



# Drivers of spin-off performance in industry clusters: Embodied knowledge or embedded firms?

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## ARTICLE INFO

### Keywords:

Spin-offs

Clusters

Labor mobility

Social networks

Betweenness centrality

Eigenvector centrality

## ABSTRACT

Numerous studies attest to the distinctive performance of intra-industry spin-offs located in agglomerated regions. Besides entrepreneurs' pre-entry experience, both superior hires and regional embeddedness have been suggested as factors contributing to this pattern. We employ linked employer-employee data to assess their relevance in the empirical context of the Portuguese plastic injection molds industry. We find that the longevity of entrants is associated with the number and quality of early employees hired from within the industry, consistent with the importance of embodied knowledge flows. Our findings do not suggest that entrants' centrality in the regional industry network enhances their longevity.

## 1. Introduction

Knowledge and skills acquired in prior employment are crucial determinants of entrepreneurial performance (Parker, 2004). Successful entrepreneurs who started up after leaving their jobs at incumbent firms are legendary, and their ventures played important roles in the evolution of various industries and regions. Witness for example the proverbial "Fairchildren": large numbers of ventures were organized by employees leaving Fairchild Semiconductor, Silicon Valley's first prominent semiconductor firm. These spin-offs were key to the subsequent ascent of Silicon Valley to become the undisputed center of the global high-tech industry (Kenney and Von Burg, 1999; Moore and Davis, 2004). As is equally well known, Fairchild Semiconductor itself was formed in 1958 by a group of leading employees who had quit their jobs at Shockley Semiconductor Laboratory. Moreover, while Fairchild may be the most spectacular case of employee or spin-off entrepreneurship, many similar stories could be told.

Accounting for the distinctive performance of spin-offs has proven to be elusive (cf. Klepper, 2009, for a review of theories and evidence). Exactly why spin-offs are prominent in the evolution of regional industry clusters, and how spin-off dynamics relate to regional characteristics, has been particularly contentious. According to the "heritage theory" of industrial agglomeration (Klepper, 2007, 2010, 2016; Buenstorf and Klepper, 2009, 2010), spin-off entrepreneurship may

trigger and sustain the geographic concentration of industries even when and where traditional Marshallian economies of agglomeration are absent. As critics have been quick to point out, however, finding that only spin-offs but not other *de novo* entrants in clusters outperform more isolated entrants does not prove that agglomeration economies are irrelevant. It might instead indicate that spin-offs are better positioned than other entrants to benefit from agglomeration, a possibility acknowledged by Klepper (2007); cf. also Golman and Klepper (2016), as well as Boschma (2015) for an insightful discussion.

Spin-offs' embeddedness in localized social networks might plausibly underlie their superior ability to benefit from agglomeration (Hervas-Oliver et al., 2017). Localized social networks have frequently been suggested to be important in the evolution of regional industry clusters, including the Akron tire cluster that was used as an early example of the heritage theory of industrial agglomeration (Sull, 2001). Boschma (2015) accordingly calls for studying the network positions of spin-offs, which we begin to do in the present paper. Recent work moreover shows that spin-offs benefit from their founders' industry experience when hiring their initial labor force (Carias and Klepper, 2010; Cheyre et al., 2014). The recruitment of employees may contribute to firms' regional embeddedness, possibly enhancing their ability to absorb localized knowledge from external sources. At the same time, new hires add to the skills and capabilities available within the firm. These skills and capabilities presumably contribute to firm

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performance, which we also study below.

Disentangling the effects of spin-offs' superior capabilities due to the prior experience of their founders and employees from the effects of embeddedness in localized industry networks is challenging. It requires information on the backgrounds of founders and employees, as well as on their ties to other relevant actors in the industry and the region. In this paper, we draw on a unique dataset allowing us to recover both types of information. Specifically, we use 24 years of linked employer-employee data covering the entire Portuguese private-sector labor market to study the longevity of new entrants into the Portuguese plastic injection molds industry. Based on the linked employer-employee data we can trace the backgrounds of entrepreneurs to identify spin-offs. We also identify entrants' early-hires and use within-industry labor mobility to reconstruct the network of personal ties within the industry. We then analyze how founder backgrounds, locations, early-hires, and centrality in the regional industry network relate to the survival of entrants in the molds industry. To the best of our knowledge, our study is the first attempt to account for the roles of both employee mobility and network position in a study of spin-off performance.

The Portuguese plastic injection molds industry is ideally suited for the purpose of this study. It is one of the country's showcase industries. Portuguese molds makers, which are heavily concentrated in two clusters in Marinha Grande and Oliveira de Azeméis, are among the global industry leaders. They attained their position mostly because they were quick to embrace innovation. In addition, prior work on the industry has demonstrated the relevance of spin-off entry for its evolution (Costa and Baptista, 2012).

We find that firm survival in the Portuguese plastic molds industry is systematically associated with the number and quality of early employees hired from within the industry. Consistent with the importance of embodied knowledge flows, early-hires account for about 10% of the estimated spin-off premium in longevity. In contrast, our findings do not suggest that more pronounced embeddedness of entrants in the regional industry network, which we measure by betweenness centrality or alternatively by eigenvector centrality (Jackson, 2008), enhances their performance.

