ARGUMENTA OECONOMICA
No 1 (26) 2011
PL ISSN 1233-5835

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INTANGIBLE RESOURCES AND EFFICIENCY. A COMPARISON OF POLISH AND SPANISH TEXTILE AND CLOTHING INDUSTRY

The purpose of this paper is to test the hypothesis that there is a positive relationship between intangible resources across firms and the efficiency levels of those firms. This idea is related to the Resource-Based View of the Firm. As an empirical subject we chose the Polish and Spanish textile and clothing industry during the 1998-2001 period, contrasting the transitional and developed countries. We use a non-parametric frontier technique of Data Envelopment Analysis to derive efficiency indices and then relate them with the measure of intangible resources, while we account also for the impact of a firm's age and an industrial activity. The main result of this study supports the hypothesis for the textile and clothing firms in the developed country of Spain, while intangibles proved to be insignificant in explaining the efficiency of companies in the transitional economy of Poland.

JEL classification codes: C14, L67, P52

Keywords: textiles, clothing, efficiency, intangible resources

1. INTRODUCTION

The question of why some firms perform better than others is analyzed extensively in many business disciplines. In particular, strategic management focuses on the concepts that affect the firm's performance; since the mid-1980s the dominant paradigm treating those issues is the Resource-Based View of the Firm (hereafter *RBV*) (Barney, 1991; Barney et al., 2001; Wernerfelt, 1984). The theory argues that the competitive advantage and the performance of firms are based on the companies' resources and the ability to exploit them, rather than on exogenous conditions (Wernerfelt, 1984). Specifically, these are the intangible resources that are considered to be the main source of performance heterogeneity (Hall, 1992). In recent years there was a vast amount of literature examining the main question of the *RBV* (Carmeli and Tishler, 2004; Firer and Williams, 2003; Hult et al., 2005).

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The author acknowledges the financial assistance from the Spanish Ministry of Science and Innovation (SEJ2007-67582-C02-02). The author would also like to thank two anonymous referees for their valuable comments.

However, while the *RBV* concerns performance, surprisingly in the research not enough attention was paid to performance measurement. Most of the papers on the relative importance of a firm's effects relied traditionally on the accounting ratios such as return on total assets (*ROA*), return on investment (*ROI*), return on equity (*ROE*) or return on sales (*ROS*) (Carmeli and Tishler, 2004; Hult et al., 2005; Yiu et al., 2005). However, there was a call for alternative methods to account for the multidimensionality of performance (Banker et al., 1996; Carmeli and Tishler, 2004). To make this possible it would be desirable to connect the *RBV* with a multidimensional model of performance measurement. In contemporaneous research the performance framework which fulfils this requirement and supports the *RBV* predictions is the Data Envelopment Analysis (*DEA*) method. *DEA* measures the efficiency that is the degree to which a firm's production process reflects the benchmark of best practices, and it approaches company performance from the multi-input, multi-output perspective. On the other hand, in the same line, Williamson (1991) pointed out that *RBV* is an efficiency perspective; hence efficiency, is a factor that captures the difference in resource utilization among firms.

Motivated by the above remarks, the objective of this paper is to examine the relationship between the *RBV* factors and a firm's efficiency. Drawing from the *RBV* premises, our main hypothesis is that intangible resources are associated positively with the efficiency of firms in the Polish and Spanish textile and clothing industry. Our empirical methodology to test this hypothesis involves two consecutive steps. First, using the *DEA* method we measure the efficiency of each firm relative to the best practice benchmark, separately for Polish and Spanish samples. Then the efficiency indices are regressed in the second stage against the measure of intangible resources and a set of control variables.

