Coagglomeration patterns in Portuguese labour-intensive industries: complementarity and specialisation dynamics

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The aim of this paper is to analyse the patterns of industrial agglomeration in Portugal in order to understand their underlying dynamics. Industries tend to be concentrated geographically, rather than due to random causes, natural advantages or Marshallian forces. Empirically, industry pairwise coagglomeration is measured using the Ellison and Glaeser (1997) metric, with the goal of understanding the complementarity versus specialisation dynamics behind the industrial geographic concentration in Portugal. It is concluded that the most prominent industrial clusters in Portugal are as follows: textiles and clothing, footwear and transport, each one having a different agglomeration dynamic. While some sectors tend to benefit more from the interdependencies along the value chain (meaning vertical industrial relationships, related to complementary dynamics), others are more vulnerable to labour pooling (more to do with horizontal industrial relationships and specialisation dynamics), and others to both. For policymakers, for instance, it is of great use to know exactly the right triggers as the success of any programme results from the suitability of the initiatives being financially supported.

Introduction

The aim of this paper is to analyse the patterns of industrial agglomeration in Portugal in order to understand their underlying dynamics. Industries tend to be concentrated geographically, rather than because of random causes, natural advantages or Marshallian forces. It is not the intention of this paper to measure those Marshallian forces, as in Ellison *et al.* (2010), Stuart *et al.* (2001) and Rosenthal and Strange (2003). Instead, the aim is to measure industry pairwise coagglomeration using the Ellison and Glaeser (1997) metric of coagglomeration (hereafter 'EG index'). This exercise will hopefully provide an extensive understanding of the different dynamics and geographic delimitations behind the industrial clustering in Portugal. This constitutes a significant issue for experts given the fact that past studies had proven that industrial agglomeration positively contributes to firms' productivity (e.g. Ciccone, 2002 and Lall *et al.*, 2004), especially in labour-intensive manufacturing industries in medium-cost countries in southern Europe, like Portugal. In these industries, competitive advantages emanate not from low-wage production, but from high-value-added goods, meaning that firms'

performance becomes highly dependent on locally embedded capabilities boosted by agglomerative forces. The knowledge of their spatial forms and functions could be used by managers and policymakers as a crucial tool for the promotion of both labour and firm-level productivity.

The role of agglomeration for general management

The role of agglomeration in facilitating transactional interactions and increasing opportunities to match needs and capabilities is now widely recognised and empirically tested. It eases the dynamics of backward and forward interlinkage of firms, allows the formation of dense local labour markets around multiple workplaces, and facilitates the emergence of localised relational assets promoting learning and innovation effects (Marshall, 1930).

With the growing capacity of statistical tools and computational methods (Haedo and Mouchart, 2015), the spread of spatial economic models is assisted confirming the effect of agglomeration on the spatial behaviour of firms (de Bok, 2009). The results of such models tend to suggest that agglomeration economies do influence the location decision of firms, this being among the most costly decisions that organisations make (Zelbst *et al.*, 2010), and point to the gains from land use specialisation and firm clustering (Maoh and Kanaroglou, 2009). This line of thinking suggests that the advantages of location proximity go beyond transactional efficiencies, and include various kinds of externalities, such as knowledge spillovers and dependence on human relations, rules and customs that enable firms to coordinate under conditions of uncertainty. Also, the path- and place-dependent nature of local assets stresses the importance of geographic closeness for the strategic positioning of firms, but contrarily to the idea that economic agglomeration means territorial enclosure, empirical works confirm that spatial clustering may be a way of avoiding early lock-in (Baglieri *et al.*, 2012) and stimulating networking exploration, within and outside the cluster (Rama and Calatrava, 2002).

