The Porter Report Revisited – Creating and assessing a cluster evaluation framework - Application to the Douro region wine cluster

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Abstract

Clusters have been a highly discussed concept regarding economic development and competitiveness, either at national or regional level. Several countries, governments and policy-makers have used clusters as an economic policy to increase regional competitiveness. However some authors also alert for the lack of evaluation methods and frameworks designed to evaluate cluster policies. One of the countries that have tried to use and implement clusters as an economic policy was Portugal. In 1994 a report was conducted - The Porter Report - in which six clusters were deemed relevant by public and private organizations to be part of a cluster initiative. Since 20 years have passed from the report’s creation, and given the fact that Portugal is now facing a situation of lack of competitiveness, it seems suitable to revisit the Porter Report and the clusters it studied. Thus this article briefly reviews the economic situation in which Portugal is, nowadays. Secondly, this work provides some statistical regressions to ascertain whether a more clustered region have fared better in terms of sales and employment. This paper hence focuses on the Douro Region Wine Cluster (DRWC), one of the six clusters studied: wine, tourism, automobile, footwear, textiles and wood products. The results from those regressions show that the DRWC’s location affects positively employment and sales, thus proving the positive effects of clustering and the relevance of pursuing a cluster policy.

Keywords: industrial clusters, cluster evaluation, wine industry, location quotients.

1. Introduction

Clusters have been a much discussed topic within the larger topics of industrial organization and agglomeration economics. This concept has been used by national institutions, companies, universities and other economic agents that wish to spur growth through reaping benefits of clustering. This chapter concisely introduces the Portuguese Economy, by presenting the background of the topic to be analyzed, as well as the data used in the developed models.

The Portuguese Economy had a strong economic growth from 1958 to 1973, a period in which the GDP per capita in Portugal grew 7.5% per year (Lains, 2007). Baer and Leite (2003) present one main conclusion explaining the growth after 1973: Portugal’s trade with the EU countries had increased greatly, a condition that also increased the specialization in the “traditional textile–clothing–shoes” industries and consequentially increased the share of exports in the Portuguese GDP, which rose from 23.8% in 1970 to 34.5% in 2000. Albeit the positive growth experienced since the 1960’s until the 1990’s, since 1996, the Portuguese GDP variation follows a negative trend, as represented by Figure 1.
Prior to 1996 these longstanding structural problems had also been identified, when in 1992 the Portuguese Government and some private companies sought the advice of the renowned Professor Michael E. Porter and the Monitor Company in order to assess the most competitive clusters and to foster initiatives to prompt the economic growth, specifically in those clusters. The result of this advice came in the form of what would later be known in Portugal as The Porter Report (*Construir as Vantagens Competitivas de Portugal* (Monitor Company, 1994)). The report concluded that Portugal presented six clusters with economical potential to become competitive in the international market: wine, wood derivatives, footwear, textile, automobile and tourism (Monitor Company, 1994, pp. 135–136).

Industrial clusters, as presented by Porter (2000, p. 8), provide “powerful benefits to productivity and the capacity to innovate”. Furthermore, Porter (2000, p. 8) also presents three broad ways that allow an enhancement of competitive advantage in the cluster: “increasing the current (static) productivity of constituent firms or industries, increasing the capacity of cluster participants for innovation and productivity growth, and stimulating new business formation that supports innovation and expands the cluster”.

Twenty years later, and bearing in mind the paramount challenges faced by the Portuguese Economy, it seems an appropriate moment to evaluate the Porter Report, and especially the consequences of that same report on the clusters it touched. Primarily this article aims at evaluating the performance of one of clusters that were studied by the Porter Report: the wine cluster, which in this case is located in the Douro region, and not nationally implemented, as the Porter Report presented it.