We chose the Polish and Spanish textile and clothing industry as our empirical setting not only because of the data availability (in fact, there exist databases containing information of other countries too), but mostly because they are particularly interesting cases for this study. According to the project undertaken in Poland on "Transformation of textile and clothing industry from labour-intensive to knowledge-intensive", the textile and clothing companies in the developing countries should consider the experience of more developed counterparts, hence the benchmark of the Spanish sector is relevant to the economy of Poland. The comparison of Poland and Spain is an interesting case to study, where a developed economy is compared to the less progressed and transitional. Furthermore, the textile and clothing

industries in both countries are similar to each other for a number of reasons. In both regions this sector is traditionally an important part of the national industries as well as a large source of employment in manufacturing. According to the European Commission study "The textiles and clothing industry in an enlarged community and the outlook in the candidate states", in both countries the value added and the employment in the textile and clothing reached in 2002 approximately 5,000 million euros and 250,000 employees, respectively. Taking into account that the population in Poland and Spain was very similar in the analyzed period, those figures might indicate the similarity of industries. Moreover, within the overall Polish manufacturing industry, textile and clothing accounted for about 4.3% of total production in 2002 ("The textiles and clothing industry in an enlarged community and the outlook in the candidate states"), while in Spain in the same period this figure was approximately 3.7% (Stengg, 2001). In addition, in those regions, the textile and clothing industry experienced the most turbulent chapter in its history due to competition from the low wage countries, the advance in technology with a rapid progress in information technology, and the increasing demand for variety (Owen, 2001). It is believed that this sector, in order to increase the competitiveness and survive in a global economy, needs to change its production from labour-intensive to knowledge-intensive and focus on products with more value-added; therefore, needs to invest in intangible resources (Keenan et al., 2004).

The time analyzed in the paper consists of four years, between 1998 and 2001. This is an especially interesting period to study, because it concerns the part of a ten-year transition time of increasing trade liberalization in the textile and clothing industry. During 1995-2005 the trade quotas against developing countries were being removed gradually, which resulted in increased competition in the European markets. In particular, the period analyzed encompasses the second phase of integration from 1998 to 2001, when more than 30% of imports were being liberalized (Stengg, 2001). Therefore, analyzing this period we can additionally assess in the paper, if and how the increased competitive pressures impacted the level of textile and clothing companies' efficiency.

The rest of the paper is organized as follows. The next section concerns the theoretical development of this study, which hypothetically links the intangible assets and efficiency of firms in the textile and clothing industry based on the *RBV* theory. The following sections describe the data, the empirical procedure, and the measurement of variables. The next section discusses the empirical application in the textile and clothing industry

comparing the results between firms operating in Spain and Poland. The final section summarizes the conclusions, implications and suggests ideas for future research.

2. INTANGIBLE RESOURCES AND EFFICIENCY BASED ON THE *RBV* RATIONALE

The efficiency-based approach to a firm's competitiveness is consistent with the Resource-Based View of the Firm (Williamson, 1991). According to the *RBV* theory, some (efficient) firms do better than others (inefficient), because they are different and possess heterogeneous resources (Barney, 1991). In other words, the efficiency is embedded in the notion of creation of specialized resources and resource heterogeneity (equation 1). The cause-effect relationship between resources and efficiency has two directions: the creation of specialized resources is based on efficient operations, while firms with superior resources are able to produce more efficiently. Peteraf (1993) suggested that different resources used by firms in the production process will lead to different outcomes. In particular, there will be efficiency differences across resources since some of them are superior to others. Therefore, firms with superior resources are able to produce more cost-effectively and achieve incomes.

$$\text{Efficiency} = f(\text{Heterogeneous resources}) \quad (1)$$

A firm's resources are defined as tangible and intangible resources that are tied semipermanently to the firm (Wernerfelt, 1984). Tangibles refer to the fixed and current assets of the organization; they include firm physical technology, plant, equipment, financial assets and so on. While they are relatively easy to measure, however, they are quite easy to duplicate by competitors and most of the *RBV* scholars claim that they are a relatively weak source of competitive advantage and economic benefit (Barney, 1991). On the other hand, intangibles are resistant to competitors' duplication and they include such factors as brand names, reputation, trademarks, patents, customer loyalty, company networks and know-how of employees (Hall, 1992). These are the basis for sustaining a firm's competitive position, because they possess certain characteristics such as: value, rareness, inimitability and non-substitutability (Barney, 1991). Enterprises nowadays are not considered anymore as a combination of tangible resources organized for a productive process to achieve some objectives; they have intangible resources as the strategic component necessary to compete and to obtain