Despite the increasing global flow of ideas, capital, goods and labour, the role of proximity in the creation of economically useful knowledge appears to be even more important than before (Scott and Storper, 2003; Sonn and Storper, 2008; Storper, 2009). Indeed, the 'death of geography' thesis cannot be sustained, because it wrongly assumes that the rapid diffusion of information and codified knowledge means the rapid diffusion of understanding, and that is not correct (Morgan, 2004). Firms receive increasing returns from a trinity of agglomeration economies, with Marshall's forces of labour pooling, supplier linkages and local knowledge spillovers being an important and updated conceptual framework (Potter and Watts, 2014). In fact, in recent years, there has been a growing number of empirical studies analysing the influence of spatial agglomeration on industrial or regional productivity and most conclude that a positive relationship exists. For example, Graham (2006), Broersma and van Dijk (2008), Hafner (2013) and Chang and Oxley (2009) showed the positive effect of geographic concentration on productiv-

ity, supporting industrial clustering theories. Similarly, Yamamura and Shin (2007) found that firm efficiency improves in areas where the division of labour among geographically concentrated small establishments is advanced, while Hashino and Kurosawa (2013) detected agglomeration advantages that go beyond the scope of the Marshallian externalities, arising from the ease of imitating improved ideas and transacting unfinished products among clustered enterprises by facilitating joint actions in the supply of public goods, such as through the creation of local district brands and through the efficient provision of business information. Helsley and Strange (2007) call it 'local outsourcing' and confirmed that agglomeration reduces opportunism, promotes a thick market effect and serves as a substitute for integration, with a reduction in transaction costs. As previously argued by Krugman and Venables (1996), intermediate usage creates cost and demand linkages between firms, which encourages economic integration and induces agglomeration. This brings long-run gains, although during the adjustment process some of the labour force may suffer lower real wages and unemployment problems as relocation of industry occurs in most cases (Cesário and Vaz, 2012).

The impact of agglomeration effects on a firm's productivity growth is well documented (Cainelli, 2008) in a range of different perspectives: Andini *et al.* (2013) considered labour market pooling from the perspective of both workers and firms and found that there is a general positive relationship between turnover and local population density, and provided evidence consistent with agglomeration improving job matches; Becchetti and Rossi (2000) found that geographical agglomeration of small-to-medium firms in a delimited area significantly affects their export intensity and their probability of becoming exporters; and Daskalopoulou and Liargovas (2010) proved that localisation economies in the form of positive Marshallian forces constitute important determinants of start-up ratios. Basically, and specifically regarding labour-intensive industries, such as textiles, clothes and footwear, lines of research focus on examining the impacts of agglomeration externalities from two main perspectives: (i) impacts on labour productivity, such as in Ciccone and Hall (1996), Henderson (2003), Maré and Timmins (2006) and Lee *et al.* (2010); and (ii) impacts on firm-level productivity, decomposed into innovation and imitation, such as in Lall *et al.* (2004) and Cainelli (2008).

Besides knowing the effects of the agglomerative forces, it is equally important to understand the process of agglomeration itself, its spatial form and function, as a crucial tool for the promotion of regional economic development. Phelps (2004) emphasised that the geographical scale at which external economies and agglomerative effects operate is on the increase. Such changes in the spatial form and functional dynamics of agglomeration over time pose important questions for general management, especially when considering the specific case of small firms. Unlike big firms, SMEs (*Small and Medium Sized Enterprises*) interact intensely with the territory in which they are located, as a sign of their embeddedness. The particularly tight links they develop with the external environment also reduce uncertainty risks. In general, SMEs are not only located near the residence of their owners, but also have geographical and sociological proximities as their main sources of

assets and information. This fact constrains the perspectives and strategic choices of firms, because most of the market perception arises from the inputs that the territorial institutional context supplies. Small firms learn from close interaction with suppliers, customers and competitors, and knowledge processes are deeply influenced by local resources, institutions, and social and cultural structures. Most SMEs and their respective managers are to a large extent generated by the local context, and, in order to face changing and uncertain economic conditions, their decision-making process is firmly based on socialised practices, thereby stressing the importance of geographic proximity as a mediating factor (Camagni, 2002).

Agglomeration and the economic resilience of labour-intensive industries in the global economy

The liberalisation process and the challenges of globalisation can be considered the most important drivers of change in European labour-intensive sectors. In a global economy, and particularly for labour-intensive sectors such as the textiles and clothes, transport and footwear industries, it is expected that the sourcing of low-value-adding activities will increasingly go to low-cost countries, with more aggressive retail strategies in the West and the emergence of new markets. Also, and in comparison with manufacturing as a whole, the import penetration in these sectors is significantly higher, particularly in the clothing sector where ' . . .the EU industry has experienced serious difficulties in competing with foreign operators working with lower labour costs and less stringent social and environmental regulations' (European Commission, 2003: p. 4).

