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Efficiency and convergence analysis in a women's clothing retail store chain: Evidence from Portugal

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Efficiency and convergence analysis in a women's clothing retail store chain

Evidence from Portugal

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Abstract

Purpose – The purpose of this paper is to estimate retailing efficiency in a 26-store women clothing retail chain and to decompose it in several measures in order to contribute to the performance improvement of this retail service firm, as well as to compare the efficiency of the different decision making units.

Design/methodology/approach – This paper uses the following measures to estimate efficiency: sigma convergence analysis; efficiency analysis; technical efficiency (TE) analysis; pure technical efficiency (PTE) analysis and scale efficiency (SE) analysis for a set of 26 stores of a women retail service brand operating in Portugal. A cross-section input-oriented data envelopment analysis (DEA) is used to analyse quarterly data sets from 2010 to 2013.

Findings – The results show that costs with personnel are slightly increasing when analysed using the sigma convergence method, although there are some geographical differences. Moreover, it is possible to witness that the retail store chain's TE diminishes as the operations outputs do not grow as fast as input savings. On the other hand, there are no SE problems as the levels of SE are larger than pure efficiency levels.

Research limitations/implications – The main limitation of the study stems from the fact that the analysis is based on a simple retail chain, which makes it a single case study. Therefore, the generalisation of the conclusions for other firms or for other periods of analysis should be made cautiously.

Practical implications – It is shown that some stores have a good TE and other stores have some SE advantage. As such, it is possible to select some stores as benchmarks to deploy internal efficiency throughout the retail chain.

Originality/value – The contribution of this paper is based on the application of the sigma conversion and DEA techniques to evaluate efficiency in retail service store.

Keywords Portugal, DEA, Scale efficiency, Sigma convergence, Technical efficiency, Women clothing retail stores

Paper type Research paper

1. Introduction

The growing market liberalisation and international trade has created a competitive environment across markets encompassing almost all sectors of the economic activity. In the Portuguese case, specifically, the retailing industry has been witnessing shorter product life cycles, one clear example being the case of the clothing collections, which are strongly influenced by the growing exposure of this sector to international markets.

The evaluation and improvement of the efficiency of the clothing industry businesses require the use of analytical techniques that provide more precise and objective information than the one obtained when analysing financial indicators or

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profitability indicators. In most of the firms of the clothing industry, the performance is evaluated based on financial and operational ratios, quite often using profits as the main key performance indicator, complemented with the comparison between defined goals and what effectively was accomplished.

Given the lack of studies in the apparel industry, specifically assessing the performance of companies with regard to the evaluation of their resources, we decided to explore this gap in the literature. As such, the objective of this paper is to analyse and evaluate the resource efficiency of a women's clothing retail store chain that has a set of 26 stores nationwide, and is one of the main women's clothing retailer in Portugal.

Given the privileged information at quarterly level, initially we analyse the convergence/divergence path of the variables (as profit and operational costs) that will be included in the optimisation problem. In a second phase we apply the data envelopment analysis (DEA) method in order to rank the level of efficiency of the 26 stores to implement benchmarking policies for the group of less efficient units. Technical efficiencies (TEs) are used to analyse the 26 shops. As such, the purpose is to estimate the retailing efficiency and to decompose it in several measures to contribute to the performance improvement of the stores.

It seems consensual in most of the reviewed literature that performance evaluation of the clothing supply chain should be done at operational level, in order to estimate TE parameters, whose efficiency levels are connected to the scale effect and/or to the productivity effect of each unit.

Given the scarcity of empirical literature focusing on efficiency and/or productivity evaluation of specialised clothing retailers, we chose to review the relevant contributions from studies closely related to the target industry we are addressing. Thus, we chose the distribution retailing industry and the textile and clothing industry.

The state of the art of the literature concerning the realm of operational business evaluation has shown, on one hand, that the application of the DEA technique concerning the efficiency or performance evaluation in the retail or in the textile and clothing industry is still scarce. On the other hand, in textile industry it is possible to highlight mainly cross-sectoral studies (Thomas *et al.*, 1998; Dubelaar *et al.*, 2002; Moreno, 2008; Mostafa, 2009, 2010a, b).

Among others, Thomas *et al.* (1998) applied the output-oriented DEA methodology to study 520 outlets in the US multi-retailer chain having complemented this analysis with a MANOVA. Dubelaar *et al.* (2002) applied a structural equation modelling methodology in the analysis of 800 pharmacy stores in Australia and New Zealand. Moreno (2008) used the input-oriented DEA methodology to evaluate the efficiency of 234 Spanish hypermarket stores of four different chains. Mostafa (2009, 2010a, b) used the output-oriented DEA method to study US generalist retailers. Beriha *et al.* (2011) applied the constant returns to scale (CRS) DEA model to calculate the security-level performance of Indian manufacturing units. The level of accidents control (outputs) and the percentage of the annual budget of the various security activities were considered as inputs. The results show that there are seven inefficient units and 30 efficient units. Moreover, a benchmarking process was implemented in inefficient units in order to increase their efficiencies according to the best practices of efficient units.

Chang (2011) used both the input- and output-oriented DEA models to calculate the TE and scale efficiency (SE) indices in order to evaluate the performance of a technology development programme. The results show that materials, chemical engineering, machinery and aerospace fields have better performance than other fields. They used the efficient decision making units (DMUs) to generate benchmarking

policies for inefficient DMUs. Lee and Pai (2011), based on a DEA model, analysed the top ten electronics manufacturers in Taiwan, Korea and Japan from 2002 to 2007 that sought to introduce light, thin and energy-saving technologies in their products. The results revealed that some brands/firms performed better than others, with Innolux and LGD outperforming among others, Sharp, Sony and Toshiba.

Memon and Tahir (2012) applied both constant and variable returns to scale (VRS) non-parametric DEA model to assess the TE and SE in 49 manufacturing companies in Pakistan. After decomposing total efficiency into pure technical efficiency (PTE) and SE it was found that the PTE was the source of inefficiency. Furthermore, the results reveal that most companies operate within increasing returns to scale (IRS). Shetty *et al.* (2012) applied a modified non-oriented, non-radial directional distance DEA model to evaluate the efficiency of information technology (IT) and IT enabled services companies for a set of 66 bankrupt companies in India. The scores obtained reveal that the average score of failing companies indicated that Hewlett-Packard Globalsoft Ltd, Infosys Technologies Ltd, Aftek Ltd, NIIT Ltd and Wipro Ltd were the top five companies with less probability of bankruptcy. These companies were outperforming their counterparts, even in unfavourable conditions. Saeidi *et al.* (2013) address the problem of optimising the ranking of woven fabric defects (WFDs) observed in the textile manufacturing industry using the DEA method. This study also ranks observed WFDs from the worst score obtained from the suggested DEA formulation. The main contribution of this study stems from the introduction of a new DEA method for ranking WFDs in textile manufacturing, whose efficiency ratios enabled firms to improve their manufacturing process.