advantages in the market. Intangible resources are emphasized by the *RBV* as the most important source of a firm's competitiveness and efficiency (Barney, 1991). Therefore, we can specify equation 1 as:

$$\text{Efficiency} = f(\text{Intangible resources}) \quad (2)$$

The importance of intangible assets for a firms' efficiency concerns the textile and clothing industry in Poland and Spain. The companies in this sector struggle to survive and attempt to find a niche in international markets by investing in new technologies, developing new products and orienting themselves on the market and customer, which influences the broadly defined intangible assets (Stengg, 2001). Such resources as brands, manufacturing intelligent systems, innovation and *R&D*, are seen as the future of textile and clothing firms in those countries (Karabegović and Ujević, 2006; Llach et al., 2006; Malinowska-Olszowy, 2005). Hence, the hypothesis tested in this paper is the following:

H: Intangible resources are positively related to the efficiency of firms in the Polish and Spanish textile and clothing industry.

In the empirical part which follows, we examine the efficiency as a function of intangible resources, while we control also for other factors that are likely to influence this relationship.

3. DATA

The empirical analyses were carried out on the samples of firms that operated in Poland and Spain during the 1998-2001 period, which represent two *NACE Rev. 1.1* codes: 17 – Manufacture of textiles and textile products, and 182 – Manufacture of other wearing clothing and accessories. *NACE Rev. 1.1* is a classification of economic activities used by *EUROSTAT*. We delimited the scope of the clothing industry to include only the wearing apparel, excluding the production of leather and fur. We possess the accounting data, that is the balance sheet and profit and loss account for each individual firm, which was collected from multiple sources that we linked together, which implied a significant time devoted to harmonize the data. In the Polish case, the firm-level data was derived from two sources: the *AMADEUS* database and "*MONITOR POLSKI B"*. *AMADEUS* is a data set containing financial information for a considerable amount of public and private companies in 38 European countries, including Eastern Europe, while *"MONITOR POLSKI B"* is a Judicial and Business Journal which publishes financial statements of public and private companies in Poland.

The source of the Spanish individual firm information was the *SABI* database. *SABI* (Sistema de Análisis de Balances Ibéricos) contains financial accounts for a vast number of Spanish and Portuguese companies. In order to get the dataset with characteristics similar to the Polish sample, a special downloading criteria were employed restricting the branches of textile and clothing industry. Although we combine three different sources, the homogeneity of data is guaranteed, because: (1) we use public information, regulated by the harmonized accounting rules; (2) for the majority of firms the information is audited; and (3) *SABI* and *AMADEUS* are databases constructed by the same provider and variables' definition is exactly the same; at the same time the information for Polish firms contained in *AMADEUS* is derived from "*MONITOR POLSKI B"*. The main criterion to choose the firms from the databases was the availability of information for the variables required for the analysis. The data extracted from *AMADEUS* and *SABI* was expressed in thousands of US dollars in international current prices. Constant price measures from 1998 were obtained through the price index deflators, based on the information from Spanish and Polish Statistical Offices. Deflators were adjusted to the type of variable; therefore, the industrial price index for the textile and clothing industry was used for the turnover and operating cost, while the price index for capital goods was applied as a deflator of fixed assets. In addition, because the data taken from *"MONITOR POLSKI B"* was expressed in Polish zloty (PLN), it was calculated into US dollars (USD) using the exchange rate between USD and PLN for 31 December each year, provided by the National Bank of Poland. The initial database was modified to control for outliers and extreme observations, following the iterative procedure of Prior and Surroca (2007). After removing outliers and filtering out some firms that did not provide all the information that was necessary, the final samples consist of 436 Polish and 565 Spanish observations for the 1998-2001 period. Those samples have at least one limitation: they miss the information about micro enterprises, because the databases which were the source of data are devoted to small, medium and large companies. Besides this, to our knowledge our study is the most extensive taking into account the number of firms under the analysis. Table 1 presents the final structure of samples, which indicate the outliers as well.