The new global economy is getting firms to face two different phenomena: increasing competition, as a result of the liberalisation process, and increasing outsourcing, in search of lower production costs. These new economic conditions are forcing a restructuring in these industries and challenging the resilience capacity of managers by adjusting to this new global market perspective. Two strategic responses may be given by firms: cost reduction or knowledge creation. In labour-intensive industries, the first option means the relocation of manufacturing production activities to low-cost areas. The second has proved to be the only alternative pathway for high-cost regions.

Given the restraints in winning through price competition, the quality argument appears to be a strong weapon for European industry. In contrast with the more price-competitive and scale-advantageous industries of northern Europe, the medium-cost countries in the south, like Portugal, have a customised fashion-oriented industry, which is less vertically concentrated and less oriented to outsourcing in low-cost countries. For these countries, and as verified in Cesário and Vaz (2012), new dynamic competitive advantages emanate not from low-cost and low-wage production, but from the technological capacity of firms to produce high-value-added goods. In the end, the capacity of management to adjust to new production technologies is what determines whether or not firms are producers of high-value-added sophisticated goods and services or merely low-cost subcontractors. As explained by Dosi (1988 *et al.*), the economic performance of such industries

depends on their locally embedded capabilities. For instance, their learning and technological capacity is largely influenced by the relationship patterns that producers develop with their suppliers and customers. These are essential to information exchange in sectors where the process of innovation is primarily a process of diffusion of best practice. The urge for high-quality specialisation is confirmed by Tsampra and Palaskas (2002). The authors confirmed that firms committed to export-production suffer a serious decline when their products are not of a specialised nature, and conclude that low-cost production indicates the use of unskilled labour and firm inadequacy in absorbing and diffusing knowledge. This idea is confirmed in Cesário and Vaz (2012). The empirical analysis developed by the authors allowed the conclusion to be drawn that the adoption of new technologies in labour-intensive industries from southern Europe is a process developed internally, depending largely on the skills of the workforce, but it is also supplier dominated, in the sense that the ideas, suggestions and/or impositions of suppliers play an important role in the technological process. Locally embedded capabilities, based on agglomerated patterns, promoting learning and innovation, happen to be a determinant competitive tool for entrepreneurship.

Research questions

The literature review confirmed the importance of geographic proximity between economic agents for the decision-making process of SMEs and their respective managers, given the strong interaction between these firms and their local context. This is even truer in the particular case of labour-intensive industries, where learning and technological processes are largely influenced by the relationship patterns that producers develop with their suppliers and customers. Given these arguments, better understanding the spatial forms and functions of territorial agglomerations in labour-intensive sectors in Portugal constitutes a key instrument for management. Therefore, the major research questions addressed in the paper are as follows:

1. What is the geographical delimitation of the industrial geographic concentration in Portugal (NUTS III or municipality level)?
2. Which industries are geographically concentrated?
3. Which type of dynamics explains the geographic concentration: complementarity or specialisation?

Data and method

Classical measures of industrial agglomeration, such as the Gini index, have been criticised for having several drawbacks in the measurement of spatial inequality. Several recent contributions argue that only when the share of an industry's employment in manufacturing employment varies significantly across regions can the existence of industrial agglomeration within a region (Lin *et al.*, 2011) be referenced. Ellison and Glaeser (1997) simultaneously considered the share of an industry's employment within a region and the share of aggregate manufacturing employment within a region.

In this paper, pairwise agglomeration was computed for manufacturing

industries (Section C – NACE Rev. 2 at 3-digit level) using employment data from INE Portugal (National Statistical Institute) for the year 2011. The agglomeration index was calculated both at the NUTS III and municipality levels[1], in order to identify the geographical delimitation of the industrial concentrations. The sample contains 4513 industry pair observations from 95 manufacturing industries.

The coagglomerations of industries i and j were calculated using the EG index (Ellison *et al.*, 2010), as follows:

$$EG_{ij} = \frac{\sum_{m=1}^{M}(s_{mi} - x_m)(s_{mj} - x_m)}{1 - \sum_{m=1}^{M} x_m^2}$$

where:

m = geographic areas

S_{mi} = share of industry i's employment contained in area m

S_{mj} = share of industry j's employment contained in area m

X_m = aggregate size of area m, modelled as the mean employment share in the region across manufacturing industries.

