have occurred in most countries.

The high degree of internationalization of main European retailers allows transferring efficiency improvements to less developed countries. However, this does not imply efficiency is homogeneous across borders because the efficiency of retail distribution heavily depends on country-specific variables. Hence, this study evaluated the impact of such factors on efficiency. The results showed that both population density and the percentage of urban population in a country increased efficiency. These effects are explained by lower logistic supply costs. Results also found that the average store size and the retail concentration increased efficiency. Retail systems with bigger companies and stores allowed obtaining economies of scale derived from size.

The impact of these four variables on efficiency recommends managers considering such variables in the identification of favourable markets during their internationalization processes. This applies not only to managers in the EU retail industry, but also to others outside our research context, as long as they are involved in internationalization processes. Besides, managers –typically judged on the basis of improving the efficiency of their firms– need to acknowledge the impact of these drivers of their efficiency in order to accurately evaluate their own decisions. This is especially relevant to avoid wrongly transferring some managerial actions to countries with different external conditions that affect efficiency. Additionally, out of any internationalization process, retailers can adopt a more proactive role regarding these factors.

Hence, they can show governments through retail lobbies what factors are limiting their efficiency and urge them to act properly.

In this regard, our findings have also several implications for policy makers. At a national level, estimations of the different countries' efficiency might be used as external benchmarks. This process implies that an inefficient retail system within a country should examine the reasons why other countries are more efficient, identifying the determinant causes of their different efficiency levels, which finally allows for the measurement of the value of the different strategies adopted.

In this sense, the results evidence that economic freedom positively affected efficiency. Reducing regulation barriers improves the efficiency of the distribution system within a country. Thus, governments can stimulate the efficiency of retail systems by enhancing free competition, thus also favouring consumers. Similarly, mergers and acquisitions must be allowed, as concentration increases efficiency. However, authorities must be cautious and prevent the formation of spatial monopolies as a result of such operations. Governments should also be cautious about limiting store size when retailers open new stores. This decision usually has positive effects in terms of protecting small business, keeping the character of local communities, etc., but it diminishes retail efficiency. Moreover, dependence on foreign trade reduces efficiency. This may be due to higher supply costs associated with this dependence on imports. Therefore, fostering lower dependence on foreign trade could have a positive impact on the retail system.

At a supranational level, our results are relevant for governments participating in economic integration processes, such as the EU (but not limited to). Our research helps diagnosing differences in efficiency, and it allows identifying what external variables affecting

efficiency can potentially delay economic integration. Once that these variables are identified, supranational authorities can dictate specific policies to reduce efficiency differences across countries and hence boost economic integration.

There are several limitations to this study. First, possible supply and demand restrictions deriving from the scope of retailing as a service activity were not taken into consideration. These restrictions could affect the ability of firms to transform inputs into outputs and affect retailers' efficiency. Second, other relevant variables could be included in the retailers' production process, such as the degree of technological development of the companies themselves. The level of analysis (country-specific) hinders the inclusion of technology-related variables, since this type of analysis might be done better at a firm level. Third, this paper provides a starting point for the further study of other external factors causing the observed differences in efficiency. Additional efficiency determinant drivers could thus be considered, and future lines of research should try to overcome these limitations.

To conclude, the dynamic nature of the retailing sector may give rise to seemingly excessive use of resources which are intended to produce beneficial results in the future. Thus, analysing the dynamic nature of efficiency, considering the analysis of productivity along time, and its decomposition into frontiers shifts (which are interpreted as technological change) and catching-up effects (which are interpreted as efficiency changes) might represent an interesting future line of research.

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Appendix

This research employs the following algorithm (Simar and Wilson 2007) to estimate efficiency and the impact of external factors on it:

Step 1. Efficiency indexes ($\hat{\delta}_i$) are computed using a DEA model for each country.

Step 2. A truncated regression model is estimated by maximum likelihood to obtain $(\hat{\beta}_i, \hat{\sigma}_\varepsilon)$. The dependent variable was the efficiency computed in step 1 ($\hat{\delta}_i$). The regressors were the external variables (Z_i).

Step 3. For each country ($i=1 \dots n$), the next steps (a-d) are implemented L_1 times by bootstrapping. Hence, L_1 bootstrap estimates ($\hat{\delta}_{i,L}^* = 1 \dots L_1$) are obtained.

a. $\varepsilon_i = (1 - \hat{\beta}_\varepsilon Z_i)$ is obtained from the left-truncated distribution $N(0, \hat{\sigma}_\varepsilon^2)$.

b. $\delta_i^* = \hat{\beta}_{Zj} + \varepsilon_i$ is computed.

c. The pseudo-data (x_i^*, y_i^*) is built, where $x_i^* = x_i$ and $y_i^* = \hat{y}_i \delta_i / \delta_i^*$.

d. Efficiency ($\hat{\delta}_i^*$) is estimated using a DEA model from the pseudo-data (x_i^*, y_i^*) .

Step 4. For each country $i=1 \dots n$ a non-biased estimate of efficiency $\hat{\hat{\delta}}_i = \hat{\delta}_i - bi\hat{a}s_i$ is obtained, where $bi\hat{a}s_i = \sum_{L=1}^{L_1} \hat{\delta}_{i,L}^* / L_1 - \hat{\delta}_i$.