Table 1

Final structure of a database

NACE Rev. 1.1 Code	1998	1999	2000	2001	1998-2001
POLAND					
17-Manufacture of textiles and textile products	64 **(4)**	67 **(1)**	66 **(2)**	67 **(1)**	264 **(8)**
182- Manufacture of other wearing clothing and accessories	43 **(3)**	43 **(3)**	45 **(1)**	41 **(5)**	172 **(12)**
TOTAL	**107 (7)**	**110 (4)**	**111 (3)**	**108 (6)**	**436 (20)**
SPAIN					
17-Manufacture of textiles and textile products	93 **(6)**	94 **(5)**	96 **(3)**	94 **(5)**	377 **(19)**
182- Manufacture of other wearing clothing and accessories	46 **(8)**	49 **(5)**	47 **(7)**	46 **(8)**	188 **(28)**
TOTAL	**139 (14)**	**143 (10)**	**143 (10)**	**140 (13)**	**565 (47)**

Source: own elaboration

Outliers are indicated in the parentheses

4. EMPIRICAL PROCEDURE AND VARIABLES

4.1. Estimation of efficiency

As stated previously, we used a two step methodology to compute the efficiency indices and then relate those measures with intangible resources and control variables, which is the most common strategy applied in the studies analyzing factors affecting efficiency. At the first stage, we employed a non-parametric technique Data Envelopment Analysis (*DEA*) to calculate the efficiency indices. *DEA's* main idea is to apply linear programming techniques to evaluate the efficiency of decision making units (*DMUs*), that is the homogenous organizations such as firms, which are responsible for converting multiple inputs into multiple outputs. Next, *DEA* constructs an efficient production frontier based on best practices. Each *DMU's* efficiency is then measured relative to this frontier. Therefore, *DEA* assesses how well a particular firm performs compared to the benchmark of best companies in the analyzed group, but not compared to the theoretical maximum in the population. When this feature can be considered as a weakness of this method, on the other hand, however, *DEA* has several characteristics that are not available in other methodologies to assess a firm's

efficiency like ratio or regression analysis: (1) it uses multiple output and input variables, and consequently considers multidimensional aspects of organizational performance; (2) it does not require the ex-ante specification of functional form of the model and each firm is evaluated based on its own production function; and (3) it does not require the assignment of predetermined weights to the input and output factors. The origin of the method comes from Farrell's (1957) writings on efficiency measurement, while the seminal paper describing and labelling approach was that of Charnes et al. (1978). The *DEA* model developed by those authors is known as *CCR,* which in technical terms assumes the constant returns to scale evaluation (*CRS).* Returns to scale measure the change in the output levels due to the changes in the input levels, and constant returns imply that an increase in the input levels results in a proportional increase in the output levels. However, Banker et al. (1984) noted that the constant returns to scale assumption skewed the results when making comparisons among *DMUs* differing significantly in size. Therefore, they developed a new formulation of *DEA* that is commonly known as the *BCC* method. Their model in technical terms implies the evaluation under the variable returns to scale (*VRS*) technology, which means that the proportional increase in inputs does not necessarily yield a proportional increase in outputs – the output level may increase or decrease. For both *CRS* and *VRS* cases, the *DEA* model can be classified as output or input oriented, which refers to efficiency as a firm's ability to maximize outputs for given inputs or to minimize inputs for given outputs, respectively (Farrell, 1957). In both cases the values of efficiency measures obtained are bounded by 1: in the input orientation they are always equal or less than 1, in the output model they are equal or bigger than 1, and the value of 1 implies that the firm is 100% efficient.