From a dynamic perspective, panel data studies stand out. Barros (2006) uses the output-oriented DEA method to evaluate the efficiency of 22 Portuguese hypermarket and supermarket chains. He subsequently used a bootstrapped Tobit regression to complement the analysis. Sellers-Rubio and Mas-Ruiz (2006) also used an output-oriented DEA to study 100 stores of a Spanish grocery retail chain having complemented their study with Spearman correlations. Perrigot and Barros (2008) use an output-oriented DEA to study the efficiency of 11 French generalist retail chains strengthening the analysis with a two stage bootstrapped Tobit regression. Moreno (2010) uses an input-oriented DEA method to analyse 1,323 non-specialised retailers from six European countries using a two stage approach method, in which first, the firms belonging to different countries are compared against each other and second, best practices are used to improve performance throughout the whole sample.

Although there are several studies on Portuguese retailing efficiency (Barros and Alves, 2003, 2004; Barros, 2005, 2006; Farhangmehr *et al.*, 2000; Vaz *et al.*, 2010; Vaz and Camanho, 2012; Camanho *et al.*, 2009), none of them analyse the efficiency of the textile retailing sector. For example, while Barros and Alves (2003, 2004) and Barros (2005) analyse efficiency and productivity of hypermarkets and supermarkets using DEA, Farhangmehr *et al.* (2000) analyse customers' perceptions of hypermarkets *vis-à-vis* traditional retailers.

On a different vein, although addressing supermarkets and hypermarkets, Vaz *et al.* (2010) analysed the store performance at section and store level. Camanho *et al.* (2009) analysed how internal factors of each DMU in a retail store condition external non-discretionary factors. Finally, using the Malmquist-type index Vaz and Camanho (2012) analyse how supermarkets and hypermarkets differ in terms of group of stores defining best practice frontiers.

We would like to mention that in the current state of the productivity analysis-related literature we highlight mainly the studies about the partial factor productivity, applied in India among others, in the garment industry (Bheda, 2002; Rangarajan, 2005; Joshi *et al.*, 2005; Duzakin and Duzakin, 2007). On the other hand, there are some studies regarding the total factor productivity applied both to the textile and to the garment industries in India (Hashim, 2005; Bhandari and Ray, 2007; Joshi and Singh, 2008, 2010).

Bearing these studies in mind, we decided to study efficiency from a static and dynamic point of view. In static terms we chose the cross-section efficiency evaluation based on quarterly data, thus reflecting the seasonality of the clothing collections throughout different seasons.

After this succinct introduction/review, the challenges of the apparel industry are presented in Section 2, whereas the methodology used in this paper is presented in third section. The results and the discussion are presented in Section 4. Finally, the main conclusions are presented in Section 5.

2. The apparel industry

The apparel industry is characterised by the short life cycles of its products and/or collections, where the introduction of new products is used to capture consumer needs in what pertains to new styles and images. Moreover, the instability of consumer preferences and consumption decisions has led retailers to adhere to the fast-fashion concept, which simultaneously causes an increase in the heterogeneity of production, marketing and supply management activities in the clothing industry (Ghemawat and Nueno, 2003). This provokes a constant struggle for strategic market suitability and sales management.

Most clothing retailers can be aggregated into two broad categories: the specialised retailers (usually composed of chains of aggregated stores); and non-specialised ones (which integrate most retail warehouses and department clothing stores in hyper or supermarkets).

Modern retailers no longer have warehouses full of items ready to ship garments to stores. They have become lean retailers, possessing a limited amount of in-store inventory proportional to the size of the shopping area (Caro and Gallien, 2010). As such, the relationship with suppliers throughout the supply chain has become very challenging as a consequence of the importance of the inventory and transportation costs.

Specialised retail stores present a huge variety and types of business models. Among them, it is possible to highlight major industry players such as, among others, Zara (Inditex Group), H&M, C&A, Benetton and Lanidor. Some of these companies are the sole proprietors of the aggregated store chain while others are structured based on franchise agreements.

Among specialised retail stores, fully integrated firms (in which production, transportation and distribution and commercial activities are totally internalised in the value chain) coexist with semi-integrated firms, which rely on the outsourcing of manufacturing and distribution activities, such as H&M, C&A and Lanidor. Also, one particularity of this group of specialised retailers is that most of them have their own brands whose own production can be granted by a set of preferred suppliers providing high-quality raw-material, finished or semi-finished products.

One important aspect when analysing sales volumes in specialised retail industry is the fast-fashion phenomenon (based on shorter product life cycles and more complete and efficient supply chain) based on larger stock rotation. Specialist retail chains (the closest and most direct competitors of the case study analysed in this paper) that have adopted a fast-fashion strategy grew on average three to four times faster than the average growth

of the garment industry, as shown in Table I. The main reasons for this difference are the clear improvements in inventory turnover (5-8 per cent) and net margins (15-20 per cent).

As the fast-fashion paradigm is closely associated with the level of stock rotation, the supply chain management of this type of industry is crucial. Since the fast-fashion retailers dictate the rules of the game in the clothing retail market, it is expected that factors such as the speed of stock replenishment, brand and/or design exclusiveness and store efficiency are crucial in the near future. Thus, in order to bring new light to the study of efficiency and enhance competitiveness of specialised clothing retail chain, this study reports the case of a Portuguese clothing retail company that has a set of 26 stores nationwide, and is one of the main women's clothing retailers in Portugal.

3. Methodology

For confidentiality reasons, the name of the firm cannot be disclosed. The firm is composed of 26 different retail stores of women's clothing, 21 located in shopping centres. All the stores are located in urban areas across Portugal. Seven stores are located in the greater Lisbon area, six on the greater Oporto area, whereas the remaining stores are scattered in other main Portuguese cities. In total, 21 stores are located in modern shopping malls, while five stores are located in classy traditional retail stores.

In order to evaluate the efficiency of these women's retail stores, convergence analysis, efficiency analysis, TE analysis and PTE are going to be carried out based on data from 2010 to 2013. Moreover, we will first analyse aggregated data and then three situations involving three main groups will be analysed: one involving the greater Oporto region; another involving the greater Lisbon region; and finally, the remaining set of stores will be grouped separately.