For example, coagglomeration at the NUTS IV level, between industry pair **101**, *Processing and preserving of meat and production of meat products*, and **102**, *Processing and preserving of fish, crustaceans and molluscs*, is given by:

$$EG_{101,102} = \frac{\sum_{m=1}^{M}(s_{m101} - x_m)(s_{m102} - x_m)}{1 - \sum_{m=1}^{M} x_m^2} =$$

$$= \frac{(s_{1,101} - x_1)(s_{1,102} - x_1) + (s_{2,101} - x_2)(s_{2,102} - x_2) + \ldots + (s_{278,101} - x_{278})(s_{278,102} - x_{278})}{1 - \left[(x_1)^2 + (x_2)^2 + \ldots + (x_{278})\right]^2}$$

where $S_{1,101}$, for instance, means the proportion of employment in industry from NACE code 101 (*Processing and preserving of meat and production of meat products*) contained in region m = 1, which corresponds to the municipality *Arcos de Valdevez*, ranked number 1 in the list of Portuguese regions provided by the National Statistical Institute. On the other hand, X_1 stands for the mean employment share in the region across manufacturing industries. In this case $X_1 = 0.16\%$, meaning that employment in manufacturing industries in *Arcos de Valdevez* accounts for only 0.16% of the total manufacturing employment in Portugal. This metric, which was used to detect both industry pair coagglomeration ($i \neq j$) and industry concentration ($i = j$), can be regarded as a measure of the strength of agglomerative forces. It is closely related to the covariance of the region-industry employment shares in the two industries

[1] The NUTS system - Nomenclature of territorial units for statistics - subdivides the nation into three levels: NUTS I, NUTS II and NUTS III. In some European partners, as is the case with Portugal, a complementary hierarchy, respectively LAU I and LAU II (posteriorly referred to as NUTS IV and NUTS V), is employed. In the Portuguese context, there are 28 continental NUTS III regions, while the LAU I, or *Local Administrative Units*, pertains to the 278 municipalities on the mainland.

considered. The denominator rescales the simple covariance to eliminate sensitivity to the fineness of the geographic breakdown (Ellison *et al.*, 2010). The expected value of the EG index is zero when the spatial allocation of employment is as one would expect from a random location process. Negative values indicate that the industry pair is agglomerated in different areas (when $i \neq j$), or that the intra-industry employment is diffused (when $i = j$).

It should be noted that positive values indicate concentration, but not necessarily agglomeration economies, as the observation of the concentration does not allow a distinction to be drawn between the influence of Marshallian forces and natural advantages on the location decisions of firms. This metric has the advantage, when compared to the Gini index, of being able to capture both horizontally agglomerated activities (activities from the same industries) and vertically agglomerated ones (activities from different sectors along the value chain). However, one needs to be aware of its limitations and be careful when interpreting outcomes. For instance, there is a need to understand whether the input-output and hiring patterns between industries are the cause or the result of coagglomeration. For example, does the high coagglomeration level between the leather and footwear industries occur because of the strong input-output and hiring patterns between them, or because if, for some reason, the footwear industry was located near the plastic industry there could be more plastic and less leather in shoes nowadays? Another important limitation to bear in mind regards the measurement of the impact of natural advantages in terms of natural resources, transport costs and labour inputs on the location decision of firms. Previous large-scale studies have shown that, taken together, the Marshallian factors appear to have a stronger effect on coagglomeration patterns than shared natural advantages (Ellison *et al.*, 2010). The author recognises, however, that only a limited number of natural advantages can be measured and that the proxies used in her studies were not always perfect, so this is still a limitation that should not be ignored.

The results

The results are now presented in order to answer the three research questions proposed.

Geographical delimitation of industry concentration

Table 1 presents descriptive statistics for X_m and the EG index, both at the municipality and NUTS III levels.

The results for the industry shares at NUTS III and IV levels provide a general picture of these two geographic delimitations. At the NUTS III level the highest concentration of employment (more than 20%) is found in the Grande Lisboa region (see number 20 in Figure 1), while the Lisboa Municipality accounts for about 5% of employment share.

