

Published in *Regional Studies*, On-Line First December 2014

Industrial Dynamics and Economic Geography

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Capasso M. Stam E. and Cefis E. Industrial Dynamics and Economic Geography *Regional Studies* How do industries emerge and evolve over space? In this special issue the fields of industrial dynamics and economic geography are brought together, in order to achieve a richer and more fundamental understanding of the organization of industries over time and space than each of these fields could do separately. Firm heterogeneity on the micro level and industry composition of a region on the macro level, provide important elements in the explanation of industry emergence and evolution over space. History and space matter in the evolution of industries: this special issue shows how and why.

Industrial cluster, Firm heterogeneity, Industrial dynamics, Localization economies, Urbanization economies, Economic geography

JEL classifications: L10, L20, L22, L60, R10, R11

This special issue explores the intersection of the fields of industrial dynamics and economic geography. Bringing together these two fields leads to a richer and more fundamental understanding of the organization of industries over time and space than each of these fields could do separately. They are complementary with their focus on the dynamic and contextual aspects of industrial organization. Both fields share their explicit rejection of the traditional economic assumptions regarding the representative agent and markets in equilibrium. This means that agents (both firms and entrepreneurs) are seen as heterogeneous and that markets are never in equilibrium. The heterogeneity and dynamics of firms, industries and regional clusters are key concerns of both fields. The field of industrial dynamics provides well articulated theories about the heterogeneity of firms and industries, while the field of economic geography provides analytical tools to analyse the role of the geographic context in the dynamics of

firms and industries. Time and space matter, and can be analysed in a rigorous way once the fields of industrial dynamics and economic geography are combined. This combination even leads to a better understanding of how firms, industries and regions evolve over a longer time period, and how they mutually affect each other.

Industries evolve according to patterns that do not always correspond to the pattern of the whole economy. Distinguishing features in the life of an industry are the particular development of the demand and supply of the goods and services produced by the industry. Technological advances, as well as changes in the patterns of consumption, affect the level of activity of an industry. Just as the aggregate movements of the economy are partly determined by industry specific changes, so does the evolution of an industry result from firm specific changes. These firm specific changes are partly the result of macroeconomic and industry specific selection processes, and new opportunities arising from changes in the environment. Research on industrial dynamics explicitly considers these aspects.

Economic activities are often geographically distributed and organized according to non-random patterns. The agents involved in those activities are situated in a particular location because of particular, endogenous or exogenous, characteristics of the location. The reason for choosing a location can be, for instance, the proximity to a mine providing raw materials for the production process, or to other firms or individuals that can influence the supply and demand of a product. The research on economic geography investigates how the location affects and is affected by the economic activity. Next to these traditional location factors, knowledge has become an increasingly important element of the production process. If knowledge flows are at least partially localized, then producers can benefit from the co-location with other producers, as Alfred Marshall already analysed more than a century ago (Marshall, 1890), and generations of scholars have explored ever since. Learning about the same production process, or about a similar production process, will bring benefits from co-location to producers of the same industry. Innovation and growth can also derive from other industries' knowledge input, and the positive performance of a firm can thus depend on geographic proximity to firms which operate in different industries. Urbanized areas can provide a peculiar stimulus to innovation in that knowledge flows from a diverse array of industries (Jacobs, 1969). Since knowledge is also embedded in the workers' skills, labour market pooling can be a source of agglomeration economies. In addition, the local density of upstream suppliers can play a role in locational choices.

The first paper of this special issue, by Frenken et al. (2014, in this issue) provides a review of the literature on clusters and their effects on the entry, growth and exit of firms, as well on the evolutionary dynamics underlying the process of cluster formation. This review shows that even though there is strong evidence that clusters promote entry, the evidence for the positive effect on firm growth and firm survival is much more mixed. The reason for this might be related to the ignorance of firm heterogeneity in these studies, as new studies that do take into account firm heterogeneity (e.g. with respect to age, size, organization structure, network position, nature of capabilities) show that this substantially moderates the effects of clusters on the performance of firms.

