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Agents of structural change

The role of firms and entrepreneurs in regional diversification

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Abstract

Who introduces structural change in regional economies: Entrepreneurs or existing firms? And do local or non-local establishment founders create most novelty in a region? Using Swedish matched employer-employee data, we determine how novel the activities of new establishments are to a region. Incumbents mainly reinforce a region's current specialization. Their growth, decline and industry switching further align incumbents with the rest of the local economy. The unrelated diversification required for structural change mostly originates via new establishments, especially via those with non-local roots. Interestingly, although entrepreneurs often introduce novel activities to a local economy, when they do so, their ventures have higher failure rates compared to new subsidiaries of existing firms. Consequently,new subsidiaries manage to create longer-lasting change in regions.

Key words: Structural change, entrepreneurship, diversification, relatedness, regions, resource-based view

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> "Our remote ancestors did not expand their economies much by simply doing more of what they had already been doing: piling up more wild seeds and nuts, slaughtering more wild cattle and geese, making more spearheads, necklaces, burins and fires. They expanded their economies by adding new kinds of work. So do we." (Jacobs, 1969, p. 49)

1. Introduction

Penrose (1959) famously argued that firms can only sustain growth if they expand not just the scale of their production, but also the scope of production. What is true for firms holds at the aggregate level of the economies of cities (Jacobs, 1969): unless they diversify into new activities, cities will be unable to prosper in a changing competitive landscape.[1] However, unlike a firm, a city and its surrounding region do not act for themselves, but instead they must rely on firms and entrepreneurs to introduce new activities, together with the resources these activities require. At the same time, a region's resources condition the type of activities local firms can successfully unfold. In this study, we ask the question of who is responsible for the most salient structural change in a region. Are entrepreneurs or existing firms the most important economic agents of change? Does novelty arise from local entrepreneurs and firms, or is it introduced by actors from outside the region? And, once introduced, how sustainable is this novelty?

These questions address the interdependencies between firms and their local environments that have recently created an active field of research at the intersection of cluster research, entrepreneurship, strategic management, economic geography and urban economics (Alcacer and Chung, 2007; 2013; Porter, 2003; Delgado *et al.*, 2012; Glaeser and Kerr, 2009; Glaeser *et al.*, 2010). Moreover, our inquiries investigate the extent to which novelty is homegrown, i.e., pushed forward by

[1] Detroit, for instance, went through a particularly devastating episode of this kind when the Great Recession hit the city's automotive industry so hard that it eventually defaulted on part of its debt (Pendall *et al*., 2010).

the creativity of local firms and entrepreneurs, and to what extent new activities are transplanted from elsewhere. We aim to contribute to this literature in three ways.

Firstly, we explore to what extent the Resource-Based View (RBV) of the firm can be adapted to the aggregate level of regional economies. Although much of what we will argue is compatible with, and draws on, classical notions of spillovers, agglomeration externalities and clusters, the RBV has at least two features that make it attractive for organizing our thinking about local economies. For one, the RBV's explicit acknowledgement of the inherent specificity of many important strategic resources offers a natural way to discuss the direction of regional diversification. Given that many resources that firms use are embedded in the local context (such as skilled labor, infrastructure, knowledge institutes, suppliers, etc.), the services (Penrose, 1959) these resources provide are only accessible from within the region. This suggests that it is possible to conceive of regions as endowed with resource bases to which only local firms have easy access (Lawson, 1999; Boschma, 2004). Moreover, although the RBV's emphasis on rents to firm-owned resources would seem to preclude applying the framework to regions – which do not own resources – the discussion of rents actually has implications for which agents will be most dependent on locally available regional resources. Given that such agents will use existing resources instead of introducing new ones to the region, these implications translate into testable hypotheses on which agents will induce most structural change.

Secondly, we introduce quantitative instruments to infer how much structural change a region undergoes when new activities are added to the industry mix. These instruments rely on measuring how unrelated such new activities are to the current local economy to infer the implied change in the underlying resource base.

Thirdly, we test these instruments on a comprehensive employer-employee linked dataset that covers every worker in the Swedish economy between 1994 and 2010. Here, we distinguish among five types of economic agents. First, we distinguish between the owners of existing establishments and the

founders of new establishments. Among the founders of new establishments, we further differentiate new establishments that belong to existing firms (new subsidiaries) from those that belong to entrepreneurs. Finally, we subdivide both founder types into local and non-local founders.

We find that structural change unfolds much slower than a superficial analysis of employment reallocation across local industries would suggest. Although we find that there is substantial churning of local industries and that large amounts of workers are shifted among a region's industries, most of these shifts take place among industries that are closely related. Our interpretation of this finding is that the volatility of the industrial profile of a region often does not translate into a renewal of the underlying resource base. Moreover, decomposing these changes by agent type shows that the growth, decline and industrial reorientation of existing establishments all tend to reinforce a region's existing resource base, whereas new establishments are often set up in more unrelated activities and hence induce more structural change. However, there are marked differences among the establishments of different founder types. If we rank local industries by how related they are to their regional economy, we find that non-local firms and entrepreneurs generate most structural change. Moreover, entrepreneur-owned establishments (i.e., start-ups) induce most structural change in the short run, but in the long run, this role is increasingly assumed by new subsidiaries of existing firms. Indeed, whereas the long-term survival rates of entrepreneur-owned establishments are lower in regions with few related activities, we find no such relation for the new subsidiaries of existing firms. Overall, although the establishments of non-local founders represent only one third of all employment created by new establishments, they contribute 56% of new establishment employment in the local industries that are least related (i.e., in the bottom 5^{th} percentile) to the region's economy. In other words, radical structural change predominantly depends on non-local firms and entrepreneurs transferring new activities to the region.

In section 2, we outline the theoretical framework, highlighting the similarities and differences between regional and firm diversification and deriving hypotheses regarding which agents induce most structural change. In section 3, we introduce the data. In section 4, we describe how we measure industrial and structural change. In section 5, we present the empirical findings. Section 6 concludes.

2. Theory

The resource-based view (RBV) of the firm (Wernerfelt, 1984; Barney, 1991) conceptualizes firms as bundles of resources. These resources have a number of important characteristics. First, if they are valuable, rare and hard to imitate and substitute (i.e., fulfill the so-called VRIN conditions, see Barney, 1991), resources confer sustained competitive advantage to their owners. Second, resources are often specific to the economic activities that require them. More precisely, resources yield productive services (Penrose, 1959) that can be applied in only a limited number of related activities. Indeed, this sharing of resource requirements is what makes activities related (Bryce and Winter, 2009). Third, over time, firms become better at exploiting the resources they use, generating internal pressures to diversify. That is, whenever a firm cannot expand its existing activities sufficiently to absorb the growth in services it extracts from its resources, it has an incentive to search for alternative applications that leverage these resources (Montgomery and Wernerfelt, 1989; Peteraf, 1993), providing a rationale for related diversification (Penrose, 1959; Teece 1982). Fourth, long-term survival requires firms to renew their resource-base through dynamic capabilities (Teece *et al.*, 1997).

Following Lawson (1999), we argue that the notion of a resource base at least partially carriers over from firms to regions. This statement builds on four observations: (1) like firm-internal resources, firm-external local resources, such as the local infrastructure, knowledge institutions, specialized labor markets, etc., can display characteristics that are typically associated with sustained competitive advantage; (2) such local resources are often specific, yet also fungible to a degree; (3) some of them grow when they are used more intensively; and (4) given that resources become obsolete with the

inevitable changes in technologies and final demand, regions decline if their resource bases are not updated accordingly. Observations (1) to (3) suggest that, like firm diversification, regional diversification is a path-dependent process, while observation (4) suggests that to avoid decline, regions must renew their resource bases.

In spite of their commonalities, regional and firm resource bases differ in at least two ways. First, regional resource bases do not develop by the volition of a central actor. Instead, a region depends on firms and entrepreneurs to introduce new productive resources and retire old ones. Indeed, the main question of the present study is how regional resource bases change, or to be more precise, *who* change them.

Second, because firms control their internal resource bases, they can often extract rents from them. In contrast, it is not obvious who will appropriate the rents of a *regional* resource base. The resource base of a region is, in principle, available to all firms that locate there. Therefore, although local firms may gain a competitive advantage over firms outside the region, *a priori*, firms within the same region are at "competitive parity" (Pouder and St. John, 1996, p. 1203). Consequently, if firms can freely enter a region, the rents of a superior regional resource base do not necessarily accrue to the firms that use it. Instead they may end up with the owners of local production factors with a relatively inelastic supply, such as labor or land.[2] The relation between resources and rents is useful, because it allows us to formulate hypotheses on these questions. Before doing so however, we discuss how the notion of a regional resource base fits in with the existing literature in urban economics and cluster research.