Thus, this article aims at presenting an evaluation of the benefits of clustering in the Portuguese wine regions, focusing mainly on the DRWC. This paper then analyzes the effect of some variables on the DRWC’s employment and sales. The models presented in the next chapter thus help to evaluate the effects of several factors on the performance (measured in terms of sales and employment) of the DRWC.
2. Statistical Models

To evaluate the effect of some factors on two main topics (employment and sales), this article uses Ordinary Least Square (OLS) models to attain this. The data used on the following statistical models is summarized in the table below, table 1:

Table 1. Summary data - Independent variables and dependent variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Measurement</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Employment Variables</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Employment in the Wine Industry in</td>
<td>Number of people employed in the wine industry, as defined above</td>
<td>450</td>
<td>346,773</td>
<td>602,697</td>
<td>0</td>
<td>3579</td>
<td>QP (Quadros de Pessoal)</td>
</tr>
<tr>
<td>the Region</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New employment</td>
<td>Employment created by companies aged 1 year or less</td>
<td>450</td>
<td>3,22</td>
<td>10,895</td>
<td>0</td>
<td>98</td>
<td>QP</td>
</tr>
<tr>
<td><strong>Companies' Variables</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Companies in the Region, in The</td>
<td>Aggregated number of companies in the NUTS III region, in the wine Industry</td>
<td>450</td>
<td>29,227</td>
<td>69,761</td>
<td>0</td>
<td>666</td>
<td>QP</td>
</tr>
<tr>
<td>Industry</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Average equity, by company, in the</td>
<td>Average equity of the region's companies</td>
<td>450</td>
<td>506142,7</td>
<td>1864024</td>
<td>0</td>
<td>2,81E+07</td>
<td>QP</td>
</tr>
<tr>
<td>region</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Startups</td>
<td>Number of companies aged 1 year or less, per year in the Region</td>
<td>450</td>
<td>0,873</td>
<td>3,008</td>
<td>0</td>
<td>47</td>
<td>QP</td>
</tr>
<tr>
<td>Average Sales, by company, in the</td>
<td>Average sales of the region's companies</td>
<td>450</td>
<td>1083211</td>
<td>1503730</td>
<td>0</td>
<td>1,25E+07</td>
<td>QP</td>
</tr>
<tr>
<td>region</td>
<td></td>
<td></td>
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<tr>
<td><strong>Regional Variables</strong></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LQ</td>
<td>Share of employment in the wine industry in the region, divided by total</td>
<td>450</td>
<td>1,8</td>
<td>3,606</td>
<td>0</td>
<td>23,09</td>
<td>QP</td>
</tr>
<tr>
<td></td>
<td>regional employment, divided by share of national employment in the wine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>industry, nationally</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CMO</td>
<td>Existence of a CMO (dummy variable)</td>
<td>450</td>
<td>0,033</td>
<td>0,18</td>
<td>0</td>
<td>1</td>
<td>CMO website</td>
</tr>
<tr>
<td>GDPC</td>
<td>Gross Domestic Product Per Capita, in the NUTS III Region</td>
<td>450</td>
<td>4508,296</td>
<td>7921,18</td>
<td>199,8</td>
<td>54541,8</td>
<td>Statistics Portugal</td>
</tr>
</tbody>
</table>

The table shown above presents the main statistics for the variables used in the models displayed ahead. In the employment variables, it is possible to conclude that the average number of employees in the wine industry per region have averaged 347 people per NUTS III region, whereas each new company that is founded has added, on average, 3,22 employees to the labor market. Regarding the companies’ variables, one can conclude that the average number of companies in a NUTS III region varies widely since its standard deviation is approximately three times higher than the mean. From the same data, it is also possible to
conclude that the average equity by company varies widely since it is more than 3 times higher than the mean average equity. In terms of startup creation, the regions have seen, on average, the creation of 0,873 startups per year. In terms of average sales, they have averaged 1 083 211€ per year, per region.