The characteristics of firms in our samples are best captured by the input oriented *VRS DEA* method. The justification for such a model can be the following. Because we analyze rather heterogeneous samples of Polish and Spanish firms, *VRS* is preferred in this study as it already takes into account the firm's size. On the other hand, concerning the motivation for the input oriented model, the textile and clothing firms in order to survive in the severe environment cannot assume to expand their market share in a significant way due to the competitive pressures originating from Asian countries. Therefore, companies cannot focus on output expansion as a way to achieve efficiency and instead they invest in intangible assets, subcontract parts of manufacturing, reduce the size of factories as well as decrease employment. In particular, the government of Spain implemented the textile

and clothing industry downsizing programs directed to inefficient firms. These were government loans to buy the new machinery, reduce the size of factories and decrease employment. Such evidence is a clear orientation towards input reduction. Therefore, for the aforementioned reasons, the input oriented model is more suitable in the context of the industry under consideration. For the interested reader, we provide the detailed mathematical representation of *VRS* input oriented model in the Appendix.

Because *DEA* methodology as a departing point requires information on firms' inputs and outputs, we need to define those variables. For this purpose we use the idea of Smith (1990) to extend *DEA* for the utilization of input-output data derived from the financial statements of for-profit organizations. Although there exist a number of potential problems with accounting data, in the efficiency literature there are many studies which follow this strategy to analyze industrial sectors (Destefanis and Sena, 2007; Piesse and Thirtle, 2000; Thore et al., 1994). In this paper, we follow Piesse and Thirtle (2000) and Thore et al. (1994), and we apply the following variables:

y: operating revenues (turnover) as output,

x_1: operating cost as an input,

x_2: fixed assets as an input,

x_3: number of full-time of employees as an input.

All variables, except for number of employees, are measured in thousands of US dollars. The summary of descriptive statistics for these data is presented in Table 2. The data show that the average turnover for firms operating in Spain is approximately double that for Polish firms, while the average values of operating cost and fixed assets are comparable. Another characteristic is that the average Polish textile and clothing firm in the sample has about three times more employees than the average Spanish company. This might indicate that Spanish firms are more technologically intensive than Polish counterparts, and the countries are in different stages of development. This further confirms the relevance of a comparative study of those regions. In addition, it is worth pointing out that the samples presented in Table 2 represent the real population as the average Polish firm has 539 employees, while the Spanish 170 employees, which corresponds to the size characteristics of the entire industry. In Poland, large and medium-sized companies are dominant in the textile and clothing sector, while the Spanish sector is predominantly the micro, small and medium-sized companies-based industry (Stengg, 2001; "The textiles and clothing industry in an enlarged community and the outlook in the candidate states").

Table 2

Input/output specifications for DEA (descriptive statistics for 1998-2001)

Variable	Mean	Std. Dev.	Min	Max
POLAND				
Turnover	11938.17	11819.54	779.39	85502.65
Operating cost	11108.18	10406.77	797.72	73477.21
Fixed assets	4290.34	4937.52	57.82	34825.91
No. of employees	539	393.44	35	2773
SPAIN				
Turnover	24220.19	40315.87	1519.76	407230.04
Operating cost	15091.37	32601.37	0	371273.92
Fixed assets	4948.50	6730.80	281.45	80169.49
No. of employees	170	154.03	50	1638

Source: own elaboration

Monetary values are presented in thousands of US dollars, constant prices from 1998

4.2. Efficiency determinants

The goal of the second stage of the analysis is to examine the effect of intangible resources and some control factors (the independent variables) on the *DEA* relative efficiency (the dependent variable). Since efficiency measures have values censored at 1, the traditional ordinary least squares regression would provide inconsistent and biased estimates. Hence, in order to treat this limited variable properly, we use the Tobit regression instead as it limits the range of scores and avoids inconsistency. It is worth pointing out that this is a very common method applied in the efficiency research. Given that our dataset is time-series as we possess the data for 4 years, we employ a panel regression model.