The analysis refers to the 2010-2013 period of this women's clothing retail chain. In the literature of efficiency and productivity analysis of the retail industry, the choice of input and output measures of the DMU is not arbitrary. As such, the maximisation of the operative efficiency will be conducted based on an input-oriented objective function, as they are more easily controllable *vis-à-vis* the outputs. According to Dubelaar *et al.* (2010), Reardon *et al.* (1996), De Jorge (2008) and Thomas *et al.* (1998), the size of the shops (size effect), personnel-related costs, rent expenses and the accomplished investments are the determinants (inputs). Based on Sellers-Rubio and Mas-Ruiz (2007) and Perrigot and Barros (2008), sales volume and earnings before income taxes and amortisation (EBITA) are the outputs. The inputs and outputs were obtained for each of the 26 stores (DMUs) for each unit and for each quarter from 2010 to 2013. In what pertains to the dynamic analysis, the application of convergence analysis with the three efficiency measures explains, in the long run, the (non)persistency of the operative efficiency problems or the efficiency scale.

3.1 Convergence analysis

For the preliminary assessment of the clothing stores' performance we use sigma convergence analysis to assess the long run trend of the stochastic differences, between costs (inputs) and operational profits (outputs) among the clothing stores of the firm.

Table I. Percentage of variation of sales volumes of fast-fashion retailers

Specialised retailers	2001-2002	2003-2004	2006-2011
Inditex	15	11	15.2
H&M	22	13	13.2

Source: Own preparation based on firms annual reports

Our aim with this type of analysis is to explain if the short-term accumulated random differences of these series represent a possible explanation for the long-term shocks we find in these series. In this study we use the sigma convergence measure, an expression that is referred to in the literature by Boyle and McCarthy (1997).

This sigma convergence measure allows one to study the inter-temporal variations of the different output and input variables of the clothing stores. For example, to analyse the variation of sales in store i (Sales), we use the following expression to calculate the measure:

$$\sigma = \left(\frac{\text{var}(Sales_{ti})/mean(Sales_{ti})}{\text{var}(Sales_{t0})/mean(Sales_{t0})} \right)$$

where t_i represents the present time and t_0 is the first time moment. If we observe a break in that measure, it means that at that moment of time there is a sales convergence for the analysed units.

3.2 Efficiency analysis

The model's original formulation, known as the Charnes, Cooper and Rhodes (CCR) model, (Charnes *et al.*, 1978), assumes no significant relationship between the scales of operation and efficiency, i.e., there are CRS. To accommodate the situations in which there is a relation between the scales of operation and efficiency, Banker *et al.* (1984) proposed the formulation known as Banker, Charnes and Cooper (BCC) model, and considered an additional convex restriction to allow the efficiency evaluation of the DMU characterised by VRS, which can be either increasing (IRS) or decreasing (DRS).

To analyse the efficiency of 26 women's clothing stores we calculated the TE indexes for each unit and for each quarter from 2010 to 2013. We used the input-oriented CRS and VRS models. The consideration of an input-oriented DEA model is based on the assumption that DMUs tend to have less control over outputs. In this study, outputs analysed are: sales (in euros) and EBITDA (in euros). We considered as inputs, the size of the stores (in square metres), investments (in euros) and the personnel costs (in euros).

3.2.1 TE. The efficiency index initially developed (Charnes *et al.*, 1978) used the assumption of constant scale returns, which implies that an increase in resources leads to a proportional product increase for all DMUs, ignoring the size of the firms or stores. This index is known as TE, which is basically a measure by which the performance of some DMUs are evaluated *vis-à-vis* the performance of other DMUs. This measure is also called global efficiency and can be computed by the following expression:

$$TE_k = \frac{v_1 y_{1k} + v_2 y_{2k} + v_3 y_{3k} + \ldots + v_m y_{mk}}{\varpi_1 x_{1k} + \varpi_2 x_{2k} + \varpi_3 x_{3k} + \ldots + \varpi_n x_{3nk}} = \frac{\sum_{p=1}^{k} v_p y_{pk}}{\sum_{q=1}^{k} \varpi_q y_{qk}} \quad (1)$$

where TE is the technical efficiency punctuation given to the k unit; x and y represent inputs and outputs; v and ϖ represent the inputs and outputs weights; p is the number of inputs ($p = 1, 2, \ldots, m$); q is the number of outputs ($q = 1, 2, .., n$) and k represents the kth DMU ($k = 1,2, .., j$).

Equation (1) can be expressed as a linear programming problem stated as:

$$\max \theta = \sum_{p=1}^{k} v_p y_{pk}$$

subject to the following set of restrictions:

$$\begin{cases} (1) \sum_{q=1}^{k} \varpi_q y_{qk} x_n = 1, \quad i = 1, 2, 3, \ldots, k \\ (2) \sum_{p=1}^{k} v_p y_{pk} - \sum_{q=1}^{k} \varpi_q y_{qk} x_n \leqslant 0 \\ (3)\ v_p \geqslant 0, \quad p = 1, 2, 3, \ldots, m \\ (4)\ \varpi_q \geqslant 0, \quad q = 1, 2, 3, \ldots, n \end{cases}$$

in which θ is the TE parameter. In this paper the input-oriented model, usually referred to as CCR-DEA, introduced by Charnes *et al.* (1978), is going to be used. In this model the existence of CRS is assumed under the condition that the set of production possibilities is built/formed without any scale effect.

The DEA efficiency score is given by a specific v value, between 0 and 1, where 1 indicates that a DMU shows the best performance localised in the production frontier and reveals no potential reduction. However, any v value lower than 1 indicates that the DMU uses inputs inefficiently. The objective function of the model maximises the outputs ratio weighted by inputs as well as by the DMU analysed, as long as there are similar relations for all the DMUs in presenting efficiency scores equal to, or lower than 1. The optimal value for the objective function is the efficiency score attributed to a certain kth DMU. If the efficiency score equals 1 in a kth DMU, this decision unit satisfies the necessary condition to be considered efficient, otherwise it is inefficient.

3.2.2 PTE. More recently, a new version of this model was developed (Banker *et al.*, 1984) with VRS in which the efficiency depends on the firms' size (as such, the effect of an increase in product resources being different among DMUs). This relation is known as the PTE and it is a measure of the transformation process of resources into products.

The BCC model can be described by a dual linear programming problem expressed by the following objective function:

$$\max z = vy_i - v_i$$

subject to the following set of restrictions:

$$\begin{cases} (1)\ \varpi x_i = 1, \\ (2)\ -\varpi Y + vX - v_0 \varepsilon \leqslant 0 \\ (3)\ \varpi \geqslant 0, v \geqslant 0 \wedge v_0 \end{cases}$$

in which v_o is unrestricted in sign; where z and v_o are scalars with expected positive or negative signs; ϖ are outputs; v is the matrix of the input weights; and Y and X are the corresponding outputs and inputs matrixes, respectively. y_i and x_i refer to the inputs

and outputs of a DMU. The main advantage of the BCC model is that the units with inefficient scale are only compared with efficient and similar size units.