It is more interesting to observe the EG metric for the two geographic breakdowns, as this metric is not scale sensitive. The mean values are, as expected, close to zero, as positive deviations from X_m in one industry are compensated with negative ones. In its turn, standard deviation of the EG

Table 1: Descriptive statistics

	Mean	SD	Min	Max
Share of industry employment in a municipality	0.003	0.006	0.000	0.053
Share of industry employment in a Nuts III region	0.034	0.041	0.003	0.206
EG at municipality level	0.002	0.016	–0.020	0.998
EG at Nuts III level	0.008	0.041	–0.119	1.072

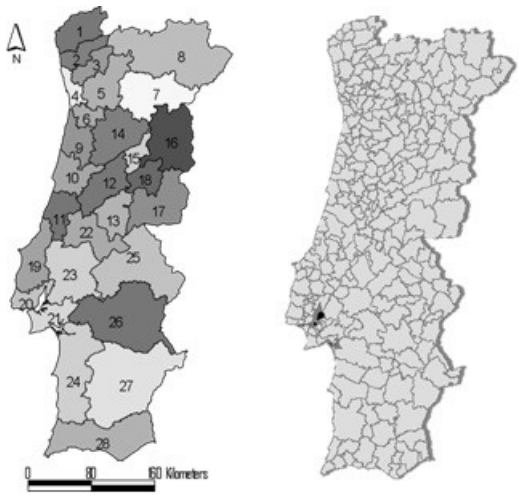

Figure 1

index reflects the magnitude of coagglomerations and this statistic is substantially higher at the NUTS III level. In answer to the first research question proposed, it can be said that the geographical delimitation of industry concentration /coagglomeration in Portugal occurs mainly at the NUTS III level and only to a lesser extent at the municipality level.

Industrial clustering in Portugal

Tables 2 and 3 list the 30 highest results for the EG index at NUTS IV and NUTS III levels. At the municipality level, only six out of the 30 highest EG results refer to coagglomeration. All the others are within industry agglomeration. A different result is obtained when the geographic breakdown is increased. Out of the top 30, 16 are coagglomerated industries. This means that, at the municipality level, only concentration is captured, and collaboration logics with other complementary industries occur at a wider geographic delimitation. Given this result, from this point forward the focus will be on the NUTS III level.

With regard to *fur goods (CEA 142)*, there is only one firm from this industry in the country, and one could expect that its location is due to natural advantages. In their turn, the remaining highest agglomerated industries, such

Table 2: EG index at Nuts 4 level

Rank	Industry 1	Industry 2	EG Nuts 4 level
1	142: Manufacture of articles of fur	142: Manufacture of articles of fur	0.998
2	304: Manufacture of military fighting vehicles	304: Manufacture of military fighting vehicles	0.470
3	254: Manufacture of weapons and ammunition	254: Manufacture of weapons and ammunition	0.342
4	264: Manufacture of consumer electronics	264: Manufacture of consumer electronics	0.236
5	272: Manufacture of batteries and accumulators	272: Manufacture of batteries and accumulators	0.186
6	264: Manufacture of consumer electronics	322: Manufacture of musical instruments	0.169
8	322: Manufacture of musical instruments	322: Manufacture of musical instruments	0.150
9	272: Manufacture of batteries and accumulators	303: Manufacture of air and spacecraft	0.137
10	232: Manufacture of refractory products	232 Manufacture of refractory products	0.122
11	303: Manufacture of air and spacecraft	303: Manufacture of air and spacecraft	0.122
12	321: Manufacture of jewellery, bijouterie	321: Manufacture of jewellery, bijouterie	0.119
13	152: Manufacture of footwear	152: Manufacture of footwear	0.119
14	309: Manufacture of transport equipment n.e.c.	309: Manufacture of transport equipment n.e.c.	0.117
15	143: Manufacture of knitted, crocheted apparel	143: Manufacture of knitted, crocheted apparel	0.112
16	133: Finishing of textiles	133: Finishing of textiles	0.110
17	268: Manufacture of magnetic and optical media	268: Manufacture of magnetic and optical media	0.110
18	120: Manufacture of tobacco products	120: Manufacture of tobacco products	0.103
19	143: Manufacture of knitted, crocheted apparel	133: Finishing of textiles	0.095
20	267: Optical instruments, photographic equip.	267: Optical instruments, photographic equip.	0.093
21	239: Abrasive and non-metallic mineral products	239: Abrasive and non-metallic mineral products	0.092
22	254: Manufacture of weapons and ammunition	301: Building of ships and boats	0.092
23	133: Finishing of textiles	132: Weaving of textiles	0.088
24	243: Other products of first processing of steel	243: Other products of first processing of steel	0.087
25	151: Tanning and dressing of leather	151: Tanning and dressing of leather	0.082
26	191: Manufacture of coke oven products	191: Manufacture of coke oven products	0.080
27	131: Preparation and spinning of textile fibres	133: Finishing of textiles	0.079
28	132: Weaving of textiles	132: Weaving of textiles	0.076
29	324: Manufacture of games and toys	324: Manufacture of games and toys	0.074
30	131: Preparation and spinning of textile fibres	131: Preparation and spinning of textile fibres	0.072