2.1 Regional resource bases

Regional resource bases offer a framework for how firms co-develop with the local economies that host them. This question is by no means new. For instance, economic geographers and urban economists

[2] Indeed, urban economists often seek (and find) evidence for agglomeration externalities in elevated wages or house prices instead of in the profits of local firms (Rosenthal and Strange, 2004; Glaeser, 2005).

describe the interdependences between firms and their local environment using notions of spillovers and agglomeration externalities. So what do we gain from bringing resource-based thinking to the regional context? The main benefit is that it offers a way to theorize about regional diversification. In contrast, the conceptual apparatus of agglomeration externalities, although it does differentiate between benefits of specialization and of diversity of existing activities,[3] has little to offer when it comes to understanding regional diversification. Indeed, in the absence of additional assumptions, the agglomeration literature typically remains agnostic about among which activities such spillovers and externalities exist[4], let alone which *new* activities will arise in a region.

Consequently, diversification, and in particular the notion of related diversification, only plays a minor role in the urban economics literature. That is not to say that the importance of related industries *per se* has remained unnoticed. Pioneering work on the role of inter-industry relatedness is found in cluster research (Porter, 1998, 2003; Maskell, 2005; Delgado *et al.*, 2013). For instance, the presence of related industries has been shown to increase entrepreneurial activity (Delgado *et al.*, 2010) and the survival rates of manufacturing plants (Neffke *et al.*, 2012) in a region, suggesting the existence of what Florida *et al.* (2012) call "geographies of scope". Similarly, in urban economics, Ellison *et al.* (2010) and Dauth (2010) use a variety of relatedness measures to disentangle different externality channels. Still, despite recognizing the importance of inter-industry relatedness, the question of how such relatedness affects diversification has not received nearly as much attention in the literature on regional growth as in work on firm growth.

Recently, however, this topic has enjoyed growing attention. For instance, Frenken and Boschma (2007) and Boschma and Frenken (2011) argue that regional development is characterized by a

[3] Benefits of specialization are often referred to as *localization* or *MAR* externalities, whereas benefits of a large diversity in local economic activities are called *Jacobs* externalities (e.g., Glaeser *et al.*, 1992; Henderson *et al.*, 1995).

[4] A notable exception is the work by Ellison *et al.* (2010).

branching process in which new, yet related activities spin out of existing activities. This conjecture has been accruing more and more empirical support. At the national level, Hidalgo *et al.* (2007) show that countries diversify their export portfolios according to such a branching logic. Neffke *et al.* (2011) show that similar processes are at work in the long-term development of Swedish regions, a result that has subsequently been replicated for regions in Spain (Boschma *et al.*, 2013) and the United States (Essletzbichler, 2013; Muneepeerakul *et al.*, 2013).

Is it sensible to speak of regional resources? And if so, what would they be? Interestingly, the work on regional diversification mentioned above implicitly acknowledges the existence and importance of regional resources. For instance, Boschma and Frenken refer to regional knowledge bases in their work, whereas Hidalgo and co-authors explain their findings in terms of capabilities (examples of which include infrastructure, climate and institutions) that exist at the level of national economies, whereas Muneepeerakul *et al.* (2013, p. 1) refer to a city's "portfolio of technologies and skills". Moreover, regional resources have been identified by others, albeit using different terminologies. For instance, economic geographers stress the importance of skilled local labor markets, specialized suppliers and local knowledge (Glaeser *et al.*, 1992; Henderson *et al.*, 1995; Almeida and Kogut, 1999; McCann and Simonen, 2005; Faggian and McCann, 2006). In cluster research, elements of Porter's (1990) diamond, such as the availability of production factors and the non-traded goods and services of supporting industries, can be regarded as regional resources. Finally, the learning region and regional innovation system frameworks (Cooke and Morgan, 1998) highlight the importance of regions' "untraded interdependencies" (Storper, 1995) or "localized capabilities" (Maskell and Malmberg, 1999), such as inter-organizational knowledge networks.

Regardless of terminology, from an RBV perspective, regional resources can help local firms compete in global markets if they are valuable, rare, inimitable and non-substitutable. Many of the regional resources described above fit this definition. Firstly, that regional resources are often valuable

and non-ubiquitous is all but beyond dispute. Secondly, analogous to the inimitability requirement, regional resources are often highly localized because many of them are not tradeable across places. However, regional resources are not necessarily non-substitutable, especially not if establishments can access firm-internal resources, a particularity to which we return later.

Apart from fulfilling VRIN conditions, regional resources are often specific to the economic activities they are used in. For instance, specialized car parts suppliers are of little use to pharmaceutical firms. Likewise, access to skilled actuaries is valuable to local insurance companies, not to operators of spas. Still, external resources are often to a certain degree fungible (Teece, 1982). For example, although the presence of skilled mechanical engineers may not be useful to all economic activities, their services are valued in multiple manufacturing and business services activities.

Finally, regional resources often grow the more they are used. For instance, skilled workers are attracted to places with employment opportunities that fit their qualifications. Similarly, specialized suppliers are attracted to regions that host potential clients. These processes are self-reinforcing: firms that use specialized resources are attracted to regions where these resources are available, while specialized resources are attracted by the presence of firms willing to pay for them (Duranton and Puga, 2004). Accordingly, regions grow through related diversification for similar reasons that firms do: regions host resources that expand with their use and are valuable, rare, specific to the existing set of economic activities and hard to access from outside the region. It is important to note that this argument does not require that local firms appropriate rents from regional resources. Regardless of rent appropriation, a region's carrying capacity for a given industry depends on the extent to which the regional resource base fulfills that industry's particular needs. Therefore, the activities that arise most easily typically build on existing resources, i.e., regional diversification will predominantly be *related* diversification.

2.2 Unrelated diversification and structural change

The problem of related diversification is that economic environments are not static. Changes in technologies and demand can render existing resources obsolete and erode incumbent firms' competitive advantage (Tushman and Anderson, 1986). Within the RBV research community, this has raised interest in so-called *dynamic capabilities*, i.e., capabilities that not just help firms diversify into new products, but also rearrange the underlying resource configurations (Henderson and Cockburn, 1994; Teece *et al.*, 1997; Eisenhardt and Martin, 2000; Helfat and Peteraf, 2003).

Resource obsolescence does not only affect firms but also regions (Grabher, 1993; Pouder and St. John, 1996; Glaeser, 2005). Once the existing regional resources become insufficient for firms to compete at global markets, the regional resource base must be renewed or lose its attraction. In much the same way as the "new resource configurations" (Eisenhardt and Martin, 2000) generated by dynamic capabilities go beyond changing a firm's product portfolio, renewal of the regional resource base goes beyond a mere change in the region's industrial employment composition. However, because regional resources co-evolve with the firms that use them, building up new resources requires new activities that utilize these resources. In other words, it is important to distinguish between regional diversification in general, which often merely changes the industrial composition of a local economy and to which we refer as *industrial change*, and the unrelated regional diversification that requires a transformation of the local resource base. Only the latter type of diversification we call *structural change*.

2.3 Rents to regional resources and agents of structural change

Because the resource base is affected by the production decisions of local firms, the regional counterpart to dynamic capabilities (Teece *et al.*, 1997) resides in the ways in which such local economic agents affect the resource base of a region by expanding and destroying existing economic activities and creating new ones. We distinguish between two different types of economic agents that can induce

change in a region. Firstly, there are the region's existing establishments. Existing establishments affect the regional employment structure and, concurrently, the regional resource base, whenever they expand or reduce employment, change industrial orientation or leave the region altogether. Secondly, new establishments can act as agents of change. New establishments either belong to existing firms or to entrepreneurs. Moreover, these existing firms and new entrepreneurs originate from either inside (local agents) or outside the region (non-local agents).

Who of these agents are most likely to introduce new resources to a region? To answer this question, recall that, although regional resources share similarities with firm resources, a main difference is that firms own their resources, whereas regional resources are in principle shared among all local firms. Still, that this would indeed place local firms at competitive parity in terms of regional resources is probably too strong an assumption. For one, accessing regional resources becomes easier as firms grow roots in a region (Grabher, 1993; Pouder and St. John, 1996; Storper and Venables 2004). For instance, preferred access to local suppliers may require long-standing relationships (Ghemawat, 1986) and firms do not all participate equally in local knowledge networks (Giuliani, 2007). For another, given the importance of (often localized) social networks in job search, it is easier for local firms than for newcomers to find suitable workers (Sorenson and Audia, 2000). In line with this reasoning, Dahl and Sorenson (2012) show that "regional tenure", *i.e.*, the number of years an entrepreneur has worked in a region, is almost as strong a predictor of a venture's success as industry tenure is. Moreover, the subsidiaries of larger firms can often access their parents' resources and firms that have strong ties to other parts of the world can access some resources in other regions (Bathelt *et al.*, 2004). Consequently, the importance firms attach to regional resources, and therewith, the degree to which these resources affect corporate strategy, differs by firm.