Finally, the regional variables concern variables which are strongly related with the region. The first one, location quotient (LQ) is commonly used as a figure that identifies a cluster in a given region, and from the statistics shown above, one might see that the LQ has averaged 1,8, having a maximum value of 22,89. The variable CMO is a dummy variable which tells if a certain region has a CMO, a characteristic only attributable to the DRWC. Finally, the statistics also present the average GDP per capita, per region, which throughout the years 1995 to 2009 has averaged 4508,296€, having, nevertheless a wide standard deviation (approximately twice the mean).

To measure the impact of the aforementioned variables on employment in the industry 4 OLS regressions were run on two different dependent variables (resulting in 8 regressions): employment in industry in the region, and average sales by region. The equations for the models are shown below, in equations 1 through 8, and as it can be seen, the models are built by set of variables (employment, companies and regions).

Using a standard OLS model: \( y_i = \beta_0 + x'_i \beta + \epsilon_i \)

**Employment Models**

Employment, model 1:

Employment = \( \beta_0 + \beta_1 \cdot \text{New employment} + \epsilon \)

Employment, model 2:

Employment = \( \beta_0 + \beta_1 \cdot \text{Location quotient} + \beta_2 \cdot \text{CMO, in the region} + \beta_3 \cdot \text{Average equity, by company, in the region} + \beta_4 \cdot \text{Startups} + \beta_5 \cdot \text{Average Sales, by company, in the region} + \epsilon \)

Employment, model 3:

Employment = \( \beta_0 + \beta_1 \cdot \text{Location quotient} + \beta_2 \cdot \text{CMO, in the region} + \beta_3 \cdot \text{Gross Domestic Product, per capita, in the region} + \beta_4 \cdot \text{Average Sales, by company, in the region} + \epsilon \)

Employment, model 4:

Employment = \( \beta_0 + \beta_1 \cdot \text{New employment} + \beta_2 \cdot \text{Companies in the Region, in the Industry} + \beta_3 \cdot \text{Average equity, by company, in the region} + \beta_4 \cdot \text{Startups} + \beta_5 \cdot \text{Average Sales, by company, in the region} + \beta_6 \cdot \text{Location quotient} + \beta_7 \cdot \text{CMO, in the region} + \beta_8 \cdot \text{Gross Domestic Product, per capita, in the region} + \beta_9 \cdot \text{Average Sales, by company, in the region} + \epsilon \)

**Average sales models:**

Average Sales, model 1:

Average Sales = \( \beta_0 + \beta_1 \cdot \text{New employment} + \beta_2 \cdot \text{Startups} + \epsilon \)

Average Sales, model 2:
Average Sales = $\beta_0 + \beta_1 \cdot \text{Companies in the Region, in the Industry} + \beta_2 \cdot \text{Average equity, by company, in the region} + \beta_3 \cdot \text{Startups} + \epsilon$

Average Sales, model 3:

Average Sales = $\beta_0 + \beta_1 \cdot \text{Location quotient} + \beta_2 \cdot \text{CMO, in the region} + \beta_3 \cdot \text{Gross Domestic Product, per capita, in the region} + \beta_4 \cdot \text{Average Sales, by company, in the region} + \epsilon$

Besides using OLS models, Fixed and Random Effects OLS were also used for the full models (Employment, Model 4 and Average Sales, Model 4). STATA 12, a statistical software, yielded the following:

Fixed effects (FE) and Random Effects regressions were also run, as well as Hausman Tests for both models. The Hausman test tells us that if the $\text{Prob} > \chi^2$ is significant the FE regression holds (Baltagi, 2005). Thus, the Hausman Test for Employment, model 4 does not hold, since the $P > \chi^2$ is not significant. Lastly the Average Sales, Model 4 should use a FE regression since the $P > \chi^2$ is significant. When running a Wald Test on Average Sales, Model 4’s estimators, the test results in a significant model, since the $\text{Prob} > F$ is relatively small.