as *military fighting vehicles (CEA 304)*, *refractory products (CEA 232)*, *weapons and ammunition (CEA 254)*, *finishing of textiles (CEA 133)* and *transport equipment (CEA 309)*, are industries where one might expect agglomeration economies to be important (Rosenthal and Strange, 2003). Out of the remaining 24 industry pairs in Table 3, 16 are from the textiles-clothes and

Table 3: EG index at Nuts 3 level

Rank	Industry 1	Industry 2	EG Nuts 3 level
1	142: Manufacture of articles of fur	142: Manufacture of articles of fur	1.072
2	304: Manufacture of military fighting vehicles	304: Manufacture of military fighting vehicles	0.623
3	232: Manufacture of refractory products	232: Manufacture of refractory products	0.411
4	254: Manufacture of weapons and ammunition	254: Manufacture of weapons and ammunition	0.399
5	133: Finishing of textiles	133: Finishing of textiles	0.385
6	309: Manufacture of transport equipment n.e.c.	309: Manufacture of transport equipment n.e.c.	0.344
7	132: Weaving of textiles	133: Finishing of textiles	0.322
8	133: Finishing of textiles	131: Preparation and spinning of textile fibres	0.316
9	264: Manufacture of consumer electronics	264: Manufacture of consumer electronics	0.309
10	304: Manufacture of military fighting vehicles	301: Building of ships and boats	0.296
11	133: Finishing of textiles	143: Manufacture of knitted, crocheted apparel	0.291
12	304: Manufacture of military fighting vehicles	202: Manufacture pesticides, agrochemical prod	0.284
13	143: Manufacture of knitted, crocheted apparel	143: Manufacture of knitted, crocheted apparel	0.275
14	132: Weaving of textiles	132: Weaving of textiles	0.273
15	131: Preparation and spinning of textile fibres	131: Preparation and spinning of textile fibres	0.271
16	131: Preparation and spinning of textile fibres	132: Weaving of textiles	0.269
17	139: Manufacture of other textiles	133: Finishing of textiles	0.253
18	152: Manufacture of footwear	152: Manufacture of footwear	0.248
19	143: Manufacture of knitted, crocheted apparel	132: Weaving of textiles	0.239
20	120: Manufacture of tobacco products	120: Manufacture of tobacco products	0.238
21	304: Manufacture of military fighting vehicles	291: Manufacture of motor vehicles	0.228
22	139: Manufacture of other textiles	131: Preparation and spinning of textile fibres	0.220
23	143: Manufacture of knitted, crocheted apparel	131: Preparation and spinning of textile fibres	0.220
24	191: Manufacture of coke oven products	304: Manufacture of military fighting vehicles	0.220
25	133: Finishing of textiles	221: Manufacture of rubber products	0.218
26	139: Manufacture of other textiles	132: Weaving of textiles	0.217
27	303: Manufacture of air and spacecraft	303: Manufacture of air and spacecraft	0.213
28	133: Finishing of textiles	268: Manufacture of magnetic and optical media	0.210
29	120: Manufacture of tobacco products	303: Manufacture of air and spacecraft	0.208
30	133: Finishing of textiles	141: Manufacture of wearing apparel, except fur	0.206

footwear cluster (highlighted in light grey) and six are from the transport cluster (in dark grey). As regards the second research question, *Which manufacturing industries are geographically concentrated in Portugal?*, the answer will be textiles and clothes, footwear and transport.