Based on the hypothesis tested in this study, we need to measure the intangible resources to be used in the second stage regression. We proxy those assets by the accounting information on intangibles derived from the firm's balance sheet. For example, the *RBV* study of Firer and Williams (2003) use the accounting data to measure intangibles. We take this accounting magnitude and we further proxy it as a percentage of total assets. Additionally, we control for the firm's age (measured as a number of years since its establishment) and for the industrial activity (a dummy variable indicating whether the firm belongs to the textile or clothing industry, 0=textile, 1=clothing). Table 3 contains the descriptive statistics for these

variables. Note that the statistics for efficiency scores are presented and interpreted in the next section. The data in Table 3 show that on average the intangible resources of Spanish firms (as a percentage of total assets) exceed by about three times those of Polish companies. Concerning age, the average Spanish firm in the sample is younger than the Polish enterprise. Additionally, it is worth to observe that the oldest Polish firm is 179 years old which confirms the long traditions in the Polish textile and clothing industry.

Table 3

Independent variables used in the regression, except for dummies
(descriptive statistics for 1998-2001)

Variable	Mean	Std. Dev.	Min	Max
POLAND				
intangible resources (% of total assets)	0.70	1.89	0	17.84
age	39.18	36.29	0	179
SPAIN				
intangible resources (% of total assets)	2.50	4.89	0	48.73
age	27.53	16.13	2	82

Source: own elaboration

5. RESULTS AND DISCUSSION

Following the empirical strategy of the paper, we first report the efficiency results. To obtain the efficiency scores for each firm in the samples, we applied the *DEA* model presented in the Appendix, using the *EMS* (Efficiency Measurement System) software. The means for these measures are included in Table 4.

Table 4

DEA efficiency scores (means for consecutive years)

	1998	1999	2000	2001	1998-2001
POLAND	0.86 (0.12)	0.83 (0.12)	0.87 (0.09)	0.88 (0.10)	0.86 (0.11)
SPAIN	0.86 (0.11)	0.85 (0.12)	0.85 (0.12)	0.86 (0.12)	0.86 (0.12)

Source: own elaboration

Standard deviations are indicated in the parentheses

The efficiency statistics show that for the 1998-2001 period the average Spanish firm in the sample was equally efficient as the average Polish firm. The average efficiency found is relatively high and reaches the level of 0.86 (86%), which indicates only 0.14 (14%) of inefficiency, and a scope for efficiency improvement by reducing the input by 0.14 (14%). Also, standard deviations of efficiency measures are reasonably low, which suggest that the analysis yielded reliable results. Concerning each year under analysis, we find only slight fluctuations in efficiency; therefore, the increased competition in the textile and clothing sector did not impact the efficiencies of firms in the samples.

Table 5 reports the results of Tobit regression for panel data with regard to the effects of intangible resources, age and industrial branch on the firm's efficiency. *STATA* version 9 was used to perform this regression.

Table 5

Results of Tobit regression for panel data: intangible resources and efficiency

Dependent variable: Efficiency scores	**POLAND**	**SPAIN**
	Number of obs = 436 Number of groups = 111 Obs per group: min = 1 avg = 3.9 max = 4 Wald chi2(3) = 39.30 Prob > chi2 = 0.00 Log likelihood = 409.53	Number of obs = 565 Number of groups = 143 Obs per group: min = 2 avg = 4.0 max = 4 Wald chi2(2) = 41.27 Prob > chi2 = 0.00 Log likelihood = 454.75
Independent variables	Coefficients	
intangible resources	-0.06 (0.26)	0.28* (0.09)
age	-0.01* (0.01)	-0.01* (0.01)
textile-clothing	-0.04* (0.01)	0.05* (0.01)
constant	0.91* (0.01)	0.86* (0.01)
sigma_u	0.04* (0.01)	0.06* (0.01)
sigma_e	0.09* (0.01)	0.09* (0.01)
rho	0.2 (0.01)	0.27 (0.05)
	Observation summary: 436 uncensored observations 0 left-censored observations 0 right-censored observations	Observation summary: 565 uncensored observations 0 left-censored observations 0 right-censored observations

Source: own elaboration

*significant at 0.01. Standard errors are in the parentheses.