3.2.3 SE. SE is the potential productivity gain of a DMU obtaining the optimal dimension. It can be calculated as the ratio between TE and PTE given by the following ratio: $SE = TE/PTE$, which is equivalent to $TE = PTE \times SE$, highlighting that the sources of inefficiency of a DMU can stem from an inefficient operation (PTE), or a disadvantageous size (SE), or both (PTE and SE).

To maximise the average productivity in this transformation process, the DMU should operate in a CRS region in which average productivity equals marginal productivity. If the DMU falls into an IRS zone, or decreasing returns to scale (DRS) zone, it is possible to increase its productivity by increasing or reducing its scale. This measure is known as the SE and evaluates the operation SE of the DMU. If a DMU operates in an IRS region, a proportionate increase in its resources results in a more than proportionate increase of its outputs, but if a DMU operates in a DRS region, its output increases by less than the proportional change of its inputs. In sum, in the assumption of CRS, the TE is decomposed in PTE and in the assumption of VRS, it is decomposed in SE, which allows situations of CRS, DRS and IRS. Analytically, TE is the product of PTE and SE.

4. Results and discussion

4.1 Convergence analysis

The evolution of the sigma coefficient convergence for women's clothing retail chain is shown in Table II, as well as for the women's store of the greater Oporto and Lisbon regions.

From Table II it is possible to witness a convergence tendency only in the first quarter of 2011 with values close to 0.8 for the three variables considered (sales, EBITA and personnel costs). There are two different degrees of convergence for the variables personnel costs and sales in the third quarter of 2012 and the first and second quarter of 2013, with values close to 0.5 and 0.6, respectively.

Having disaggregated the study variables by type of clothing stores, the sigma convergence by type of geographic location shows a uniform behaviour, either upward or downward, for the of the sales sigma coefficients, and particularly for women's stores of the greater Oporto and Lisbon regions, as shown in Table II.

In the first and third quarters of 2013, convergence values around zero occur for the EBITA variable, in particular for stores located outside the Oporto and Lisbon regions, as shown in Table II. Finally, we also considered the behaviour of three variables altogether but analysing their convergence by geographical location. Thus, in this context, for the group of stores in the greater Oporto region, between the third quarter of 2010 and the fourth quarter of 2012, there is an alternating upward and downward convergence for the variables EBITA and personnel costs. This is contrary to the convergence behaviour revealed with sigma values around 0.5 in the transition between the respective quarters of 2013, for the variables sales and EBITA.

Regarding the stores of the Greater Lisbon region, there is strong convergence evidence throughout the whole period of analysis for the variables EBITA and Sales. However, the Personnel costs variable reveals a strong convergence towards values below 0.5 in the transition from the fourth quarter of 2010 to the first quarter of 2011, with a new sigma convergence for this value in the transition of the fourth quarter of 2011 to the first quarter of 2012.

Table II.
Sigma convergence of the women retail store chain

	Personnel costs				Sales				EBTIDA			
	Oporto	Lisbon	Others	Nationwide	Oporto	Lisbon	Others	Nationwide	Oporto	Lisbon	Others	Nationwide
1Q 2010	1.00	1.00	1.00	1.0000	1.00	1.00	1.00	1.0000	1.00	1.00	1.00	1.0000
2Q 2010	0.91	2.08	1.11	1.4144	1.32	1.42	1.18	1.2212	1.40	1.40	1.40	1.3961
3Q 2010	0.91	2.08	1.11	1.4144	0.85	0.99	2.06	0.9840	1.06	1.06	1.06	1.0579
4Q 2010	1.84	1.34	2.42	1.8051	1.54	1.72	0.98	1.4879	1.76	1.76	1.76	1.7622
1Q 2011	1.07	0.39	5.95	0.9437	0.82	0.97	0.71	0.9078	0.96	0.95	0.53	0.7869
2Q 2011	1.07	0.39	5.95	0.9437	1.22	1.58	1.21	1.1217	1.34	1.32	0.73	1.0986
3Q 2011	0.91	2.08	1.11	1.4144	0.80	1.01	1.27	0.8000	1.01	1.00	0.56	0.8324
4Q 2011	1.84	1.34	2.42	1.8051	1.40	1.44	1.15	1.1639	1.69	1.67	0.93	1.3866
1Q 2012	0.97	0.48	1.27	0.7689	0.97	1.05	0.67	0.9269	0.90	1.00	0.38	0.7831
2Q 2012	1.33	0.66	1.75	1.0547	0.87	1.01	0.83	0.7799	1.25	1.39	0.53	1.0933
3Q 2012	1.26	0.63	1.66	1.0009	0.65	1.02	0.71	0.7481	0.95	1.05	0.40	0.8284
4Q 2012	2.11	1.05	2.78	1.6790	1.06	1.50	1.06	1.0673	1.58	1.75	0.66	1.3799
1Q 2013	0.92	1.32	1.84	0.9919	0.58	0.87	0.65	0.6269	0.46	0.82	0.18	0.5457
2Q 2013	1.15	1.66	2.32	1.2498	0.59	1.14	0.36	0.6805	0.63	1.13	0.24	0.7496
3Q 2013	1.22	1.75	2.45	1.3192	0.48	1.19	0.65	0.7904	0.49	0.86	0.19	0.5758
4Q 2013	1.43	2.05	2.88	1.5474	1.01	1.27	0.58	0.9264	0.82	1.44	0.31	0.9600

Lastly, for the group of stores outside the metropolitan areas of Oporto and Lisbon, there is distinct evidence of convergence for the variable EBITA in the transition from the last quarter of 2010 to the first quarter of 2011. There is strong convergence evidence for the variables EBITA and sales in the transition from the last quarter of 2011 to the first quarter of 2012 and in the transition from the first quarter to the second quarter of 2013.

4.2 Efficiency analysis per store

Regarding the results of the convergence analysis, in which it is possible to spot some variability, we decided to analyse the store efficiency per quarter.

Tables III-VI show the results (in percentage) of the various efficiency coefficients of the respective quarterly efficiencies (TE, PTE and SE) per quarter, per year of analysis and for each store (DMU). Taking into account the type of performance to scale, it is possible to explain how management has been operating at operational and sales level per clothing store. Such evidence will be supported based on the input-oriented model used to measure efficiencies. This implies that input slacks of the efficiency vs the inefficiency solution are also analysed.