Step 5. A truncated regression model is estimated by maximum likelihood, where the dependent variable was the efficiency computed in step 4 ($\hat{\hat{\delta}}_i$) and the regressors were the external variables (Z_i) to obtain the parameters $(\hat{\hat{\beta}}_i, \hat{\hat{\sigma}}_\varepsilon)$.

Step 6. The next three steps (a-c) are implemented L_2 times by bootstrapping. Hence, $(\hat{\hat{\beta}}_L^*, \hat{\hat{\sigma}}_L^*; L = 1, \dots, L_2)$ are obtained:

a. For each country $i=1 \dots n$, $\varepsilon_i = (1 - \hat{\hat{\beta}} Z_i)$ is obtained from the left-truncated distribution $N(0, \hat{\hat{\sigma}}_\varepsilon^2)$.

b. $\delta_i^{**} = \hat{\beta} Z_i + \varepsilon_i$ is computed for $i=1 \dots n$.

c. A truncated regression model is estimated by maximum likelihood, where the dependent variable was the efficiency obtained at the previous step (δ_i^{**}) and the regressors were the environmental variables (Z_i) to obtain the following parameters ($\hat{\beta}^*, \hat{\sigma}^*$)

Step 7. Confidence intervals are built for δ_i^{**} and ($\hat{\beta}^*, \hat{\sigma}^*$).

Following standard practices in the implementation of this algorithm (Simar and Wilson, 2007) L_1 is set to 100 and L_2 is set 2000. To implement this methodology, the rDEA library for R has been employed (Simm and Besstremyannaya, 2016).

Table 1. Descriptive estimates.

	Mean	Standard deviation	Minimum	Maximum	Source
Points of sale	54828.570	64805.106	2062	278731	Eurostat
Distribution companies	145060.520	167632.609	3969	692593	Eurostat
Employees	749579.420	923626.521	44133	3705195	Eurostat
Investment	2415.640	3459.116	74.00	21851.00	Eurostat
Total sales	462.067	606.856	23.85	2062.56	Eurostat
Gross value added	177.210	247.291	5.68	1039.38	Eurostat
Prices	96.44	19.79	56.40	145.50	Eurostat
Store size	227.395	111.837	54.784	427.432	Euromonitor
Population density	128.883	106.965	17.3	502	Eurostat
Retail concentration	1039.789	638.744	50	2862.24	Euromonitor
Foreign trade dependency	26.695	12.769	10.552	72.129	Euromonitor
Economic freedom	80.204	10.582	53.70	99.90	The Wall Street Journal and The Heritage Foundation
Urban population	71.246	11.711	49.65	97.86	

Table 2. Correlation among variables.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Points of sale (1)	1											
Distribution companies (2)	0.965**	1										
Employees (3)	0.709**	0.716**	1									
Investment (4)	0.617**	0.623**	0.87**	1								
Total sales (5)	0.697**	0.740**	0.959**	0.884**	1							
Gross value added (6)	0.639**	0.684**	0.976**	0.889**	0.980**	1						
Store size (7)	-0.324**	-0.256**	0.132*	0.14	0.171**	0.237**	1					
Population density (8)	0.219**	0.208**	0.398**	0.382**	0.364**	0.397**	0.179**	1				
Retail concentration (9)	-0.554**	-0.499**	-0.277**	-0.225**	-0.235**	-0.188*	0.700**	-0.208**	1			
Foreign trade dependency (10)	-0.490**	-0.468**	-0.440**	-0.389**	-0.450**	-0.410**	0.154*	0.286**	0.242**	1		
Economic freedom (11)	-0.174**	-0.111	0.184**	0.253**	0.230**	0.272**	0.711**	0.209**	0.530**	0.117	1	
Urban population (12)	0.028	0.104	0.227**	0.263**	0.274**	0.299**	0.386**	0.454**	0.181**	0.111	0.605**	1

* significant at a 0,01 level ; ** significant at a 0,05 level

Table 3. Average efficiency.

Country	Effic.	Effic-BC	Bias	Lower bound	Upper bound
Austria	0.894	0.871	0.023	0.854	0.891
Belgium	0.956	0.921	0.035	0.893	0.960
Bulgaria	0.474	0.441	0.033	0.421	0.470
Croatia	0.655	0.610	0.045	0.579	0.637
Czech Republic	0.625	0.603	0.022	0.586	0.624
Denmark	0.873	0.849	0.025	0.829	0.869
Estonia	1.000	0.857	0.144	0.771	0.966
Finland	0.977	0.942	0.035	0.912	0.982
France	0.995	0.936	0.059	0.888	1.017
Germany	0.954	0.908	0.045	0.871	0.982
Greece	0.813	0.760	0.053	0.723	0.801
Hungary	0.855	0.824	0.031	0.801	0.857
Ireland	0.867	0.841	0.026	0.822	0.867
Italy	0.745	0.719	0.026	0.700	0.744
Latvia	0.759	0.679	0.081	0.629	0.747
Lithuania	0.724	0.655	0.069	0.609	0.704
Holland	0.879	0.856	0.023	0.839	0.879
Poland	0.771	0.735	0.035	0.707	0.787
Portugal	0.625	0.603	0.022	0.588	0.623
Romania	0.484	0.467	0.017	0.455	0.480
Slovakia	0.712	0.643	0.069	0.599	0.686
Slovenia	0.995	0.938	0.057	0.893	0.996
Spain	0.899	0.873	0.026	0.854	0.903
Sweden	0.928	0.901	0.027	0.879	0.931
United Kingdom	0.959	0.907	0.052	0.863	1.001
Total	0.817	0.774	0.043	0.743	0.816

Table 4. Efficiency in 2006-2015.