Firstly, Pooled OLS models were run, as it is displayed in table 3. Secondly, a Fixed Effects OLS model was run on Average Sales, Model 4, since the Hausman Test was inconclusive for Employment, Model 4. Hence the only model to be used with OLS FE is Average Sales, Model 4.
The employment models have as its dependent variable the industry’s employment. The first model, which only includes the variable new employment, is ill-adjusted, due to its low $R^2$.

However, only the independent variable (New Employment) positively and significantly influences employment in the regions which have wine industries. The second model (Employment, Model 2) focuses only on companies’ variables, and yields a positive influence from all of the independent variables (Companies in the Region, Startups and Average Sales by company and Average equity). Nevertheless, only three of those four variables are deemed significant by the results of those variables’ p-values. The third Model, which includes only regional specific variables, yields 3 significant variables, being the variable LQ the most significant, thus proving that a cluster has significant effects on the industry’s employment. Despite the positive effect of the variable LQ, the variable showing the presence of a CMO in a certain region has a negative impact on the industry’s employment, whereas the per capita GDP in the region has a positive influence on employment. Finally all the variables are significant at 5% of confidence. The last model aggregates all the dependent variables and all of them are

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Employment Model</th>
<th>Average Sales Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment in the Wine industry in the Region</td>
<td>NA</td>
<td>1754,2***</td>
</tr>
<tr>
<td>New employment</td>
<td>29,68***</td>
<td>-49551,9***</td>
</tr>
<tr>
<td>Companies’ Variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Companies in the Region, in The Industry</td>
<td>NA</td>
<td>355,27</td>
</tr>
<tr>
<td>Average equity, by company, in the region</td>
<td>NA</td>
<td>0,41***</td>
</tr>
<tr>
<td>Startups</td>
<td>NA</td>
<td>-25,24***</td>
</tr>
<tr>
<td>Average Sales, by company, in the region</td>
<td>NA</td>
<td>-25739,29</td>
</tr>
<tr>
<td>Regional Variables</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LQ</td>
<td>NA</td>
<td>128,08***</td>
</tr>
<tr>
<td>CMO</td>
<td>NA</td>
<td>-530,87**</td>
</tr>
<tr>
<td>Gross Domestic Product, Per Capita</td>
<td>NA</td>
<td>0,015**</td>
</tr>
<tr>
<td>Constant</td>
<td>250,15</td>
<td>63,85</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0,29</td>
<td>0,41</td>
</tr>
<tr>
<td>F</td>
<td>181,59</td>
<td>102,61</td>
</tr>
<tr>
<td>n</td>
<td>450</td>
<td>450</td>
</tr>
</tbody>
</table>

Significance measure:
*: Significant at the 10% level of confidence
**: Significant at the 5% level of confidence
***: Significant at the 1% level of confidence
significant at a 1% confidence level, and the overall model also presents a good fit, having an adjusted $R^2$ of 0.85. All of the variables have a positive effect on employment, except for Startups and CMO variables. However the result for startups contradicts the value for new employment, which is the number of employees added by startups, per year on average, since New Employment affects employment positively, whereas Startups affects it negatively. Finally, the presence of a CMO also affects employment negatively, which might be explained by the other regions’ lack of a CMO, despite their employment’s changes.

The average sales models are also divided into four types: (Employment-only, Companies-only, Region’s only and Total model), which follows the same methods as the Employment Models. As stated, the first model for average sales relates employment in the wine industry and new employment, being Employment in the Wine Industry not only positive but significant, whereas New Employment has a fairly negative impact on sales (-49551,9€ for each added new employee). However this model’s variables do not fit well, since its $R^2$ is only 0.3, which denotes a weak fitness to the model. For model 2 only one variable is significant (Average Equity), which affects positively sales and is likewise significant, nevertheless the model seems unfit, with a $R^2$ of only 0.256. The third model relates the regional variables with sales, and all three variables are significant, being the LQ a variable which affects sales rather positively (for each unitary increase of LQ sales increase by 131153€). Nonetheless, the variable CMO affects quite negatively Average Sales, whereas the GDP per capita affects average sales positively. Finally, the fourth model uses all of the variables used in the 3 models before. For this model one can see that two variables are strongly significant and positively affecting average sales: employment in the wine industry and average equity, while new employment and the number of companies in the region’s wine industry are both significant and affect negatively the region’s average sales. Finally, within this model the GDP per capita is also significant while negatively affecting the average sales.