Hence, establishments will differ in (1) their access to local regional resources, (2) their access to resources in other regions and (3) their overall reliance on local resources. Starting with the first, we

argue that agents who can access regional resources more easily are more likely to build on existing regional resources. Hence, they are less likely to introduce new resources into the region, i.e., they are less likely to induce structural change. We have argued that access to regional resources is easier if firms have already developed ties in the region. Therefore, we arrive at the following hypothesis:

> **Hypothesis 1:** Incumbent establishments are less likely to induce structural change in the region than new establishments.

Secondly, several authors (e.g., Storper, 1995; Pouder and St. John, 1996, Lawson and Lorenz, 1999; Gertler, 2003; Boschma, 2004) argue that firms often follow a locally dominant logic. Local firms are therefore more likely to perpetuate the existing resource base. In contrast, agents that enter the region from elsewhere may not only lack access to some of the resources in their new region, but they may also infuse their new region with ideas, skills and relations, bringing with them resources from other regions. This suggests that local agents are less likely to change the region's resource base than agents that enter the region from elsewhere:

> **Hypothesis 2:** New establishments of *local* entrepreneurs and firms are less likely to induce structural change in the region than new establishments of *non-local* entrepreneurs and firms.

Thirdly, agents differ in the extent to which they *depend* on local resources. In particular, new establishments of existing firms often have access to their parents' firm-internal resources, which may substitute for regional resources. Therefore, these establishments can develop activities that rely on resources that do not yet exist in the region. If these resources get transferred to the region, the regional resource base expands. In contrast, entrepreneur-owned establishments do not have access to parent-firm resources. This suggests that entrepreneurs will be more reliant on regional resources and, therefore, induce less structural change than new subsidiaries of existing firms.

At the same time, there is a long history of thought that associates entrepreneurship with structural change. Indeed, at least since the writings of Schumpeter (1934), entrepreneurship has been associated with new combinations, innovation, and structural change. For instance, entrepreneurs are typically more risk-taking (Cramer *et al.*, 2002) and creative (Zhao and Seibert, 2006) than the average person. Given these contradictory considerations, both (opposing) hypotheses are justifiable:

Hypothesis 3a: New establishments of entrepreneurs are less likely to induce structural change in the region than new establishments of existing firms.

Hypothesis 3b: New establishments of existing firms are less likely to induce structural change in the region than new establishments of entrepreneurs.

3. Data

We test these hypotheses on data that are derived from the administrative records of Sweden.[5] These records contain yearly information on individuals' workplaces and incomes for the country's entire workforce. Because the income information distinguishes between income derived from wages and from a private business, it allows us to identify entrepreneurs. Individuals are linked to the establishments of their main job for which location and industry affiliation are known. Moreover, all establishments that belong to the same parent firm are linked through a shared firm identifier.

We aggregate the individual-level data to the firm and region-industry level to analyze employment dynamics in 110 labor market regions in Sweden between 1994 and 2010. Industries are defined at the 4-digit level of the European NACE classification, which distinguishes over 700 different industries and remains relatively stable for the period 1994 to 2010.

An important assumption in this paper is that locally available resources influence an establishment's location choice. However, in some industries, location choice is severely restricted

[5] Data access was provided by Statistics Sweden (SCB). Further information on data access and a detailed documentation of the data can be found on the SCB website (SCB, 2011).

because of the need to be close to some natural resources or to the large numbers of customers in urban agglomerations. Therefore, when defining a region's industry mix, we focus on 259 traded, non-natural-resource-based industries in the private sector, excluding non-traded services (*e.g.*, retail stores and restaurants), government activities and natural-resource-based activities (*e.g.*, mining and agriculture).[6]

3.1 Measurement

To test the hypotheses formulated in section 2, we have to quantify by how much each agent type diversifies the regional resource base. The word "diversification" can be used either in a static sense ("How diversified is a region?") or in a dynamic sense ("By how much did the portfolio of local economic activities change?"). When combined with the distinction between industrial and structural change, "diversification" can refer to four different concepts, each of which can be quantified (see Table 1). Firstly, the static concept of *industrial diversity* can be measured by the number of different industries in a region or by the entropy of the employment distribution across industries. Secondly, the dynamic notion of *industrial change* refers to how much the industrial composition of a region changes, and can be measured by entry and exit rates of industries or by the cosine distance of a region's changing industrial employment vector vis-à-vis a base year. Moving to the level of resources, the static notion of diversification refers to the *coherence* (or lack thereof) of the economic activities in a region in terms of overlap in resource requirements.[7] The dynamic notion, *structural change*, refers to a change in these resource requirements.

[6] See Appendix A. Because all industries contribute to the local resource base, we do take the omitted industries into account when measuring the resource match between an industry and the local resource base.

[7] Although the word "coherence" evokes positive associations, coherent regions are not necessarily better off than incoherent regions. On the one hand, the compact resource base of coherent regions is easier to maintain. On the other hand, this compactness limits diversification options. In the long run some intermediate level of coherence may therefore be optimal, in the same way that there is an optimal level of diversification for firms (Palich *et al.*, 2000). This issue of optimality is left for future research.

A complication in measuring coherence and structural change is that we do not observe regions' actual resource bases, let alone changes therein. We do, however, observe a region's industry mix. This industry mix provides information on the kind of resources that are accessible in the region. After all, regardless of what the resources exactly are, local firms that are active in a certain industry must (by definition) have access to the resources this industry requires. For instance, a local car producer must have access to the resources required in car-making. Some of these resources will be regional resources (such as qualified labor, dedicated infrastructure and specialized suppliers) that grow the more intensively they are used in the region and are (or become) available to others in the region.

Obviously, little is gained by deducing for each product X in a region that the region provides access to resources required in X-making. However, we can make some progress by using information on the relatedness among economic activities. Industries are related if they require similar resources (Farjoun, 1994; Teece *et al.*, 1994; Bryce and Winter, 2009). Conversely, this means that when a region diversifies into an industry that is unrelated to its current portfolio of industries, it typically draws on new resources, and the introduction of these resources to the region expands the regional resource base. This line of reasoning suggests that, even if we do not observe regional resources, we can still quantify regional coherence using information on how *related* activities in a region are to one another. Similarly, the degree of structural change can be measured by investigating how *unrelated* the diversification in a region is. This approach involves four different steps: (1) determining how related industries are to one another in terms of their resource requirements. This industry-to-industry relatedness can then be used to calculate (2) how related an industry is to the basket of industries that constitute a region's industry mix. We call this the *regional resource match,* or simply the *match* of an industry to a region. Next, (3) regional coherence is quantified as the average resource match of all industries in the region. Finally, (4) structural change is defined as the match of the current industry mix

to the region's past resource base. This procedure is summarized in Table 2 and explained in the following sections in detail.

TABLE 1 DIVERSICATION MATRIX

TABLE 2 DEFINITIONS OF QUANTITIES

3.2 Inter-industry relatedness: skill relatedness

Inter-industry relatedness can be measured in several ways (for an overview, see Neffke and Henning, 2013). We focus on relatedness in terms of similarities workers' skill requirements or *skill relatedness*. However, Appendix D shows that our empirical findings can be reproduced using several different relatedness measures. Our focus on skills has two reasons. Firstly, the skills embedded in a firm's human capital are among its most valuable resources (Grant, 1996; Grant and Spender, 1996) and have been shown to condition a firm's diversification path (Porter, 1987; Neffke and Henning, 2013). Secondly, human capital can and is shared between firms in a region. It therewith acts as an important channel of knowledge exchange and local externalities (Almeida and Kogut, 1999).