The role of firm heterogeneity is central in the paper by Rigby and Brown (2014, in this issue). They show that plant- and firm-specific characteristics, like age, size and organization structure, strongly affect the

impact of particular location features on plant productivity of manufacturing firms. Older firms benefit more from the co-location of upstream suppliers, while localized within-industry spillovers of knowledge have stronger influence on the productivity of younger and smaller establishments. A causal cycle seems to emerge: size heterogeneity affects, through the interaction with location, the productivity distribution, which in turn is expected to feedback on the size heterogeneity, since productivity is expected to influence firm growth. A similar cycle can be suggested by the detected interaction of plant age and location characteristics, since productivity is also expected to influence firm survival and thus the age of surviving firms.

Survival is not always an outcome of good performance. The assets of a successful firm can be attractive to the point of determining the exit of the firm by mergers or acquisitions (Freeman et al., 1983). As a consequence, the positive influence of location on firm performance can be mirrored by a higher probability of firm exit. Weterings and Marsili (2014, in this issue) show that new firms located in industrial clusters have indeed a higher probability of exit by mergers and acquisitions (M&A), while having a lower probability of exit by closing down the activities. However, the same study detects signs of a detrimental influence of industrial clustering because of increased competition, a relation often suggested by the organizational ecology literature (Hannan and Freeman, 1984). Even when referring to a particular type of exit (M&A or closure), the overall influence of co-location can derive from the sum of conflicting impulses.

Co-location is traditionally seen as the result of either the attraction of incumbent producers from other regions or the decision of potential founders to start a firm locally. An important driver of this co-location is the knowledge that is accumulated by incumbents, universities and public research organizations. However, this knowledge might also contribute directly to co-location, with the entry of spin-offs building on this knowledge. The self-feeding nature of the process precludes a simple identification of the mechanisms that triggered it in the first place. Going back in time can show how industrial clusters are generated by the location decisions of few pioneers of the same industry (Klepper, 2010). A consequent question would then ask about how the pioneers' location decisions were made. In this issue, Buenstorf et al. (2014) point out two main factors that have shaped the spatial distribution of the German laser system industry, i.e. of a new industry with a strong innovative component. On the one hand, the stock of related knowledge already available in the region, as provided by pre-existing incumbents of related industries (and in particular producers of the upstream laser source industry) and by public research centres in the field of laser technology, has favoured the entry of new laser firms (first entrants for the new industry) in given regions. On the other hand, the same incumbents and public research centres were able to stimulate entry in the new industry by providing a pool of potential capable entrepreneurs. A form of path dependence can then be identified: knowledge in related industries enables the emergence of innovations and firms of a new industry, which then might lead to a localized cluster of this new industry. This is not a narrowly prescribed path, usually referred to in the path dependence literature, but the creation of a new path, branching from the pre-existing regional industries (Frenken and Boschma, 2007; Henning et al., 2013).

Industrial clusters are not necessarily a threat to the diversity of economic activities in a region. Overrepresented industries can coexist with a wide array of different sectors, and one region can have

multiple specializations that enhance its diversity. Indeed, Noseleit (2014, in this issue) confirms, based on German data, the positive association between diversity of regions and number of industries in which the same regions are specialized. Following the evolution of cohorts of new establishments in each region, this study shows how competition and market selection, over time, are able to reduce the diversity (in terms of industry structure) within each cohort. However, since the reduction of within-cohort diversity favours different industries for each cohort, and since the cohorts present different industrial compositions even at the time of entry, regional diversity often increases over time. Moreover, differences in industrial composition across regions are found to depend not only on the different compositions of entrants across regions, but also on the different selection patterns affecting the performance of those entrants. Therefore, analysing the composition of entrants and following their selection after entry are both important to understanding differences in industrial composition within as well as across regions.

The regional industrial composition represents a major factor in determining the regional growth of particular sectors (Boschma and Van der Knaap, 1999) and the ability of a regional economy to absorb external shocks (Frenken et al., 2007). Not surprisingly, the regional industrial composition affects also the capability of a particular industry in the region to be resilient to shocks. Holm and Østergaard (2014, in this issue) study the resilience of the ICT industry in Danish regions. The choice of the ICT industry stems from the existence of a world-wide shock which in 2000 arrested a decade of growth. Different types of resilience are identified before and after the shock. Each type of resilience appears to be associated not only to the size and age of the firms belonging to the industry and present in the region, but also to both regional diversity in the industrial composition and diversity of the industry structure within the ICT sector itself.