Finally, this article answers the propositions initially presented:

**Proposition 1**: a more clustered region, as measured by a higher LQ has a positive effect on employment in the region.

**Proposition 2**: a more clustered region, as measured by a higher LQ, with higher employment in startups and also with higher average equity by company should present higher average sales in the region.

Proposition 1 holds up in both models 3 and 4, thus proving the importance of a cluster in order to foster an easier access to specialized labor and consequently creating more employment.

Proposition 2 does not hold up, since model 2 and 4 display a negative effect of new employment on sales, which might be due to the destructive effect of creating new companies. Regarding the effect of higher equity, it is positive and significant and it is explained below by the need of scale in the wine industry. Finally, the LQ is positive and significant in model 3, which again proves the importance

The first model shows that new employment has a positive effect on employment, which was expected, since new employment was, nevertheless accounted into the total employment. The second model shows that more companies lead to more employment

On both the third and fourth employment model the effect of LQ is not only positive but also significant, a result which is coherent with the literature (Wennberg & Lindqvist, 2008). This result is in accordance with the theories put forward by Marshall (1920), in which it is stated that higher specialization attracts more employment to a region. In spite of the positive and significant effect shown in the regressions, the correlation between both the variables employment and LQ is quite high, at 0.60. Nevertheless this work concludes that while having
specialized employment (as shown by higher LQ) is positive for a region’s wine industry, having a CMO has a negative effect on employment. This negative effect might be explained by the fact that a region which has a CMO will probably be technically and scientifically more advanced, thus not requiring so many employees.

The models which are concerned with average sales focus on a more financial and company-performance related variable. The first model shows that the employment created by incumbent firms, and thus probably larger firms, has a positive effect on sales. This conclusion is also in accordance with was stated by Diez-Vial (2011, p. 3) since larger firms “can invest more in forming a skilled and specialized workforce as they have a large group of employees to invest in training programs, have more workers performing the same job as informal trainers, and they suffer less from having workers in off-site training”. Hence, one can conclude that the larger the firms the better are average sales, not only because of the increased effect on skilled employment, but also since larger firms have a higher likelihood of advertising due to their possibility of taking on higher fixed costs (Chung & Kalnins, 2001).

The second model also backs the argument that larger firms (in terms of equity), allow for larger sales, since every added euro in average increases average sales by 0,41€, a fact which might be explained by higher returns on scale and increased efficiency if companies are larger (Malmberg, Malmberg, & Lundequist, 2000). Accordingly, the existence of startups (measured by the number of companies aged 1 year or less) affects sales negatively, a conclusion that is in accordance with the argument that larger firms are able to reap higher sales from the market.

The third model relates only the regional variables with the average sales, and all the variables are significant. As for positive effect, both GDP per capita and LQ have positive effects, a result which is coherent with the literature, mainly regarding LQ (Diez-Vial, 2011; Maine, Shapiro, & Vining, 2010; Wennberg & Lindqvist, 2008).

Consequently, we can conclude that the DRWC has fared better than its wine-making region counterparts since the higher the LQ, the stronger the cluster’s sales are. Moreover, the regressions yielded results which are coherent with the existing literature on the theme.

Finally, one must also state that the results point to positive effects of clustering in low-tech industries, which is in accordance with Diez-Vial (2011) and with Beaudry (2001, p. 2) “strong positive clustering effects are found in many industries, but nevertheless some clustering effects are negative. The strongest cluster effects are found in computer, motor, aerospace and communications manufacturing, along other industries in the financial sector”.