The results in Table 5 show that we cannot reject the hypothesis that intangible resources have a positive effect on organizational efficiency (Barney, 1991), but only for the Spanish textile and clothing firms. For the Polish companies the hypothesis cannot be supported as the coefficient for intangibles is found to be insignificant. This might imply that efficiency in the Polish sector does not depend on intangible assets. This is an interesting outcome since we are able to confirm a different effect of intangible resources in developed and transitional countries. The divergence in the results can verify that the level of intangible investments in the textile and clothing firms in Spain is much higher than in Poland due to the fact that Spanish firms are more involved in innovation than Polish counterparts that mostly concentrate on the production activities ("Study on the competitiveness, economic situation and location of production in the textiles and clothing, footwear, leather and furniture industries"). Such a result would be consistent with the view that the Polish textile and clothing companies still need to increase competitiveness by creating and managing certain intangible factors, such as brands, innovations and information technologies (Malinowska-Olszowy, 2005).

Furthermore, concerning the relationship between a firm's age and efficiency the similarity is found between Polish and Spanish textile and clothing sector as the results show that younger organizations tend to be more efficient in both countries. This confirms the view that older firms are prone to inertia and are not flexible enough to make rapid adjustments to the changing circumstances. On the contrary, younger firms are more innovative and entrepreneurial. We would expect that in an increasingly competitive environment surrounding the textile and clothing firms in both countries due to the increasing liberalization of international trade, older companies will be less efficient as they are unlikely to have the flexibility to adapt and quickly respond to altering conditions, thus missing the opportunities. Another possible interpretation for Polish firms is to analyze these results from the point of view of the firms' establishment in the market or centrally-planned economy. The lower efficiency of older firms might suggest that the command economy has a negative influence on firms' ability to adapt to the market economy. Therefore, companies already established in the market economy are free of a negative past heritage and tend to be more efficient.

Finally, the estimates in Table 5 indicate that the variable representing the industrial branch is a significant factor in explaining the variability in efficiency. In Poland, textile firms seem to be more efficient than clothing, while in Spain clothing firms outperform in terms of efficiency the textile

companies. For Spanish companies the ratio of investment in intangible compared to tangible resources is considerably higher for clothing than for textile firms ("Study on the competitiveness, economic situation and location of production in the textiles and clothing, footwear, leather and furniture industries"). This demonstrates that clothing companies are more intangible intensive than their textile counterparts, which might explain their higher efficiency. Another possible interpretation for this finding is that Spanish clothing firms are recognized internationally, developed well-known intangibles such as brands, while Polish clothing firms have still fewer intangibles and no valuable brands, and are less competitive than their textile counterparts (Wysokińska, 2004).

6. CONCLUSIONS, IMPLICATIONS AND FUTURE RESEARCH

Drawing from the Resource-Based View of the Firm premises and the relevance of the efficiency model for the *RBV* research, we tested in this study the hypothesis that there is a positive relationship between intangible resources and the efficiency levels of firms using two separate, country-specific datasets of textile and clothing firms. For this purpose, the samples of 436 Polish and 565 Spanish companies for 1998-2001 period were examined. Applying the Tobit regression for panel data we found the mixed empirical evidence regarding this hypothesis when comparing the developed and transition economy. Only for Spanish firms we supported the view that companies use intangible assets to achieve a competitive advantage and increase efficiency, while for Polish firms no significant relation was found. We also controlled for two factors that are likely to influence the impact of intangibles on efficiency: a firm's age and industrial activity. While a notable similarity is the negative effect of the firm's age in both Spain and Poland, with respect to the industry branch we encountered a difference as in Spain clothing companies were found to be more efficient than textile, while in Poland textile firms outperform clothing companies in terms of efficiency. With respect to the efficiency indices, we reported only slight fluctuations in the efficiency in both countries in the analyzed period, therefore the effect of increased competition in the sector cannot be observed by considerable changes in efficiencies of firms in the samples. Overall, the efficiency scores were relatively high and reached the level of 0.86 in both Poland and Spain. Summarizing, we demonstrated that the Spanish textile and clothing firm that is more efficient seems to be relatively young and more intangible-

intensive, and seems to belong to the clothing industry. On the other hand, in Poland a relatively young firm which belongs to the textile branch tends to be more efficient.