Neffke and Henning (2013) quantify similarities in skill requirements using information on cross-industry labor flows. The logic behind this is that workers are in general reluctant to switch to jobs where their current skills are not valued and firms are less willing to hire workers without relevant work experience. Therefore, industries with similar skill requirements typically display large labor flows among them. Using a simplified index proposed in Neffke *et al.* (2013), we measure the skill relatedness between two industries, i and j, as the ratio of observed to expected worker flows, where expectations are based on overall mobility rates in both industries:

$$SR_{ij} = \frac{F_{ij}}{(F_{i.}F_{.j})/F_{..}} \tag{1}$$

In this equation, F_{ij} represents the observed labor flow from industry i to industry j. Where the index i or j is replaced by a dot, the flows are summed over this omitted category, such that $F_{i.} = \sum_j F_{ij}$, $F_{.j} = \sum_i F_{ij}$ and $F_{..} = \sum_{i,j} F_{ij}$. The term $\left(F_{i.}F_{.j}\right)/F_{..} = F_{i.}\frac{F_{.j}}{F_{..}}$ represents the expected flows from i to j,

assuming that j receives workers from i proportional to j's share in total labor flows. SR_{ij} values greater than one signal that industries are skill related, whereas values between zero and one indicate that industries are unrelated.[8] This skill-relatedness index is highly predictive of corporate diversification (Neffke and Henning, 2013), stable over time and similar for workers in different wage categories and occupations (Neffke *et al.*, 2013).

3.3 Industry-region resource match

Skill relatedness characterizes industry-industry pairs. However, the relatedness of a given industry to a regional economy is an industry-region relationship. We quantify this relationship by calculating how much employment in the region is related to the focal industry. The more related employment there is, the stronger the industry's match with the region's resource base is supposed to be. Let E_{irt}^{rel} be all employment in industries related to industry i in region r in year t:[9]

$$E_{irt}^{rel} = \sum_j E_{jrt} * I(SR_{ij} > 1) \quad (2)$$

where E_{jrt} represents the employment of industry j in region r in year t and $I(SR_{ij} > 1)$ an indicator function that evaluates to one if its argument is true and to zero otherwise. The match of industry i to region r in year t is defined as the degree to which the region is overspecialized in industries related to industry i. That is, it is based on the location quotient of related employment:

$$LQ_{irt}^{rel} = \frac{E_{irt}^{rel}/E_{.rt}}{E_{i.t}^{rel}/E_{..t}} \quad (3)$$

where $E_{.rt}$ is the total employment in the region in year t, $E_{i.t}^{rel}$ the total employment in related industries in the country, and $E_{..t}$ the overall employment in the country. If LQ_{irt}^{rel} is greater than one,

[8] Detailed industry-industry labor flows can be derived from our data because we can follow all Swedish workers throughout their careers over the period 1994-2010. This results in yearly skill relatedness estimates that we average over the entire period to reduce measurement errors as explained in Neffke *et al.* (2013). The exact procedure is described in Appendix B.

[9] Related employment includes the employment in related non-traded, public sector and natural-resource-based industries. Because its labor is locally available and thus a local resource, the own-industry employment in other establishments contributes to the related employment in the region. However, excluding an industry's own employment does not substantively alter any of our findings.

the employment share of related industries in the region exceeds their share in the national economy. If it is smaller than one, the region has a smaller share of related industries than the national economy does.

By construction, LQ_{irt}^{rel} has a strongly asymmetric distribution: whereas an overrepresentation of related industries ranges from 1 to infinity, the underrepresentation of related industries lies between zero and one.[10] This asymmetry complicates calculating averages. We therefore transform LQ_{irt}^{rel} as follows:

$$\widetilde{LQ}_{irt}^{rel} = \frac{LQ_{irt}^{rel}-1}{LQ_{irt}^{rel}+1} \quad (4)$$

$\widetilde{LQ}_{irt}^{rel}$ ranges from -1 (no related employment) to +1 (a complete concentration of all related employment in region r). Because $\frac{LQ_{irt}^{rel}-1}{LQ_{irt}^{rel}+1} = -\frac{(1/LQ_{irt}^{rel})-1}{(1/LQ_{irt}^{rel})+1}$, a given level of overrepresentation of related employment has the same magnitude but opposite sign as the same level of underrepresentation. For instance, if $LQ_{irt}^{rel} = 2$, $\widetilde{LQ}_{irt}^{rel} = \frac{1}{3}$, whereas $LQ_{irt}^{rel} = \frac{1}{2}$ implies $\widetilde{LQ}_{irt}^{rel} = -\frac{1}{3}$.

3.4 Regional coherence and structural change

Whereas the resource match is a characteristic of a local industry, *i.e.*, of an industry-region pair, coherence is a regional characteristic. We define coherence as the employment-weighted average resource match of a region's industries:

$$C_{rt} = \sum_i \frac{E_{irt}}{E_{.rt}} \widetilde{LQ}_{irt}^{rel} \quad (5)$$

The coherence tells us how related the industries in a region are to one another. We also calculate how strongly the *national* industry mix matches the resource base of a given region r:

$$C_{rt}^{base} = \sum_i \frac{E_{i.t}}{E_{..t}} \widetilde{LQ}_{irt}^{rel} \quad (6)$$

[10] For instance, an industry for which related industries are twice as large in the region as in the national economy, M_{irt} equals 2. However, in the reverse situation (related industries' share of the national economy is twice as large as the one of the regional economy), M_{irt} equals 0.5.

where $\frac{E_{i.t}}{E_{..t}}$ is industry i's share in total national employment. C_{rt}^{base} can be interpreted as a baseline that tells us how well-matched a random portfolio of activities would have been to the region in which each local industry's employment is proportional to the size of the industry in the national economy.

The dynamic counterpart to coherence – structural change – can be measured in much the same way: instead of asking how related a region's industry mix is to the current local economy, we ask how related the industry mix is to the local economy of a base year, T:

$$S_{rt,T} = \sum_i \frac{E_{irt}}{E_{.rt}} \widetilde{LQ}_{irT}^{rel} \text{ , where } T < t \quad (7)$$

3.5 Structural change by agent type

The regional industry mix changes when economic agents create or destroy employment in local industries. When agents create employment in local industries with high resource-match values, agents reinforce the focus of that resource base. When agents destroy employment in such industries, central resources are eroded and the resource base's focus shifts. Similarly, for local industries with low resource-match values, employment creation expands the resource base and employment destruction erodes peripheral resources, tightening the resource base. To study structural change by agent type, we divide all establishments by whether they create or destroy employment. Incumbent establishments are divided into three groups: growing, declining and exiting incumbents. Furthermore, incumbents that switch industries create employment in the industry they enter and destroy employment in the industry they leave.[11] Therefore, we split industry switchers into two artificial types: "out-switching" incumbents and "in-switching" incumbents. For new establishments, we distinguish among the new subsidiaries of local firms and non-local firms, and the new establishments set up by local and non-local entrepreneurs. Table 3 provides an overview of all agent types.

TABLE 3 AGENT DEFINITIONS

[11] In principle, firms may also move to another region. However, such events are so rare that we do not explore them further.

A detailed description of how we determine establishment ownership and geographic origins is provided in Appendix C. In short, we first identify new subsidiaries. If an establishment shares its firm identifier with other establishments, we know that the establishment is a subsidiary of a larger firm. A subsidiary is said to belong to a *local* firm if, in the previous year, the parent firm employed most of its employees in the new subsidiary's labor market area. If the founding of the establishment leads to the creation of a new firm, we regard the establishment as entrepreneur-owned. We identify entrepreneurs in such establishments as workers with income from a private business. If the entrepreneur sets up an establishment in the labor market area where he or she was employed in the previous year, the entrepreneur is considered local, whereas all others are regarded non-local. This approach identifies the origins of all new subsidiaries and of some 35,000 out of about 60,000 entrepreneur-owned establishments. Establishments for which the origin could not be determined are hereafter dropped.

The structural change an agent type induces in a region is calculated as the weighted average resource match of the agent's establishments to the region's original economic structure, where the weights are given by the employment these establishments create or destroy within a given period of time. The structural change an agent induces between year t and the base year T is defined as:

$$A^{a}_{rt,T} = \sum_i \frac{\Delta E^{a}_{irt,T}}{\Delta E^{a}_{.rt,T}} \widetilde{LQ}^{rel}_{ir,T} \tag{8}$$

where $\frac{\Delta E^{a}_{irt,T}}{\Delta E^{a}_{.rt,T}}$ is the employment that the establishments of agent type a create (or destroy) between the base year T and the current year t in region r and industry i $\left(\Delta E^{a}_{irt,T}\right)$ as a share of the total employment created (destroyed) by this agent type in all industries in region r $\left(\Delta E^{a}_{.rt,T}\right)$. $A^{a}_{rt,T}$ thus shows how strongly an agent type's new (or destroyed) employment is related to the local economy of year T. To facilitate interpretation, we subtract the average match of existing local industries in year T (i.e., we subtract a region's base year coherence):

$$\tilde{A}^{a}_{rt,T} = A^{a}_{rt,T} - C_{rT} \quad (9)$$

Positive values of $\tilde{A}^{a}_{rt,T}$ now indicate that the agent's activities are more related to the region than the region's pre-existing activities, whereas negative values indicate the agent's activities are less related.