The remainder of the paper is structured as follows. We provide the theoretical background for our analysis and derive testable hypotheses in Section 2. Section 3 discusses the empirical context of the study, and Section 4 introduces data and methods. Results are presented in Section 5. Section 6 concludes.

## 2. Theoretical background: spin-offs, labor mobility and agglomeration

### 2.1. Spin-offs and the "heritage theory" of industrial agglomeration

Entrepreneurial ventures are crucial drivers of innovation, employment, and economic development. However, all entrepreneurial ventures are not created equal. Founding teams and early-hires bring diverse experiences, skills, and knowledge bases to new firms. A large stream of prior research has shown that these differences in pre-entry experience are systematically related to differences in post-entry activities and the performance of entrepreneurial ventures (cf. Helfat and Lieberman, 2002, and Peltoniemi, 2011, for surveys).

Among the different types of entrepreneurial or *de novo* ventures, (intra-industry) spin-offs – i.e. new firms organized by (teams of) entrepreneurs who previously worked at other firms in the same industry<sup>1</sup> – have received particularly high levels of scholarly attention. Spin-offs account for a sizeable fraction of all *de novo* entrants in high-tech industries such as semiconductors (Kenney and Von Burg, 1999; Fontana

and Malerba, 2010), disk drives (Agarwal et al., 2004), lasers (Sleeper, 1998), or biotechnology (Powell et al., 2012). They tend to outperform other entrepreneurial entrants (e.g., Klepper, 2007; Wenting, 2008; Dahl and Sorenson, 2014), with their success often matching that of *de alio* entrants diversifying from related markets (Klepper, 2002). Spin-offs are more likely to emerge from better-performing firms (Klepper and Sleeper, 2005; Cusmano et al., 2015). In addition, performance differentials within the group of spin-offs reflect differences in parent firm quality, as more successful parent firms tend to have more successful spin-offs (Franco and Filson, 2006; Wenting, 2008; Buenstorf and Klepper, 2009; Klepper, 2010).

The superior performance of spin-offs suggests that they benefit from a richer endowment of capabilities at entry. Evolutionary economists have highlighted organizational routines as *loci* of firm knowledge (Nelson and Winter, 1982). In an evolutionary perspective, spin-off performance can then be understood as the inheritance of organizational routines conducive to firm performance (Klepper, 2001). In this evolutionary process, incumbent firms serve as involuntary "training grounds" for aspiring entrepreneurs (Klepper, 2001). They enable future spin-off founders to acquire useful knowledge that can then be transferred from the parent firm to the spin-off venture (Phillips, 2002; Agarwal et al., 2004). There is only limited evidence as to exactly what types of knowledge are relevant in this process of employee learning. However, prior findings suggest that in addition to technology-related knowledge (Agarwal et al., 2004; Klepper and Sleeper, 2005), also knowledge related to the market (Buenstorf, 2007) and the institutional environment of the industry (Chatterji, 2009) contribute to spin-off performance. Inherited social capital may also be relevant (Dahl and Sorenson, 2014).

Taking into account the opportunity cost of giving up their current jobs, spin-off founders, in particular those who leave successful firms, are a highly select group of entrepreneurs. Starting a firm in the industry that one worked in before, instead of entering a (subjectively) new industry, may also reflect self-selection: more ambitious entrepreneurs enter markets that are more closely related to those served by their parent firms (Dahl and Sorenson, 2014). Empirically these dynamics of self-selection into spin-off entrepreneurship are difficult to disentangle from employee learning and the inheritance of capabilities through spin-off activities. Both self-selection and learning predict that spin-off founders are superior to the founders of other *de novo* firms, and that more successful parent firms have more successful spin-offs.

In terms of geography, the majority of entrepreneurs start their ventures close to where they previously worked (Figueiredo et al., 2002). Spin-offs are no exception, which turns the spin-off process into a powerful source of regional industry agglomeration. As more successful firms have more, and more successful, spin-offs, and each generation of spin-offs creates a new set of potential parent firms, regions where early successful entrants are located may become the geographic centers of an evolving industry. Firms located in these regions may be more successful than firms located elsewhere, which reflects their superior capability base due to larger shares of spin-offs from high-quality parents.

These success-breeds-success dynamics of spin-off-based cluster evolution are highlighted in the "heritage theory" of industrial agglomeration (Klepper, 2007, 2010; Buenstorf and Klepper, 2009, 2010). In contrast, the relevance of Marshallian agglomeration economies based on knowledge spillovers, labor pooling, and specialized suppliers has been discounted by the proponents of this theory. This focus on spin-off entrepreneurship is supported by empirical evidence from various industry clusters where only spin-offs, but not other entrepreneurial entrants located in the same region, outperformed more isolated competitors (ibid.; Boschma and Wenting, 2007; Wenting, 2008; Heebels and Boschma, 2011; but cf. Cusmano et al., 2015, for a deviating result).

These considerations about the performance of spin-offs and their role in industrial clustering inform the first hypotheses to be tested in

<sup>1</sup> Our terminology follows Klepper (2001, 2009) and Helfat and Lieberman (2002). Other authors prefer the terms "spin-out" (e.g., Agarwal et al., 2004) or "spawn" (e.g., Chatterji, 2009) when referring to what we will denote as spin-offs.

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