In view of these results our study has several implications. The findings suggest that intangible resources contribute to the increasing efficiency of firms; therefore the firms need to invest in intangibles. Such resources need to be developed in the Polish textile and clothing industry; hence, Polish managers must invest in intangibles and perform a number of important tasks related to the identification, development, protection and deployment of intangible resources. From the policy perspective, the policy makers, to enhance textile and clothing industry competitiveness, need to support the development of intangible resources. In particular, the government in Poland should provide an enabling environment to develop those assets. For example, the policy makers could facilitate firms' access to external capital (cheap bank credit) as newly developing intangibles need the capital for advertising. Moreover, in Spain as well as in Poland the policy makers could perhaps focus on the promotion of design and the introduction of new technologies. Finally, when defining the policies for the development of the textile and clothing industry, the age of firms needs to be considered. In particular, the results of this study suggest that the governments should promote the development of young entrepreneurial companies as a source of innovation.

Because we found differences in efficiency between textile and clothing industries in both Poland and Spain, future research might analyze both sectors separately to see if, for example, there are differences between those branches in intangibles' impact on efficiency. Moreover, the paper analyzed the impact of intangibles on firms' efficiency and future research can focus on the reverse link between those variables. In addition, a further opportunity for research would be the study of another period, for example, before and after Polish accession to the European Union. Finally, because the databases used in this study were omitting micro enterprises, an interesting line of future research might focus on these companies.

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Received: October 2009, revised: January 2011

APPENDIX

Mathematical formulation of DEA

The mathematical formulation of the *VRS* input oriented model goes as follows. Suppose we have *n DMUs* to be evaluated and each of them consumes varying amounts of *m* different inputs to produce *s* different outputs. DMU_k consumes quantity $X_k = \{x_{ik}\}$ of inputs $i = 1,2,\ldots m$ and produces quantity $Y_k = \{y_{jk}\}$ of outputs $j = 1,2,\ldots s$. The model evaluates the efficiency score of each observed *DMU* denoted by DMU_o relative to other *DMUs*. The model can be described as below:

$$Min \quad \theta - \varepsilon\left(\sum_{i=1}^{m} s_i^- + \sum_{j=1}^{s} s_j^+\right) \tag{3}$$

$$subject\ to \quad \sum_{k=1}^{n} x_{ik}\lambda_k + s_i^- = \theta x_{io} \qquad i = 1,2,...,m \tag{4}$$

$$\sum_{k=1}^{n} y_{jk}\lambda_k - s_j^+ = y_{jo} \qquad j = 1,2,...,s \tag{5}$$

$$\sum_{k=1}^{n} \lambda_k = 1 \tag{6}$$

$$\lambda_k, s_i^-, s_j^+ \geq 0 \qquad for\ all\ k, i, j \tag{7}$$

where:

θ is the efficiency coefficient,

ε is a very small – positive number,

x_{ik} stands for the quantity of input $i = 1,2,...m$ consumed by DMU_k ($k = 1,...,n$),

y_{jk} stands for the quantity of output $j = 1,2,...s$ produced by DMU_k,

x_{io} represents the quantity of input i consumed by the observed unit under analysis DMU_o,

y_{jo} represents the quantity of output j produced by the observed unit under analysis DMU_o,

z_k denotes the activity levels associated with inputs and outputs of DMU_k,

s^- is the input slack,

s^+ is the output slack.