Taking into consideration the four years of analysis, DMU 14 shows a TE lower than 40 per cent in the years 2011-2013, which results from management inefficiency in the years 2011 and 2013 and operations scale inefficiency in 2012. However, DMU 19 reveals low-total TE values during the 2011-2013 period due to poor resource productivity. This lack of TE resulted from poor productivity, with the exception of the summer of 2013 in which there was a low-operational scale.

From the analysis, it is possible to highlight that the DMU with best TE is DMU 13, mainly because of the productivity having been accomplished since 2011. The identification of these kinds of returns to scale is important since it conditions the growth strategy. In the presence of decreasing RTS the marginal PTE productivity is lower than the average PTE productivity. As such, the outputs grow less proportionately than the inputs increase, creating a TE reduction. In an IRS regime, the situation is reversed, i.e., the marginal productivity is higher than the average productivity, which causes outputs to grow proportionately greater than the inputs growth improving TE.

When analysing the type of short-term measures to implement in what pertains to store management, we propose to reduce the inputs, since it is crucial to analyse the proportion of DMUs with DRS. Only in these cases will there be an improvement in the total TE based on the reduction of inputs.

In order to complement the analysis carried out in the women's clothing stores performance, we propose the convergence analysis to verify the long-term stochastic differences trend among the efficiency coefficients estimated with DEA.

This sigma convergence measure translates the inter-temporal variation in the estimated TE coefficients based on the set of outputs and inputs considered in the DEA exercise. For instance, to analyse the variation between the maximum efficiency estimated coefficients based on the TE option for the set of stores, we have the following expression to calculate the sigma coefficient:

$$\sigma = \left(\frac{\text{var} \oint TE_{ti} / mean \oint TE_{ti}}{\text{var} \oint TE_{t0} / mean \oint TE_{t0}} \right)$$

where $\oint TE_{ti}$ is the current moment and $\oint TE_{t0}$ is the first moment of that time horizon.

Table III.
Quarterly efficiencies per store during 2010

Quarter		1Q			2Q			3Q			4Q		
Types of efficiency		TE	PTE	SE	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Norte shopping	SC	0.5675	0.6102	0.9301	0.8225	0.8391	0.9802	0.83858	0.84949	0.9872	0.73077	0.75643	0.9661
Gaia shopping	SC	0.6030	0.7699	0.7832	0.7789	0.8469	0.9198	0.67987	0.72228	0.9413	0.61053	0.65298	0.9350
Cascais shopping	SC	0.8836	0.9525	0.9277	0.8894	0.9196	0.9671	0.88777	0.89025	0.9972	0.89784	0.90165	0.9958
Almada forum	SC	0.8821	0.9898	0.8912	1.0000	1.0000	1.0000	1.00000	1.00000	1.0000	0.73510	1.00000	0.7351
Dolce vita Oporto	SC	0.7164	0.7596	0.9431	0.9222	0.9231	0.9990	0.71845	0.72879	0.9858	0.65846	0.76803	0.8573
Dolce vita coimbra	SC	0.4286	0.5876	0.7295	0.5690	0.6499	0.8755	0.48393	0.56453	0.8572	0.43079	0.52980	0.8131
Setubal rua	TS	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.96753	1.00000	0.9675	1.00000	1.00000	1.0000
Forum aveiro	SC	0.5494	0.7401	0.7423	0.7266	0.7721	0.9411	0.71285	0.72820	0.9789	0.67303	0.78232	0.8603
Torres shopping	SC	0.6555	0.8645	0.7582	0.6617	0.7394	0.8950	0.64246	0.69449	0.9251	0.78628	0.90860	0.8654
Boavista	TS	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.00000	1.00000	1.0000	0.98451	1.00000	0.9845
Viseu	TS	0.9095	1.0000	0.9095	0.7900	0.8070	0.9789	0.74442	0.75264	0.9891	0.78433	0.90067	0.8708
Amoreiras	SC	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.00000	1.00000	1.0000	1.00000	1.00000	1.0000
Colombo	SC	0.7502	0.7640	0.9819	0.9322	0.9382	0.9937	0.92364	0.92744	0.9959	0.75670	0.76172	0.9934
Via catarina	SC	0.3776	0.7121	0.5303	0.4597	0.5610	0.8193	0.39768	0.50854	0.7820	0.44720	0.65814	0.6795
Entrecampos	TS	0.8686	0.9161	0.9482	0.8081	0.8275	0.9765	0.87852	0.89460	0.9820	0.59611	0.65863	0.9051
Algarve shopping	SC	0.7008	0.8553	0.8194	0.7521	0.8078	0.9310	1.00000	1.00000	1.0000	0.70601	0.80908	0.8726
Ikea alfragide	SC	0.8734	0.9186	0.9509	0.8325	0.8379	0.9935	0.83502	0.83567	0.9992	0.86692	0.90791	0.9549
Palácio gelo viseu	SC	0.3925	0.5779	0.6792	0.5899	0.6734	0.8760	0.58216	0.65617	0.8872	0.43560	0.54663	0.7969
Ikea mar shopping	SC	0.7033	0.7963	0.8832	0.8132	0.8366	0.9720	0.77128	0.78845	0.9782	0.59730	0.60921	0.9805
Coimbra forum	SC	0.5672	0.6765	0.8385	0.7179	0.7943	0.9038	0.67967	0.69946	0.9717	0.53877	0.60272	0.8939
Dolce vita vila real	SC	0.6769	0.8236	0.8218	0.7444	0.7914	0.9407	0.76012	0.76167	0.9980	0.56095	0.66269	0.8465
Beloura	SC	0.9964	1.0000	0.9964	0.9052	0.9381	0.9649	0.79344	0.82852	0.9577	0.89692	0.95698	0.9372
Estação viana	SC	0.5941	0.7603	0.7814	0.6782	0.7675	0.8837	0.69222	0.73090	0.9471	0.53098	0.58952	0.9007
Cent parque	TS	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.00000	1.00000	1.0000	1.00000	1.00000	1.0000
DV tejo	SC	0.7259	0.8150	0.8906	0.8070	0.8465	0.9534	0.96951	0.97045	0.9990	0.64313	0.64424	0.9983
Braga parque	SC	0.7036	0.7696	0.9142	0.7892	0.8315	0.9490	0.73745	0.75253	0.9800	0.56427	0.60328	0.9354