The regional industrial composition depends on entry and exit rates in the different industries, in a given region. The level of disaggregation matters at both industry and geographic level, in the sense that higher levels of disaggregation imply higher levels of inter-industry and inter-regional spillovers. Moreover, the mismatch between the size of the units used to measure the variables of interest on the one hand, and the extent of the phenomenon of interest on the other hand, may give rise to spatial error autocorrelation (Anselin and Rey, 1991). Ignoring such spatial effects can lead to false conclusions. Over the last three decades, the research on spatial econometrics has progressively filled many of the gaps in the existing models, to provide estimation methods under less restrictive assumptions. Gaps still remain for the particular cases in which the nature of the data, and/or the context of the analysis present rare idiosyncrasies. An example of such idiosyncrasy can be found, within the context of industrial dynamics and economic geography, in the study of firm entry and exit events in a given region over a given time period. When the geographic and temporal units of analysis are small enough, the count nature of the number of entries and exits cannot be ignored; moreover, there can be many cases in which the events do not occur at all within a considered time unit. This problem of excess zero values, but also spatial and non-spatial overdispersion, and spatial dependence is tackled by Liviano and Arauzo-Carod (2014).^{*} Bayesian methods are used to connect the number of new establishments, as measured over the period 2002-2004 in each municipality of Catalonia, to territorial characteristics, including

^{*} This article is part of this special issue but was published earlier in error.

agglomeration economies, industrial composition and human capital. The econometric analysis confirms that spatial effects cannot be ignored during the estimation process. This finding confirms initial theoretical intuitions, for instance that the decisional process preceding the choice of a particular location for a new establishment often involves an evaluation of the neighbouring areas. It also corroborates the results of preliminary exploratory analyses according to which the spatial distribution of the variables is not random at all.

The analysis of the spatial distribution of variables, as observed at a given point in time, can be more than an exploratory step. It can provide important information about the process behind the observed distribution. In industrial dynamics, assumptions about the stochastic processes governing firm growth have often been tested by looking at the size (or growth rate) distribution of firms, as observed in a given year (see e.g. Simon and Bonini, 1958). Within a geographic context, the spatial distribution of firms can suggest the relative importance of different factors in affecting the location decisions and the following selection processes. In this issue, Bottazzi and Gragnolati (2014) analyse the spatial distribution of firms in Italy (in year 2001, sectoral disaggregation at NACE 2-digit level) to assess the relative weight of agglomeration versus urbanization economies. Localization economies are found to be much stronger than urbanization economies, although both have played a role in shaping the current distribution of economic activities.

The interests of industrial dynamics and economic geography overlap. Industrial evolution, firm growth, and technical change influence and are influenced by geographic variables. The location of economic activities influences and is influenced by the activities themselves. The relation among activities and among agents is defined also by their reciprocal distance, in spatial and non-spatial terms. Selection processes constantly reshape the economic system at all its levels of geographic disaggregation, favour some industries over others, and favour some firms over others, creating conditions for new firms, and new industries, to be created. The prosperity of regions, and the stability of that prosperity over time, can depend on the location choice of a few firms, but the reasons behind that choice, and behind the success of that choice, can be found back in time in the choices made by other firms in the same industry and region, and in other industries and regions. History and space matter in the evolution of industries: this special issue shows how and why.

Acknowledgements

The Guest Editors would like to thank the Regional Studies editors Koen Frenken and Arnoud Legendijk for their support throughout the organization and publication of this Special Issue. Also, many thanks to the 16 referees that collaborated with us for their valuable suggestions and contributions. We also thank all the participants at the DIME-HIPO Workshop: 'Industrial Dynamics And Economic Geography' organized by Ron Boschma, Marco Capasso, Elena Cefis, Koen Frenken, and Erik Stam, at Utrecht University, Utrecht, The Netherlands, 5-7 September 2010. The workshop has been financially supported by Utrecht University through the High Potential Grant (HIPO) granted to Elena Cefis and Koen Frenken.

Elena Cefis also acknowledges a grant received from the University of Bergamo (grant ex 60%, n. 60CEFI10, Department of Management, Economics and Quantitative Methods).

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