Complementarity versus specialisation patterns

With regard to the textile industry, notwithstanding the high levels of concentration of the *Finishing of textiles (CEA 133)* sector, coagglomeration values are even higher than the agglomeration ones for several sectors. At the upstream of the value chain, the activities of *Preparation and spinning of textile fibres (CEA 131)* and *Weaving of textiles (CEA 132)* are geographically closer to other firms from sector 133 than to firms from the same sector. The same happens downstream of the value chain, as *Manufacture of knitted and crocheted apparel (CEA 143)* is more coagglomerated with *Finishing of textiles (CEA 133)* than concentrated. The textiles and clothes cluster reveals both high complementarity and specialisation dynamics. While complementary dynamics occur along the vertical value chain, specialisation dynamics occur horizontally, with firms from the same stage of production. Curiously, the footwear industry performs differently. This industry is strongly concentrated and benefits basically from specialisation dynamics. The highest coagglomeration value at NUTS III level occurs with the *manufacture of furniture (CEA 310*) sector, although it is not high enough to be in the top 30 (EG = 0.135). The transport cluster also reveals some interesting location implications. Besides the high levels of concentration of the *transport equipment* (*CEA 309)* and *air and spacecraft (CEA 303)* sectors, there are relevant coagglomerations occurring between *military fighting vehicles (CEA 304)* and several other industries, directly related or not to the transport sector, such as *Building of ships and boats (CEA 301)*, *pesticides and agrochemical products (CEA 202)*, *motor vehicles (CEA 291)* or *coke oven products (CEA 191)*. This cluster generally relies more on complementary dynamics than on specialisation advantages. These results have some interesting theoretical implications. If the three Marshallian forces are returned to, it is worth recapping that industrial co-location allows the transaction costs of goods (input/output relations), people (local labour market pooling) and ideas (relational assets) to be reduced. Given the technical limitations in measuring the third force, and bearing in mind that knowledge spillovers are to a great extent captured in labour polling, the first two forces can be focused on in order to better understand the implications of the agglomeration dynamics previously identified in this exercise. Agglomeration occurs because:

(a) it eases the dynamics of backward and forward interlinkage of firms, meaning vertical industrial relationships, related in this case to **complementary dynamics**;
(b) it allows the formation of dense local labour markets around multiple workplaces, facilitating the emergence of localised relational assets promoting learning and innovation effects (Marshall, 1930); this is more to do with horizontal industrial relationships and **specialisation dynamics**.

This understanding suggests also some important implications for management. While some sectors tend to benefit more from the interdependencies along the value chain, others are more vulnerable to labour polling, and others to both. For policymakers, for instance, it is of great use to know exactly the right triggers when providing financial incentives.

The successful example of the footwear industry in Portugal (OECD, 2008) proves the benefits of providing regional actors with adequate incentives. Nevertheless the high weight of high-end activities in Portugal, the northern region of this country retains a number of key manufacturing industries mainly composed of SMEs that have continued to specialise in traditional sectors (e.g. textile and clothing, footwear, automobile parts, plastic moulds, leather, cork, furniture, mechanical construction and light engineering). The region's relatively low productivity and rising unemployment have raised concerns about future growth prospects. As already observed, the flow of emerging countries is expected to further erode the cost competitiveness of manufacturing activities in southern Europe. Innovation capacity will therefore determine these regions' resilience. An example of the major progress induced when a nationwide economic policy meets locally embedded capabilities is provided by the Portuguese footwear sector. The Programme of Incentives for the Modernisation of the Economy (PRIME) run by the central government during the period 2000–2006 successfully contributed to upgrading a traditional industry such as footwear by encouraging the valorisation of local assets (e.g. the geographic proximity of footwear manufacturing firms and their ability to collaborate). The programme was recognised as being particularly efficient in the case of the footwear industry because it put in place a comprehensive scheme of incentives that mostly supported the overall business environment (56% of the incentives) compared with direct support for enterprises (44% of the incentives). Instead of distributing financial support to individual firm-based initiatives, the programme paid special attention to joining initiatives according to the specific needs and characteristics of these sectors and given the capabilities provided by the regional environment. The national footwear association was used to help firms upgrade the skills of their workforce, for example by running an industry-specific training centre and conducting large-scale R&D projects that would benefit a wide array of member firms due to the economies of scale. The association also promoted proactive benchmarking by supporting visits to international fairs and exhibitions. Encouraging firms to develop a close relationship with customers, suppliers, competitors and institutions enabled constant introduction of changes in processes and product designs (OECD, 2008). At the end, the success of the programme results from the suitability of the initiatives financially supported: promotion of the value chain, upgrading of the workforce skills and promotion of the international market. These firms were motivated to increase synergies, moving forward from mere supplier-customer relationships to more organic links (both horizontally and vertically) capable of creating critical mass and exploiting standardisation opportunities, which should lead to reductions in costs, enhancement of quality and the reduction of technological and commercial risks (Cesário and Vaz, 2012).