4. Results

4.1 Diversity and industrial change in Swedish regions

Figure 1 shows how the diversity of Swedish regions has evolved. For each year, it depicts the employment entropy of regions' industry mixes averaged over all regions.

FIGURE 1 DIVERSITY

Overall, regions show no tendency of becoming more or less specialized: average diversity stays constant throughout the entire time period. However, as shown in Figures 2 and 3, this apparent stability masks significant industrial change. Figure 2 shows that 23% of all local industries[12] in 2010, appeared after 1994 and that 27% of the local industries in 1994 had disappeared by 2010. Moreover, Figure 3 shows this churn of local industries is accompanied by a steady move away from regions' 1994 employment compositions.

FIGURE 2 CHURNING

FIGURE 3 COSINE DISTANCE

4.2 Coherence and structural change

Figure 4 shows the coherence of regions and how it evolves over time. The average coherence significantly exceeds its proportional employment baseline in every single year, showing that local industries are more closely related to each other than to the Swedish economy as a whole. This finding suggests that the industry composition of a regional economy draws on a relatively narrow set of regional resources, in much the same way as a firm's product portfolio is often organized around some core competences. Given the observed industrial change, one would expect the resource base of regions

[12] A local industry is defined as a region-industry combination, such as for instance shipbuilding-in-Gothenburg.

to change as well. However, the average coherence fluctuates only marginally between 0.02 and 0.05, without any statistically significant shifts. Moreover, the downward-sloping line in Figure 5 implies that, although local economies drift away from their original resource bases, this process unfolds very slowly. The slope in Figure 5 is significantly negative at -0.0029 (t-statistic: -3.76), implying it would take the average region over 50 years to move one standard deviation (which is somewhat less than the average region's distance to the national economy) away from its base-year position.

FIGURE 4 COHESION

FIGURE 5 STRUCTURAL CHANGE

4.3 Agents of structural change

Table 4 summarizes the number of establishments and employment by agent type. For the new establishments, we focus on those that were created between 1994 and 2000. All new establishments together account for over 100,000 new jobs, or about 17,000 a year, or one fifth of the yearly employment created by growing incumbents. The last column of Table 4 also offers a firstassessment of which agents change the industry mix of local economies. It shows that about 4% of new subsidiaries of existing firms introduce new industries in a region against about 2% for entrepreneurs. Much of this difference can be attributed to the new subsidiaries of non-local firms. Indeed, the local-industry formation rate is slightly lower for local firms than for local entrepreneurs. In contrast, new subsidiaries of non-local firms launch new local industries more often than non-local entrepreneurs do. These results already foreshadow the findings on structural change, which take into account that some new industries represent bigger shifts in the underlying resource base than others.

TABLE 4: EMPLOYMENT / ESTABLISHMENTS / NEW INDUSTRIES

Short-term structural change

Figure 6 summarizes how much structural change is implied in the employment that each agent type creates (or destroys) within a one-year time period.[13] Agent types are listed along the horizontal axis. On the vertical axis, we plot an agent type's average resource match to its region (the agent's $\tilde{A}^{a}_{rt,T}$ value), together with a 95% confidence interval. To facilitate interpretation, the figure contains a second vertical axis that maps the $\tilde{A}^{a}_{rt,T}$-axis into percentiles of the overall match distribution. This secondary (right-hand) axis shows for each match value on the primary axis the percentage of the existing 1994 employment that is matched at least as weakly to its region. For instance, $\tilde{A} = -0.10$ means that the corresponding agent type on average creates employment in local industries in the 23rd match-percentile, placing it in the bottom 23% of all existing Swedish employment.

Agent types that *generate* employment are depicted by a green, upward-pointing arrow, those that *destroy* employment by a red, down-ward pointing arrow. The markers' sizes vary with the total employment that agents represent. Positive values of $\tilde{A}$ indicate that an agent type is generally found in industries that match the region more strongly than the (employment-weighted) average local industry. Negative values of $\tilde{A}$ correspond to industries with below-average match values.

FIGURE 6 AGENTS 1 YR

Figure 6 shows that different agents change their regions in different ways. For instance, incumbent establishments tend to reinforce current specializations. If they grow, they do so predominantly in above-averagely matched local industries. If they shrink or close down, they tend to reduce employment in below-averagely matched local industries. Moreover, incumbents that switch industries tend to move

[13] Incumbents are defined as establishments that exist in the base year, 1994. However, to increase the sample of agents that set up new establishments, we take all new establishments between 1994 and 2000. Next, we record the structural change induced one year after they were founded. That is, for new establishments, we pool $\tilde{A}^{a}_{r94,95}$, $\tilde{A}^{a}_{r95,96}$, $\tilde{A}^{a}_{r96,97}$, $\tilde{A}^{a}_{r97,98}$, $\tilde{A}^{a}_{r98,99,}$and $\tilde{A}^{a}_{r99,00.}$

to industries that fit the region better: on average, they abandon industries in the 40th and enter industries in the 47th match-percentile. In contrast, new establishments tend to diversify a region's resource base. Indeed, in support of Hypothesis 1 (incumbents induce less structural change than new establishments), almost all new-establishment types display below-average $\tilde{A}$-values. However, they do so to different extents.

New subsidiaries of existing firms occupy on average more strongly matched industries (42nd match-percentile), than those of entrepreneurs (29th match-percentile). This supports Hypothesis 3b over Hypothesis 3a: entrepreneurs induce more structural change than expanding firms.

Furthermore, establishments that come from outside the region induce much more structural change than those that originate from within the region. On average, local entrepreneurs create employment in the 32nd match-percentile, against the 22nd for non-local entrepreneurs, which is both statistically and economically significant. The difference between new subsidiaries of local (59th match-percentile) and non-local (33rd) firms is even larger. We conclude therefore that there is strong support for Hypothesis 2.

Interestingly, and contradicting hypothesis 1, the new subsidiaries of local firms are mostly found in industries that are closely related to the region's industry mix. Just like incumbent establishments, these subsidiaries reinforce the existing resource base. However, local firms' new subsidiaries can be regarded as incumbent growth that is accommodated in new facilities. In hindsight, it is therefore not surprising to find these establishments to behave much like growing incumbents.[14]

[14] These findings are related to those in Dumais *et al.* (2002) on changes in industries' spatial concentration. Consistent with our findings, these authors show that new establishments have a deagglomerating effect on industries. Furthermore, Dumais and colleagues find that exits lead to a strengthening of existing agglomeration patterns, which is similar to our finding that exits reinforce existing capability structures. However, whereas Dumais and co-authors find that the growth and decline patterns of incumbents weaken spatial concentration, we find these patterns to strengthen existing specializations.

Overall, we conclude that the new establishments of non-local entrepreneurs change a regional resource base the most, followed by those of non-local firms.

Long-term structural change

Structural change is typically associated with a much longer time horizon than the one year changes depicted in Figure 6. To induce long-lasting structural change, it is not enough for establishments in unrelated industries to get started. To change the region's resource base lastingly, these establishments need to survive and grow. Therefore, Figure 7 repeats the analyses of Figure 6, but now over a time period of 10 years. Again, the 1994 cumulative distribution of match values is provided on the right-hand vertical axis. Furthermore, the 1-year match values of Figure 6 have been retained as a reference.

FIGURE 7 AGENTS 10 YR

Differences between the 10-year and the 1-year structural change figures reflect differences in long-term survival and growth rates of establishments at different points in the match distribution. That is, the fact that almost all arrows move up when comparing the 10-year to the 1-year analyses means that establishments in local industries that are well-matched to the rest of regional economy grow faster and/or survive longer than other establishments, confirming existing studies that show that firms benefit from nearby related economic activity (Delgado *et al.*, 2010; Neffke *et al.*, 2012). Indeed, the fact that match values for out-switching and exiting incumbents shift up (*i.e.*, occur at higher match values) confirms that unrelated activities are abandoned through establishment closures and adjustments in industry orientation.

Apart from this general upward shift of the arrows, long-term structural-change patterns are similar to short-term ones. On a ten-year horizon, incumbents (weakly) reinforce a region's focus, whereas new employment in unrelated industries is mostly created by new establishments. Among these new establishments, entrepreneur-owned establishments' $\tilde{A}$-values also shift upward, implying that growth and/or survival for these establishments is concentrated in higher-matched industries. In

contrast, the new subsidiaries of existing firms either remain at the same match-value (local firms) or even move down (non-local firms). Apparently, unlike the new establishments of entrepreneurs, subsidiaries of non-local firms grow more and/or survive longer in low-match industries. As a result, although confidence intervals partially overlap, new subsidiaries of non-local firms end up in match values below those of non-local entrepreneurs. In the long run, non-local firms thus surpass entrepreneurs as the main agents of structural change.