Despite having run several tests to know which the best models were, and whether the regressions are significant, some limitations and improvement points can be attributed to the models. Using sales only does not take into account the companies cost structure and its management performance, hence it only tells part of the story. Employment in the industry is correlated with the LQ, and other employment variables can be used in future works.

Other cluster measures should be used in order to assess a cluster’s strength, thus adding to the LQ. A common measure of strong linkages within clusters is the Input-Output matrix, however and for the geographical level used in this article, it was not possible to use this option.

3. Conclusions and Further research

The statistical regressions made on the QP wine industry data for the Portuguese NUTS III regions has shown a significant and positive effect of location in the clusters’ impact (being performance measured as the region’s industry employment and average sales). Moreover, it
was found that a smaller number of companies in a certain region have proven to have a positive effect on the region’s wine industry average sales.

This article presents some limitations that should be tackled in future works and are stated below:

Due to simplification this article has only used data regarding companies. Nevertheless it would have been interesting to focus on employee data and thus link employee related characteristics (e.g.: education, years in the company) to overall company performance (sales) and socio-economic (employment) indicators. The work focuses only one industry (defined by three different Código de Actividades Económicas (CAE)), the wine industry, due to its high LQ in the Douro Region. Henceforth, it would also be relevant to assess the wine industry’s clusters vis-à-vis the other industries originally considered by the Porter Report as to control for industry specific characteristics. The indicators have not been recognized by any organization, thus making this article lack an acknowledged set of indicators, due to the theoretical context of this work.

The data used in this work had some gaps, which can be linked to the source (QP), which made a more complete assessment of the DRWC cluster unfeasible. It would have been desirable to have better quality of equity data, so as to better understand the differences in performance and impact of the country of origin of a company’s capital. Other relevant data deficiency was exposed by the Port and Douro Wine Institute data regarding exports which have a very short time span, thus not allowing a more time-comprehensive analysis.

Albeit being a widely used indicator for a cluster’s specialization, the LQ presents some shortcomings, namely due to the impossibility of measuring the strength of a cluster’s agents linkages, social connections and implicit communications among the agents (Hofe & Chen, 2006; Monsson, 2011). The usage of interviews, input-output matrixes (which are not available at NUTS III level), surveys could have improved the cluster identification and mapping. Thus this work’s contributions are three-folded: (i) recovery of the Portuguese cluster study, initiated by the Porter Report, thus providing a positive contribution to the case of the Portuguese competitiveness; (ii) design of a cluster evaluation method, therefore filling a research gap, and setting a first step for the evaluation of the Portuguese cluster; (iii) evaluation, using the cluster evaluation method, of the DRWC and usage of statistical regressions as to verify the impact of clustering in companies’ performance and in the region’s industry employment.

Nevertheless, the article and underlying dissertation have brought some much needed research on the topic of clusters and cluster evaluation, and it applied the state of the art research on an actual Portuguese case. Thus the article fulfills its objective of evaluating the DRWC using research-based and new methods, and contributes to the cluster knowledge field.

Finally, this article also suggests some changes to the way the Porter Report was designed and also some suggestions on further research: Time span of the evaluation, which is only focused on some years, thus not grasping the whole picture. As it is suggested in The Cluster Policies Whitebook (Andersson, Schwaag-Serger, Sörvik, & Hansson, 2004), the ex post evaluation is only one stage of the evaluation stage – other steps should be taken, such as ex ante setting of goals, choice of evaluation criteria, continuous monitoring of the chosen criteria, ex post assessment and finally the communication of the results of the evaluation. Lastly, the only industry used was the wine production industry; hence, to perform a more comprehensive of evaluation of clusters further research on the other industries presented by the Porter Report should also be assessed.
References