Note: SC, shopping centre; TS, traditional store

Table IV. Quarterly efficiencies per store during 2011

Quarter			1Q			2Q			3Q			4Q	
Types of efficiency		TE	PTE	SE	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Norte shopping	SC	0.6322	0.6341	0.9970	0.6346	0.6499	0.9765	0.6288	0.6800	0.6800	0.7147	0.7640	0.9354
Gaia shopping	SC	0.5636	0.7325	0.7695	0.6035	0.7216	0.8363	0.2712	0.5663	0.5663	0.5565	0.6218	0.8950
Cascais shopping	SC	0.7776	0.7942	0.9791	0.7346	0.7569	0.9705	0.4854	0.5312	0.5312	0.7975	0.8975	0.8885
Almada forum	SC	0.8316	0.9255	0.8985	0.6383	0.6503	0.9814	0.4976	0.5433	0.5433	0.7190	0.8650	0.8312
Dolce vita Oporto	SC	0.7127	0.7440	0.9580	0.7266	0.7461	0.9739	0.3633	0.4474	0.4474	0.5439	0.5481	0.9923
Dolce vita coimbra	SC	0.3980	0.5011	0.7943	0.4262	0.4953	0.8604	0.3157	0.5362	0.5362	0.5660	0.6386	0.8863
Setubal rua	TS	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.8269	0.8378	0.8378	1.0000	1.0000	1.0000
Forum aveiro	SC	0.4564	0.4699	0.9714	0.4346	0.4482	0.9696	0.3444	0.4486	0.4486	0.7051	0.8064	0.8744
Torres shopping	SC	0.4912	0.4953	0.9916	0.4125	0.4180	0.9869	0.4239	0.6362	0.6362	0.8363	0.9515	0.8789
Boavista	TS	0.7550	0.7750	0.9742	0.4963	0.7254	0.6842	0.6336	0.9004	0.9004	0.7940	1.0000	0.7940
Viseu	TS	0.7624	0.8326	0.9156	0.6851	0.7504	0.9130	0.5014	0.6497	0.6497	0.8665	0.9492	0.9129
Amoreiras	SC	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.6427	1.0000	1.0000	1.0000	1.0000	1.0000
Colombo	SC	0.9413	0.9473	0.9937	1.0000	1.0000	1.0000	0.7346	1.0000	1.0000	1.0000	1.0000	1.0000
Via catarina	SC	0.4387	0.7043	0.6228	0.2517	0.5620	0.4479	0.1779	0.5255	0.5255	0.4716	0.6596	0.7149
Entrecampos	TS	0.6215	0.6850	0.9074	0.6872	0.7148	0.9613	0.5157	0.5679	0.5679	0.6239	0.6868	0.9085
Algarve shopping	SC	0.6082	0.7385	0.8235	0.6330	0.7399	0.8556	0.4004	0.5310	0.5310	0.6675	0.7694	0.8676
Ikea alfragide	SC	0.8186	0.9012	0.9083	0.8012	0.8529	0.9394	0.5273	0.6394	0.6394	0.9134	0.9452	0.9664
Palácio gelo viseu	SC	0.4655	0.6051	0.7692	0.6917	0.7716	0.8964	0.4087	0.6390	0.6390	0.7753	0.8342	0.9294
Ikea mar shopping	SC	0.6330	0.7146	0.8858	0.5937	0.6684	0.8882	0.3582	0.4830	0.4830	0.7279	0.7285	0.9992
Coimbra forum	SC	0.5418	0.7052	0.7683	0.6518	0.7305	0.8923	0.3878	0.6050	0.6050	0.5932	0.6489	0.9141
Dolce vita vila real	SC	0.6509	0.8557	0.7607	0.6478	0.7779	0.8328	0.4001	0.6466	0.6466	0.5249	0.6327	0.8296
Beloura	SC	0.9977	1.0000	0.9977	0.7316	0.7446	0.9824	0.5307	0.6317	0.6317	0.7251	0.7356	0.9857
Estação viana	SC	0.5002	0.6299	0.7941	0.5887	0.6647	0.8856	0.3966	0.6064	0.6064	0.5120	0.5777	0.8863
Cent parque	TS	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
DV tejo	SC	0.7609	0.7678	0.9910	0.7516	0.7606	0.9882	0.5141	0.6119	0.6119	0.6175	0.6247	0.9885
Braga parque	SC	0.5485	0.5947	0.9223	0.7710	0.8442	0.9133	0.4419	0.5486	0.5486	0.8063	0.8178	0.9859

Note: SC, shopping centre; TS, traditional store

Table V.
Quarterly efficiencies per store during 2012

Quarter		1Q			2Q			3Q			4Q		
Types of efficiency		TE	PTE	SE	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Norte shopping	SC	0.8480	0.8531	0.9940	0.8039	0.8236	0.9761	0.6901	0.7260	0.9506	0.7263	0.7607	0.9548
Gaia shopping	SC	0.7118	0.7740	0.9196	0.5514	0.6930	0.7956	0.4644	0.6519	0.7124	0.4925	0.6708	0.7343
Cascais shopping	SC	0.8684	0.8813	0.9854	0.8109	0.8255	0.9824	0.8529	0.8808	0.9683	0.8482	0.8608	0.9854
Almada forum	SC	0.9733	0.9795	0.9937	0.8641	0.8811	0.9807	0.8112	0.8238	0.9846	0.7669	0.8061	0.9514
Dolce vita Oporto	SC	0.7462	0.7760	0.9616	0.6901	0.7575	0.9110	0.5752	0.6776	0.8489	0.5986	0.7204	0.8310
Dolce vita coimbra	SC	0.6170	0.7210	0.8558	0.5386	0.6784	0.7938	0.4103	0.6078	0.6750	0.4984	0.6771	0.7361
Setubal rua	TS	1.0000	1.0000	1.0000	0.9462	0.9814	0.9642	0.8450	0.8817	0.9583	0.7506	0.8574	0.8754
Forum aveiro	SC	0.5746	0.7136	0.8053	0.6449	0.7602	0.8483	0.5769	0.7287	0.7917	0.5601	0.6925	0.8089
Torres shopping	SC	0.7155	0.7744	0.9239	0.6112	0.7353	0.8313	0.5900	0.7360	0.8016	0.6247	0.7905	0.7903
Boavista	TS	0.8514	1.0000	0.8514	0.8862	1.0000	0.8862	0.8243	1.0000	0.8243	0.5518	1.0000	0.5518
Viseu	TS	1.0000	1.0000	1.0000	0.8945	1.0000	0.8945	0.7821	0.9521	0.8214	0.7283	0.9498	0.7668
Amoreiras	SC	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Colombo	SC	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Via catarina	SC	0.4527	0.7396	0.6121	0.3757	0.6577	0.5713	0.3290	0.6784	0.4849	0.3671	0.6625	0.5541
Entrecampos	TS	0.9978	1.0000	0.9978	0.7223	0.7853	0.9198	0.7283	0.7995	0.9109	0.6825	0.7719	0.8841
Algarve shopping	SC	0.5569	0.7192	0.7744	0.5975	0.7532	0.7932	0.7604	0.9230	0.8238	0.4804	0.6772	0.7095
Ikea alfragide	SC	0.9529	0.9650	0.9875	0.8184	0.8898	0.9198	0.7218	0.8161	0.8845	0.6643	0.8077	0.8225
Palácio gelo viseu	SC	0.7116	0.7582	0.9385	0.6864	0.7591	0.9042	0.7397	0.8014	0.9230	0.7333	0.8526	0.8601
Ikea mar shopping	SC	0.6714	0.6810	0.9859	0.5712	0.6014	0.9499	0.4618	0.4977	0.9278	0.4667	0.5385	0.8668
Coimbra forum	SC	0.6227	0.6684	0.9315	0.4816	0.5660	0.8508	0.4527	0.5491	0.8245	0.6700	0.7599	0.8818
Dolce vita vila real	SC	0.6366	0.6880	0.9253	0.5312	0.6604	0.8043	0.6984	0.7398	0.9440	0.7507	0.8302	0.9042
Beloura	SC	0.7331	0.8971	0.8171	0.6757	0.6763	0.9991	0.6496	0.6519	0.9965	0.6804	0.6956	0.9781
Estação viana	SC	0.5584	0.5936	0.9408	0.5428	0.6123	0.8866	0.5353	0.6084	0.8800	0.4003	0.5430	0.7372
Cent parque	TS	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.9488	1.0000	0.9488	0.8240	1.0000	0.8240
DV tejo	SC	0.5412	0.5747	0.9417	0.5346	0.5739	0.9315	0.5511	0.5768	0.9555	0.5234	0.5878	0.8904
Braga parque	SC	0.7990	0.8143	0.9812	0.7593	0.7745	0.9804	0.6251	0.6759	0.9247	0.7040	0.7452	0.9447