Plant survival

To assess more carefully the differences in survival patterns alluded to above, we investigate for which agents the presence of related industries is associated with higher establishment survival rates. To do so, for each new establishment between 1995 and 2000, we create a dummy that is valued at one if it survives for at least 10 years and at zero otherwise. Next, we estimate linear probability models, i.e., we regress this dummy variable on a set of founding agent dummies and their interactions with the natural logarithm of related employment in the region.[15] We include entry-year, region and industry dummies to isolate the effect of the founder type. However, because we are interested in *how* survival rates differ by agent type, not necessarily in *why* they do so, we do not control for any other establishment characteristics, such as start-up size. Table 5 summarizes the results.

TABLE 5: SURVIVAL

The unconditional average survival rate for new establishments is 0.201. The model in Column (1) of Table 5 contains only a dummy for whether or not an establishment's founder comes from outside the region. The negative coefficient on this dummy shows that establishments of non-local founders have a 2.1 percentage-point lower survival rate than those of local founders. Column (2) adds interactions with the amount of related employment in the region. Plants that enter regions with a large amount of

[15] In these regression analyses, a coefficient for log-transformed employment figures is easier to interpret a coefficient for the match variable, which is normalized against industry and region size. Instead we rely on industry and region fixed effects to absorb any idiosyncrasies at the industry or regional level.

related employment tend to survive longer, especially if their founders are local.[16] The estimated coefficients suggest that doubling the related employment translates into a 1.2 percentage-point increase in survival rates for local establishments and a 0.9 percentage-point increase for non-local establishments.[17] When we split founders into entrepreneurs and existing firms (Columns (3) and (4)), even larger differences emerge. Whereas firm-owned subsidiaries generally have higher survival rates than entrepreneur-owned establishments, only the entrepreneur-owned establishments seem sensitive to the amount of related employment in the region. Column (5) further subdivides establishments by their geographical origin. Regardless of whether an establishment was founded by local or non-local entrepreneurs, survival rates of entrepreneur-owned establishments are always lower than those of firm subsidiaries. However, whereas local roots are associated with higher survival rates among entrepreneurs (the omitted category consists of local entrepreneurs), the opposite holds for firm-owned subsidiaries: here, non-local origins are associated with *higher* survival rates. Furthermore, Column (6) again suggests that related employment in the region only matters for entrepreneur-owned, not for firm-owned establishments.[18]

These findings are consistent with the theoretical framework of section 2. Firstly, the finding depicted in Column (4) – that only entrepreneur-owned establishments display significantly higher survival rates in regions with related employment – is in line with the notion that entrepreneurs depend more strongly on local resources than subsidiaries of larger firms. Secondly, the hypothesis that entrepreneurs cannot draw on a parent firm to compensate for outsiders' lack of access to local resources explains why, in Column (5), we find higher failure rates for non-local entrepreneurs but not for non-local firms. However, such a causal interpretation is hazardous, because the decision to enter a

[16] A t-test reveals that this difference is statistically significant at a p-value of 0.026.
[17] The effect size of raising related employment by a factor ξ is calculated as: $\text{point estimate} \times \ln(\xi)$.
[18] Although the effect of $\ln(\text{rel. emp.})$ differs between local and non-local entrepreneurs, this difference is not statistically significant (*i.e.*, the difference of the interaction with $\ln(\text{rel. emp.})$ is statistically insignificant).

region is endogenous, even conditional on industry and region fixed effects. For instance, the fact that firm-owned subsidiaries seem unaffected by the local amount of related employment could alternatively mean that they are more careful when choosing a location. In that case, the absence of an association with higher survival rates is due to the fact that firms make fewer mistakes (or take less risk) when deciding where to locate, not because they draw fewer benefits from the local environment.

Aggregate structural change

So far, we have determined the main agents of regional structural change in terms of the intensity, not the amount of structural change they induce. However, some agent types are more prevalent than others. For instance, entrepreneurs set up far more establishments than existing firms do: the new establishments of local entrepreneurs outnumber those of non-local entrepreneurs 5-to-1 and those of non-local firms 20-to-1. Therefore, although the intensity with which they shift a region's resource base is lower, as a group, local entrepreneurs may still constitute an important factor in this shift. To determine the structural change that agents produce at the group level, we look at the employment new establishments create on a ten-year horizon in the bottom 5^{th} and bottom 10^{th} match percentiles. This employment is least related to the rest of the local economy and therefore represents most radical structural change. Non-local firms contribute about 23% of all new-establishment employment, and they account for 27% (24%) of this employment in the bottom 5^{th} (10^{th}) percentile. More strikingly, although non-local entrepreneurs create just 9% of overall new-establishment employment, they produce 29% (23%) of new-establishment employment at the bottom of the match distribution. Taken together, new establishments with non-local origins create 56% (47%) in these bottom percentiles, even though they represent just a third of all new-establishment employment, once more showing the importance of non-local agents in the process of regional structural change.

Spatial diffusion through the mobility of firms and entrepreneurs

The finding that non-local agents renew the resource base of a region suggests that non-local agents are important in the diffusion of industries and the resources they require. We explore this further by

comparing the average resource match of non-local agents to their home and host regions. If these agents indeed help economic activities and the resources they use to diffuse, the activities of these agents should be highly matched to their home region's resource base. Table 6 shows that this is indeed the case: for entrepreneurs and even more so for firms from outside the region, the resource match to their home regions is much higher than to their host regions. This implies that the mobility of firms and entrepreneurs is an important vehicle for the diffusion of resources across regions.

TABLE 6 DIFFUSION

5. Conclusion

5.1 Summary

There are many parallels between the RBVs depiction of firm growth and the way in which regional economies develop. In firms as well as in regions, growth does not only involve enlarging the scale but also the scope of production. Moreover, for both firms and regions, this expansion of scope is predominantly achieved through related diversification. These parallels suggest that regions can be conceptualized as being endowed with resource bases. However, unlike firms, which can exclude others from using their resources, access to regional resources is less restricted. Economic agents differ in their reliance on and access to these regional resources. Subsidiaries can substitute their parents' resources for regional resources whereas entrepreneurial ventures cannot, and local firms and entrepreneurs are often better positioned to access local resources than their counterparts from outside the region. As a consequence, different agents will use (and therewith change) the resource base of a region to different extents. In this paper, we therefore conducted a number of analyses that were inspired by the notion of a regional resource base. The resulting findings can be summarized as follows:

1) structural change unfolds slowly and such that regions maintain the coherence of their industry mix;

2) existing establishments tend to deepen a region's resource base by destroying employment in unrelated industries and creating employment in related ones, whereas most new establishments create employment in unrelated industries, thereby shifting the region's resource base;

3) entrepreneur-owned establishments induce more structural change in the short run than in the long run, whereas the reverse holds for new subsidiaries of existing firms;

4) consistent with finding 3), whereas entrepreneur-owned establishments tend to survive longer in regions with more related employment, no such association is found for firm-owned subsidiaries;

5) moreover, being local is associated with higher survival rates for entrepreneurs, whereas the opposite holds for firm-owned subsidiaries;

6) non-local agents induce significantly more structural change than agents from within the region;

7) and non-local agents diffuse activities from their home regions, in which these activities are typically much better matched to local resources in their home region, as compared to local resources in their new host regions.

These findings do not depend on the use of skill relatedness to measure related employment, as these findings are replicated using alternative relatedness indices based on the industry classification system and on input-output linkages in Appendix D.

5.2 Discussion

We have differentiated the industries mix a region currently hosts from the resources that allow these industries to thrive. This distinction is in itself important for local policy-making, but also for firms and entrepreneurs who need to choose suitable locations for their activities. Indeed, our finding that, although the industry mixes of regions fluctuate strongly, their resource bases change much more slowly, highlights that the current constellation of industries in a region is just *one* manifestation of how the local resources can be put to work. This suggests understanding a region's strength and weaknesses at the deeper level of its resources, shifting the focus from the industries that *are* present in the region

to those that *could* be present. Moreover, the indices we proposed can be used to quantify these strengths and weaknesses in terms of industries' resource match to regional economies.