Final remarks

Labour-intensive sectors are strongly characterised by their susceptibility to taking shape in network forms of organisation, to being part of dense agglomerations of capital and labour and to increasingly being involved in

international subcontracting and production sharing arrangements (Scott, 2006). The recent improvements in communications rather contributed to strengthening the propensity of these industries to cluster together in the same geographic space. The reason may be found in the created associations that make it possible to contest international markets but also to facilitate the shift of intra-industry blocks of work from more to less developed countries. The competitive advantages of European regions are based mainly on the use of territorial inputs, which allow firms to differentiate according to their technological trajectory. Given the restraints in winning price competition, the strong argument for Europe is product quality. In a comparison of export and import values for a range of relatively homogeneous products, European products generally have a positive quality mark-up (European Commission, 2003, 2006, 2007), which emphasises the strategic importance of increased market access to emerging economies where a middle class is growing and forming a growing quality-conscious market. Textile and leather firms in southern Europe, for instance, have a strong technological capacity and are anxious to capture new markets. While some of these firms are highly specialised and can sell their locally-based expertise to other companies in the same industry or cross over into other industries, others are contract manufacturers whose output can often be replicated at a lower cost by producers in emerging economies. Such firms in local supplier networks need help to move their businesses out of low-value-added products and upgrade into higher-value or more specialised products (OECD, 2008). Small firms' capacity to struggle in such a competitive environment is found in its strengths of innovation, quality, creativity, design and fashion. Their success depends on the capacity of their managers to explore the localised capabilities and know-hows promoted by agglomerated economies as this constitutes an important competitive advantage for these industries (Cesário and Vaz, 2012). Locating a firm in close proximity to similar types of firms or suppliers/demanders may have economic motivations in terms of enhanced productivity or reduced costs. The implied agglomeration economies across firms may be due to various factors, including the presence of knowledge spillovers, labour market pooling, input sharing and natural advantages. Agglomeration economies imply that production is more efficient or cost-effective when it is spatially concentrated: firms may benefit from the proximity of other complementary firms that are in the same or related industries or are suppliers (demanders) of their inputs (outputs).

This work started with the identification of the geographical delimitation of industry concentration in Portugal, concluding that agglomeration and coagglomeration occur at the NUTS III level and not within municipality boundaries. Next, the empirical exercise enabled the most prominent industrial clusters in the country to be identified: textiles and clothing, footwear and transport, each one having a different agglomeration dynamic. While textiles and clothing strongly benefit from vertical complementary dynamics, transport is a more horizontally oriented cluster, benefitting from the interdependencies between related industries. The footwear industry, because it is more vertically integrated, relies mostly on horizontal specialisation dynamics. Beside the theoretical implications previously discussed, these

results also present policy and managerial implications. For the Portuguese case in particular, and when implementing financial incentives for the promotion of firm cooperation and (co)petition, policymakers should bear in mind that an inter-municipality approach is more efficient and more adapted to the Portuguese industrial setting than, for instance, individual isolated municipality initiatives.

In more generic terms, due to the existence of positive agglomeration externalities that can enhance firm-level productivity, governments should be aware of the advantages of promoting the development of industrial zones and science parks to further enhance firm clustering and labour-market pooling. In their turn, managers, particularly small firms' managers, should recognise the advantages of choosing more clustered regions and account for the external economic benefits of agglomeration, driven from information sharing, greater ease in finding professionals or the savings from lower transportation costs, when assessing the costs and benefits of possible locations. As a result of these findings, it will be worth investigating the quantification of the real impact of agglomeration on firm productivity, running a regression analysis to examine the contribution of agglomeration explanatory variables (e.g. the EG index) to the dependent proxies for firm productivity.

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