Note: SC, shopping centre; TS, traditional store

Table VI. Quarterly efficiencies per store during 2013

Quarter		1Q			2Q			3Q			4Q		
Types of efficiency		TE	PTE	SE	TE	PTE	SE	TE	PTE	SE	TE	PTE	SE
Norte shopping	SC	0.5167	0.6241	0.8278	0.6715	0.7048	0.9528	0.3926	0.7260	0.5408	0.6336	0.7618	0.8317
Gaia shopping	SC	0.4013	0.4035	0.9947	0.5694	0.5748	0.9906	0.2902	0.6519	0.4452	0.3965	0.4035	0.9827
Cascais shopping	SC	0.6006	0.8667	0.6931	0.9090	0.9759	0.9315	0.5503	0.8808	0.6247	0.6731	0.9089	0.7406
Almada forum	SC	0.5655	0.6738	0.8392	0.6859	0.7987	0.8587	0.5629	0.8238	0.6833	0.5729	0.5941	0.9643
Dolce vita Oporto	SC	0.4957	0.5141	0.9641	0.4985	0.5382	0.9263	0.3370	0.6776	0.4974	0.4842	0.4857	0.9968
Dolce vita coimbra	SC	0.6965	0.7224	0.9641	0.5329	0.6387	0.8344	0.3353	0.6078	0.5516	0.5760	0.5798	0.9934
Setubal rua	TS	0.4611	0.4834	0.9539	0.7541	0.9427	0.7999	0.3510	0.8817	0.3981	0.5065	0.5088	0.9953
Forum aveiro	SC	0.4311	0.4356	0.9896	0.6460	0.6729	0.9599	0.4856	0.7287	0.6664	0.5234	0.5262	0.9946
Torres shopping	SC	0.5578	0.5608	0.9945	0.7843	0.8346	0.9398	0.5410	0.7360	0.7351	0.5816	0.5876	0.9898
Boavista	TS	0.5003	0.9132	0.5479	1.0000	1.0000	1.0000	0.4406	1.0000	0.4406	0.4900	0.9132	0.5366
Viseu	TS	0.6898	0.7097	0.9721	0.8050	0.8378	0.9609	0.4846	0.9521	0.5089	0.5902	0.5953	0.9914
Amoreiras	SC	0.7693	0.9316	0.8258	1.0000	1.0000	1.0000	0.4784	1.0000	0.4784	0.8085	0.9201	0.8787
Colombo	SC	0.9245	1.0000	0.9245	1.0000	1.0000	1.0000	0.8690	1.0000	0.8690	0.9602	1.0000	0.9602
Via catarina	SC	0.3149	0.5497	0.5729	0.3745	0.6038	0.6201	0.3092	0.6784	0.4558	0.3838	0.5497	0.6981
Entrecampos	TS	0.8923	0.9491	0.9401	0.7219	0.7950	0.9081	0.6316	0.7995	0.7899	0.6192	0.6195	0.9994
Algarve shopping	SC	0.5140	0.5206	0.9874	0.5979	0.7167	0.8342	0.6506	0.9230	0.7049	0.5243	0.5290	0.9911
Ikea alfragide	SC	0.5735	0.5831	0.9837	0.6863	0.7340	0.9350	0.5404	0.8161	0.6622	0.8907	0.8922	0.9983
Palácio gelo viseu	SC	0.4710	0.4915	0.9583	0.5406	0.5502	0.9826	0.3470	0.8014	0.4330	0.4208	0.4229	0.9950
Ikea mar shopping	SC	0.3949	0.4036	0.9784	0.4630	0.4999	0.9262	0.3451	0.4977	0.6935	0.5296	0.5301	0.9990
Coimbra forum	SC	0.4559	0.4788	0.9522	0.6024	0.6256	0.9629	0.3412	0.5491	0.6215	0.5038	0.5056	0.9965
Dolce vita vila real	SC	0.5066	0.5318	0.9526	0.7002	0.7753	0.9031	0.3828	0.7398	0.5175	0.4995	0.5029	0.9932
Beloura	SC	0.5775	0.6078	0.9500	0.7539	0.8080	0.9330	0.4324	0.6519	0.6633	0.5407	0.5431	0.9955
Estação viana	SC	0.3997	0.4160	0.9608	0.5601	0.6069	0.9229	0.4189	0.6084	0.6887	0.4870	0.4913	0.9914
Cent parque	TS	0.7294	1.0000	0.7294	1.0000	1.0000	1.0000	0.5493	1.0000	0.5493	0.7361	1.0000	0.7361
DV tejo	SC	0.4292	0.4619	0.9293	0.4964	0.5021	0.9886	0.4328	0.5768	0.7504	0.4501	0.4509	0.9982
Braga Parque	SC	0.6683	0.7187	0.9299	0.7596	0.7825	0.9707	0.5110	0.6759	0.7560	0.6404	0.6434	0.9952

Note: SC, shopping centre; TS, traditional store

If we observe a break in that measure it means that there is a convergence in the estimated coefficients in that time for the analysed units.