Our application of this framework to identify the agents of structural change in a region provides important lessons for regional renewal, a topic that ranks highly on the agenda of local policy makers. In the American context, cities like Detroit and Pittsburg are prime examples of urban economies that at some point ran into the limits of their economic specializations in car manufacturing and steel making respectively. In Europe, regional renewal and transformation are important goals of the European Union's (EU) smart specialization agenda.[19] Such policy frameworks typically place high expectations on entrepreneurs to discover new activities that are feasible in a region (Hausmann and Rodrik, 2003; Foray and Goenaga, 2013; McCann and Ortega-Argilés, 2013). However, our results question the canonical image of the heroic Schumpeterean entrepreneur as the prime transformative force in local economies. Although entrepreneurs do bring change to a region, they often fail to do so sustainably. Indeed, a more important factor in structural change than Silicon Valley-style homegrown entrepreneurship seems to be mobility: unrelated activities are typically transferred from elsewhere by entrepreneurs and firms from outside the region.

Although entrepreneurs who play a key role in shaking up the regional status quo undoubtedly exist, we find them to be rather exceptional. Indeed, entrepreneurial ventures much more often fail in the absence of related economic activities than new subsidiaries of existing firms. We attributed this to the fact that, whereas subsidiaries have direct, intra-firm links tying them to relevant resources in their region of origin, non-local entrepreneurs must rely on much weaker, social ties to their home region. Indeed, this reasoning is supported by the finding in Frost (2001) that foreign subsidiaries draw

[19] In a recent policy report for the European Commission, Foray and Goenaga (2013, p. 1) argue that "[smart specialization] seeks robust and transparent means for nominating those new activities, at regional level, that aim at exploring and discovering new technological and market opportunities and at opening thereby new domains for constructing regional competitive advantages."

substantially on their home country's knowledge base. Moreover, subsidiaries can tap the resource pool of their parents, which helps them to overcome the liability of newness that activities face in regions with few related activities. For entrepreneurs, our findings suggest that, absent the ties to a parent firm's resources, it is hard to take activities to places where they are badly matched to the existing local economy. For policy makers, they mean that transformation policies that rely wholly on local entrepreneurial discovery processes are not without risks.

5.3 Caveats

There are a number of caveats in to be considered. First, we only investigate the sources of structural change, not whether structural change is desirable or not. Most probably, leveraging existing resources will be attractive in the short run but, in the long run, regions will have to adapt to new economic realities. However, long-run structural change can be accomplished through a series of small steps, in a process of related diversification that gradually moves the region away from its traditional resource base. The optimal balance of related and unrelated diversification – and hence, the optimal speed of structural change – is an important topic, but left for future research.

Second, by focusing on the new establishments that enter an economy, we have mostly highlighted the diversification aspect of structural change. However, although our analyses show that incumbent exit and decline typically take place in unrelated industries, there are well-known examples in which the core industries of a region collapse (e.g., Grabher, 1993). In these cases, structural change occurs because of the loss of a core industry and a concurrent erosion of local resources.

Third, our analyses answer the question of who introduces unrelated economic activities in a region. In essence, this question is descriptive, not causal. We therefore remain agnostic about whether the reported differences among agent types reflect different intrinsic capacities for structural change or, for instance, differences in location choices. Similarly, in the survival analyses, we cannot distinguish

spatial sorting of establishments from agglomeration externalities, an issue that has attracted considerable attention in urban economics (e.g., Combes *et al.*, 2008).

5.4 Future research

Finally, our study raises a number of new questions. Firstly, the finding that new subsidiaries of existing firms are better able to grow and survive in unrelated environments than stand-alone establishments begs the question of why this is the case. Our proposal – that firm-owned establishments draw on their parent firms' resources – remains to be proven, and related questions arise of how and across what distance multi-establishment firms can accomplish this. Secondly, the fact that firms switch industry affiliations from low-match to high-match industries suggests that firm strategies interact with regionally available resources in ways that are still poorly understood. We hope that the framework we developed here will prove useful in approaching these and other questions on how regional economies and their resource bases co-evolve with the firms they host.

REFERENCES

Alcácer J, Chung W. 2007. Location strategies and knowledge spillovers. *Management Science* **54**(5): 760-776.

Alcácer J, Chung W. 2013. Location strategies for agglomeration economies. *Management Science*.

Almeida P, Kogut B (1999) Localization of knowledge and the mobility of engineers. *Management Science* **45**(7): 905–917

Andersson J, Arvidson G. 2006. Företagens och arbetsställenas dynamik (FAD). Memo, Statistics Sweden.

Barney J. 1991. Firm resources and sustained competitive advantage. *Journal of Management* **17**: 99–120.

Bathelt H, Malmberg A, Maskell P. 2004. Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation. *Progress in Human Geography* **28**: 31-56.

Boschma RA. 2004. Competitiveness of regions from an evolutionary perspective, *Regional Studies* 38(9): 1001-1014.

Boschma R, Frenken K. 2011. Technological relatedness and regional branching, in: H. Bathelt, M.P. Feldman and D.F. Kogler (eds.), *Beyond Territory. Dynamic Geographies of Knowledge Creation, Diffusion and Innovation*, Routledge, London and New York, pp. 64-81.

Boschma RA, Minondo A, Navarro M. 2013. The Emergence of New Industries at the Regional Level in Spain: A Proximity Approach Based on Product Relatedness. *Economic Geography* **89**(1): 29-51.

Bryce DJ, Winter SG. 2009. A general inter-industry relatedness index. *Management Science* **55**: 1570-1585.

Combes P-Ph, Duranton D, Gobillon L. 2008. Spatial wage disparities: Sorting matters! *Journal of Urban Economics* 63(2): 723-742.

Cooke P.H., Morgan K. (1998). *The Associational Economy. Firms, Regions, and Innovation*. Oxford: Oxford University Press.

Cramer JS, Hartog J, Jonker N, Van Praag CM. 2002. Low risk aversion encourages the choice for entrepreneurship: an empirical test of a truism. *Journal of Economic Behavior & Organization* **48**(1): 29–36.

Dahl MS, Sorenson O. 2012. Home sweet home: Entrepreneurs' location choices and the performance of their ventures, *Management Science* **58**(6): 1059–1071.

Dauth, W. 2010. The mysteries of the trade: employment effects of urban interindustry spillovers. *IAB Discussion Paper* 15/2010: 1-25.

Delgado M, Porter ME, Stern S. 2010. Clusters and entrepreneurship. *Journal of Economic Geography* 10(4): 495-518.

Delgado M, Porter ME, Stern S. 2013. Defining clusters of related industries, HBS working paper.

Dumais G, Ellison G, Glaeser EL. 2002. Geographic concentration as a dynamic process. *Review of Economics and Statistics*, **84**(2): 193-204.

Duranton G, Puga D. 2004. Micro-foundation of urban agglomeration economies, in Henderson J, Thisse JF. (Eds) *Handbook of Urban and Regional Economics*, vol 4, pp. 2065-2118. Elsevier, Amsterdam.

Eisenhardt KM, Martin JA. 2000. Dynamic capabilities: What are they? *Strategic Management Journal* **21**: 1105–1121.

Ellison G, Glaeser EL, Kerr WR. 2010. What Causes Industry Agglomeration? Evidence from Coagglomeration Patterns. *American Economic Review*, 100(3): 1195–1213.

Essletzbichler J. 2013. Relatedness, Industrial Branching and Technological Cohesion in US Metropolitan Areas. *Regional Studies*, 10.1080/00343404.2013.806793

Faggian A. McCann Ph. (2006). Human capital flows and regional knowledge assets: a simultaneous equation approach. *Oxford Economic Papers* 52: 475–500.

Farjoun M. 1994. Beyond industry boundaries: Human expertise, diversification and resource-related industry groups. *Organization Science* **5**(2): 185–199.