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Austria	0.799	0.837	0.828	0.837	0.912	0.896	0.894	0.890	0.900	0.920
Belgium	0.885	0.874	0.878	0.934	0.899	0.940	0.949	0.942	0.956	0.956
Bulgaria	0.473	0.360	0.341	0.378	0.425	0.443	0.467	0.500	0.535	0.491
Croatia	0.556	0.560	0.535	0.531	0.559	0.587	0.650	0.722	0.620	0.777
Czech Republic	0.650	0.658	0.507	0.605	0.596	0.564	0.548	0.579	0.662	0.656
Denmark	0.684	0.680	0.768	0.852	0.890	0.883	0.892	0.936	0.950	0.952
Estonia	0.815	0.809	0.839	0.852	0.832	0.866	0.891	0.884	0.895	0.882
Finland	0.904	0.899	0.953	0.903	0.949	0.949	0.969	0.965	0.970	0.954
France	0.928	0.885	0.943	0.945	0.954	0.957	0.950	0.922	0.935	0.935
Germany	0.915	0.942	0.942	0.877	0.899	0.893	0.891	0.889	0.920	0.916
Greece	0.569	0.638	0.652	0.795	0.848	0.692	0.879	0.832	0.867	0.828
Hungary	0.924	0.850	0.713	0.780	0.755	0.808	0.781	0.861	0.874	0.891
Ireland	0.878	0.904	0.772	0.807	0.815	0.782	0.815	0.888	0.828	0.921
Italy	0.659	0.659	0.677	0.697	0.634	0.769	0.712	0.732	0.813	0.840
Latvia	0.506	0.529	0.464	0.603	0.843	0.763	0.778	0.831	0.710	0.761
Lithuania	0.633	0.560	0.584	0.703	0.840	0.760	0.643	0.601	0.669	0.554
Holland	0.899	0.933	0.846	0.874	0.894	0.837	0.865	0.821	0.806	0.788
Poland	0.697	0.631	0.507	0.724	0.690	0.777	0.793	0.833	0.825	0.873
Portugal	0.519	0.512	0.480	0.488	0.597	0.648	0.768	0.740	0.651	0.627
Romania	0.308	0.278	0.320	0.539	0.500	0.426	0.511	0.553	0.578	0.655
Slovakia	0.794	0.800	0.801	0.689	0.612	0.544	0.674	0.531	0.498	0.488
Slovenia	0.946	0.927	0.927	0.939	0.948	0.953	0.952	0.939	0.921	0.927
Spain	0.792	0.811	0.803	0.844	0.896	0.901	0.918	0.888	0.919	0.960
Sweden	0.773	0.845	0.872	0.955	0.911	0.879	0.912	0.941	0.966	0.961
United Kingdom	0.806	0.807	0.921	0.917	0.956	0.927	0.940	0.944	0.924	0.924
Total	0.732	0.728	0.715	0.763	0.786	0.778	0.802	0.807	0.808	0.817

Table 5. Efficiency drivers.

	Model 1			Model 2			Model 3			Model 4		
	Estimate	Lower Bound	Upper bound	Estimate	Lower Bound	Upper bound	Estimate	Lower Bound	Upper bound	Estimate	Lower Bound	Upper bound
Intercept	1.962	1.492	2.422	1.642	1.067	2.108	3.646	2.961	4.649	5.469	4.084	8.156
Population density	-0.001	-0.003	0.000	-0.006	-0.008	-0.004	-0.003	-0.005	-0.002	-0.005	-0.009	-0.002
Foreign trade dependency	0.029	0.019	0.043	0.047	0.035	0.071	0.043	0.033	0.062	0.021	0.007	0.045
Store size	-0.010	-0.014	-0.008	-	-	-	-	-	-	-	-	-
Concentration	-	-	-	-0.002	-0.002	-0.001	-0.001	-0.002	-0.001	-	-	-
Urban population	-	-	-	-	-	-	-0.033	-0.048	-0.022	-	-	-
Economic freedom	-	-	-	-	-	-	-	-	-	-0.073	-0.121	-0.053
Variance	0.437	0.385	0.548	0.480	0.419	0.621	0.425	0.380	0.533	0.646	0.548	0.916

The models include year dummy variables (not included in the table)

Figure 1. Research model.

Figure 2. Average efficiency distribution across countries.

Figure 3. Evolution of average efficiency.