Table VII shows the inter-temporal evolution for the sigma TE, PTE and SE coefficients for the greater Lisbon area, greater Oporto area and for the remaining stores.

As shown in Table VII, the results of the inter-temporal evolutions concerning the sigma efficiency coefficients show that, for the greater Lisbon group of stores, the PTE is the highest, which indicates scale problems, with the exception of the transition periods between the third quarter of 2010 and the first quarter of 2011 and between the second quarter of 2013 and the fourth quarter of 2013, in which we can detect productivity problems. On the other hand, as shown in Table VII, the greater Oporto stores also reveal scale problems in most of the quarterly transitional periods analysed, with the exception of the transition between the first quarter of 2011 and the third quarter of 2011, in which we can detect productivity problems in this group of stores.

It is possible to conclude that the scale problems of the greater Lisbon and Oporto stores are related with the fact that the operations outputs would not grow as fast as the input savings, with the exception of the referred transition periods where there are productivity problems, in which most of the stores show IRS (RTS).

Lastly, there are scale problems in most of the transition periods in the group of stores that are not from Oporto or Lisbon, since the levels of SE are higher than the levels of PTE. In most of the sub-periods considered, the SE is lower than the PTE. All these evidences suggest that in the long term, the TE should be increased, giving prevalence to the operation productivity improvement in detriment of the activity expansion, that is to say, privileging the operational efficiency *vis-à-vis* SE.

5. Conclusions and management implications

The methodology used to analyse the performance takes into account each store as a DMU. As such, each store's operational performance is strictly connected and correlated to the stores' network management. Accordingly, each DMU manages its resources to optimise sales of the clothing collections and the lines of the products commercialised and available in each of the stores. Thus, in brief, at operational level we consider each store as a unit that manages a set of resources to obtain the maximum sales of the women's clothing collections and fashion accessories.

According to the results shown in this work, it is possible to state that DMU 13 presents a good total TE performance throughout the period analysed, due mainly to the level of productivity achieved. On the other hand, the stores situated in the efficient frontier are, by definition, the ones with less slack of resource variables: area of sales; total capital invested; periodic rent value; and personnel expenses. Therefore, management should focus its attention on the stores with major growth potential and higher inputs space values, as is the case of DMUs 4, 5 and 13.

Under the DEA methodology analysis it is possible to witness that the total TE of the stores diminished in most of the analysed time periods. This means that the firm faces a productivity problem in the store operations as outputs contract more than input savings obtained. It is possible to witness that there are no short-term scale problems (SE $<$ PTE) in the operations of the majority of the stores analysed. However, in the long term, scale problems prevail in most of the quarterly sub-periods considered, as the SE is lower than the PTE. Accordingly, the firm must seriously ponder what strategy to follow: either prioritising the reduction of scale of operations; or increasing the stores productivity, reducing the operational size. Another possible way out could

	Technical efficiency				Pure technical efficiency				Scale efficiency			
	Oporto	Lisbon	Others	Nationwide	Oporto	Lisbon	Others	Nationwide	Oporto	Lisbon	Others	Nationwide
1Q 2010	1.00	1.00	1.00	1.0000	1.00	1.00	1.00	1.0000	1.00	1.00	1.00	1.0000
2Q 2010	0.57	0.61	0.36	0.5011	1.00	0.63	0.41	0.6903	0.15	0.17	0.17	0.4457
3Q 2010	0.77	0.57	0.61	0.6744	1.43	0.60	0.90	1.0989	0.20	0.11	0.21	0.4213
4Q 2010	0.81	2.17	0.92	0.8915	1.30	2.97	1.47	1.5063	0.45	4.33	0.33	0.3184
1Q 2011	0.63	1.80	0.99	1.0352	0.67	1.82	1.65	1.5155	0.71	1.11	0.98	0.9768
2Q 2011	1.14	2.09	0.91	1.0265	0.99	2.48	1.76	1.4551	1.52	0.22	0.30	0.6417
3Q 2011	2.23	1.21	0.84	1.2459	2.70	6.54	0.63	1.8478	2.44	5.66	1.69	1.2985
4Q 2011	0.65	2.71	0.68	0.7115	1.60	2.95	1.05	1.2858	0.43	2.10	0.26	0.2898
1Q 2012	0.54	2.79	0.73	0.7868	0.73	2.71	0.83	1.0697	0.67	2.07	0.56	0.6007
2Q 2012	0.92	2.81	0.69	0.8633	1.24	3.18	0.95	1.1682	0.79	0.70	0.44	0.4436
3Q 2012	1.08	2.88	0.60	0.9343	1.79	3.25	0.93	1.3193	1.09	1.00	0.76	0.6908
4Q 2012	0.59	3.31	0.48	0.7862	1.53	2.88	0.64	1.0537	1.00	2.33	0.69	0.6005
1Q 2013	0.50	4.13	0.42	0.8113	3.45	6.38	0.91	2.6554	1.42	5.13	0.04	0.7809
2Q 2013	1.35	3.52	0.31	0.8863	2.47	4.08	0.77	1.6084	0.62	1.31	0.41	1.0472
3Q 2013	0.29	3.19	0.47	0.7197	1.79	3.25	0.93	1.3193	0.48	10.07	2.34	1.6962
4Q 2013	0.42	4.19	0.14	0.6804	3.04	7.11	0.27	2.4261	1.22	4.44	0.00	1.4752

Table VII.
Sigma TE, PTE and SE efficiencies by region

be the restructuring of activities aggregating, for example, the offer of women's clothing with children's clothing, inside the same store, trying to maximise the firm's portfolio throughout the retail chain.

The huge increase in the supply of clothing (even when the women's clothing retail sector faces a stagnant or reducing demand in Portugal), as well as the prevalence of the sales price as one of the main attributes in the consumer choices, push firms to strategic moves that emphasise innovation sales-based value creation processes (discounts and loyalty/fidelity cards). This strategy consists in reducing costs and at the same time increasing the customer value. In this sense, the strategic orientation that emerges from these results forces the firm to take urgent actions, namely: transforming less efficient stores; franchising some of them; or even selling or trespassing others (which is not dealt with in this study).

The DEA analysis performed consolidates the administration strategic decisions allowing the comparison between the stores relative productivity in the transformation of resources into results, and at the same time shows each store's performance potential according to the allocated resources. This analysis shows that in this set of stores, it is preferable to privilege store efficiency in what pertains to resources utilisation, even in cases of: lower SE; larger store size; even if most of the stores show IRS.

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