Florida R, Mellander C, Stolarick K. 2012. Geographies of scope: an empirical analysis of entertainment, 1970–2000. *Journal of Economic Geography,* **12**(1): 183-204.
Foray D, Goenaga X. 2013. The goals of smart specialisation, *JRC Scientific and Policy Report*, S3 Policy Brief Series No. 01/2013.
Frenken K, Boschma RA. 2007. A theoretical framework for economic geography: industrial dynamics and urban growth as a branching process. *Journal of Economic Geography* 7 (5), pp. 635-649.
Frost TS. 2001. The geographic sources of foreign subsidiaries' innovations, *Strategic Management Journal* **22**(2): 101-123.
Gertler, M.S. 2003. Tacit knowledge and the economic geography of context, or the undefinable tacitness of being (there), *Journal of Economic Geography*, 3: 75-99.
Ghemawat P. 1986. Sustainable advantage, *Harvard Business Review*, **64**(5): 53–58.
Giuliani E. 2007. The selective nature of knowledge networks in clusters: evidence from the wine industry, *Journal of Economic Geography* **7**: 139-168.
Glaeser EL. 2005. Reinventing Boston: 1630–2003, *Journal of Economic Geography* **5**(2): 119-153.
Glaeser EL, Kerr WR. 2009. Local Industrial Conditions and Entrepreneurship: How Much of the Spatial Distribution Can We Explain? *Journal of Economics & Management Strategy* **18**(3): 623-663.
Glaeser, E.L., Kallal, H.D., Scheinkman, J.A., Schleifer A. (1992) Growth in Cities, *Journal of Political Economy*, 100 (6): 1126-1152.
Glaeser EL, Kerr WR, Ponzetto GAM. 2010. Clusters of entrepreneurship, *Journal of Urban Economics* **67**(1):150–168.
Grabher G. (1993) The weakness of strong ties: the lock-in of regional development in the Ruhr area, in Grabher G. (ed.) *The Embedded Firm*. London: Routledge.
Grant RM. 1996. Toward a knowledge-based theory of the firm. *Strategic Management Journal* **17**: 109–122.
Grant RM, Spender JC. 1996. Knowledge and the firm: overview. *Strategic Management Journal* **17**: 5–9.
Hausmann R, Rodrik D. 2003. *Journal of Development Economics* **72**(2): 603-633.
Helfat CE, Peteraf MA. 2003. The dynamic resource-based view: capability lifecycles, *Strategic Management Journal*, **24**(10): 997–1010.
Henderson, J.V., Kuncoro, A., Turner, M. (1995) Industrial development in cities, *Journal of Political Economy*, 103:1067-1085.
Henderson R, Cockburn I. 1994. Measuring Competence? Exploring Firm Effects in Pharmaceutical Research, *Strategic Management Journal* **15**: 63–84.
Hidalgo CA, Klinger B, Barabási A-L, Hausmann R. 2007. The Product Space Conditions the Development of Nations. *Science* **317**: 482-487.
Jacobs J. 1969. *The Economy of Cities*. New York: Vintage Books.
Lawson C. 1999. Towards a competence theory of the region, *Cambridge Journal of Economics* **23**(2): 151-166.
Lawson C, Lorenz E. 1999. Collective learning, tacit knowledge and regional innovative capacity, *Regional Studies* **33**: 305-317.
Maskell P. 2005. Towards a Knowledge-Based Theory of the Geographical Cluster. In: Breschi S, Malerba F (Eds.). Clusters, *Networks, and Innovation*. Oxford: Oxford University Press. Chapter 15: 411-432.
Maskell P, Malmberg A. 1999. Localised learning and industrial competitiveness, *Cambridge Journal of Economics* **23**(2): 167-185.
McCann Ph, Ortega-Argilés R. 2013. Smart specialization, regional growth and applications to European Union cohesion policy, *Regional Studies*, in press.
McCann Ph, Simonen J. 2005. Innovation, knowledge spillovers and local labour markets. *Papers in Regional Science* 84(3): 465-485.

Montgomery CA, Wernerfelt B. 1988. Diversification, Ricardian Rents, and Tobin's q, *RAND Journal of Economics* **19**(4): 623-632.

Muneepeerakul R, Lobo J, Shutters ST, Goméz-Liévano A, Qubbaj MR. 2013. Urban Economies and Occupation Space: Can They Get "There" from "Here"? *PLoS ONE* **8**(9): e73676.

Neffke FMH, Henning M. 2013. Skill relatedness and firm diversification. *Strategic Management Journal*. **34**(3): 297-316.

Neffke FMH, Henning M, Boschma RA. 2012. The impact of aging and technological relatedness on agglomeration externalities: a survival analysis. *Journal of Economic Geography* **12**(2): 485-517.

Neffke FMH, Henning M, Boschma RA. 2011. How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. *Economic Geography* **87**: 237-265.

Neffke FMH, Hidalgo C, Otto A, Weyh A. 2013. Inter-industry labor flows. mimeo.

Palich LE, Cardinal LB, Miller C. 2000. Curvilinearity in the diversification-performance linkage: An examination of over three decades of research. *Strategic Management Journal* **21**: 155–174.

Pendall R, Foster KA, Cowell M. 2010. Resilience and regions: building understanding of the metaphor, *Cambridge Journal of Regions, Economy and Society*: 3, 71–84

Penrose ET. 1959. *The Theory of the Growth of the Firm*. Blackwell: Oxford, UK.

Peteraf MA. 1993. The cornerstones of competitive advantage: A resource-based view. *Strategic Management Journal* **14**: 179–191.

Porter ME. 1987. From competitive advantage to corporate strategy. *Harvard Business Review* **65**(3): 43–59.

Porter ME. 1990. *The Competitive Advantage of Nations.* Macmillan, London.

Porter, M.E. (1998). Clusters and the new economics of competition. *Harvard Business Review* 76 (November-December): 77-90.

Porter M. 2003. The Economic Performance of Regions. *Regional Studies* 37(6-7): 549–578.

Pouder R, St. John CH. 1996. Hot Spots and Blind Spots: Geographical Clusters of Firms and Innovation, Academy of Management Review 21(4): 1192-1225.

Rosenthal SS, Strange WC. 2004. Evidence on the Nature and Sources of Agglomeration Economies. In: *Handbook of Urban and Regional Economics* (4). Henderson J., Thisse J.-F. (eds.). Amsterdam: Elsevier.

SCB. 2011. *Longitudinell integrationsdatabas för sjukförsäkrings- och arbetsmarknadsstudier (LISA) 1990-2009. Arbetsmarknads- och utbildningsstatistik 2011:4*. Statistiska centralbyrån/Statistics Sweden.

Schumpeter JA. 1934. *The theory of economic development*. Cambridge: Harvard University Press.

Sorenson O, Audia PG. 2000. The social structure of entrepreneurial activity: Geographic concentration of footwear production in the United States, 1940–1989, *American Journal of Sociology* **106**(2): 424-462.

Storper M. 1995. The resurgence of regional economies, ten years later: The region as a nexus of untraded interdependencies, *European Urban and Regional Studies* **2**: 191-221.

Storper M, Venables T. 2004. Buzz: face-to-face contact and the urban economy *Journal of Economic Geography*, 4 (4). 351-370.

Teece DJ. 1982. Towards an economic theory of the multiproduct firm. *Journal of Economic Behavior and Organization* **3**: 39–63.

Teece DJ, Pisano G, Shuen A. 1997. Dynamic capabilities and strategic management. *Strategic Management Journal* **18**: 509–533.

Teece DJ, Rumelt R, Dosi G, Winter S. 1994. Understanding corporate coherence. Theory and evidence. *Journal of Economic Behavior and Organization* **23**: 1-30.

Tushman ML, Anderson Ph. 1986. Technological discontinuities and organizational environments, *Administrative Science Quarterly* **31**(3): 439-465.

Wernerfelt B. 1984. A resource-based view of the firm. *Strategic Management Journal* **5**: 171–180.

Zhao H, Seibert SE. 2006. The Big Five personality dimensions and entrepreneurial status: A meta-analytical review. *Journal of Applied Psychology*, 91(2): 259-271.

Tables and figures

Table 1: Diversity, industrial change, coherence and structural change

	Static	**Dynamic**
Industries	***Diversity***	***Industrial change***
	Measured by: entropy	**Measured by:** cosine distance
	Underlying question: How many different industries are there and how equal is their size distribution?	**Underlying question:** How fast are new industries introduced and how much does the size distribution of activities change?
Resources	***Coherence***	***Structural change***
	Measured by: see Table 2	**Measured by:** see Table 2
	Underlying question: How similar are the resources required by the various industries in the region? That is, how related are the industries in a region to one another?	**Underlying question:** To what extent does the resources base change due to changes in the region's industries? That is, how related are current industries to the industry mix in the base year?

Table 2: Definitions and relationships among quantities

quantity	unit of analysis	Definition	description	normalization	range
labor low	industry-industry	F_{ij}	How many people change jobs from industry i to j?		[0, ∞)
skill relatedness	industry-industry	$SR_{ij} = \frac{F_{ij}}{F_{i.}F_{.j}}F_{..}$	How related are two industries to one another?		[0, ∞)
employment	industry-region	E_{irt}	How many workers does industry i employ in region r in year t?		[0, ∞)
related employment	industry-region	$E_{irt}^{rel} = \sum_j E_{jrt} I(SR_{ij} > 1)$	How much related employment to industry i exists in region r in year t?		[0, ∞)
resource match	industry-region	$LQ_{irt}^{rel} = \frac{E_{irt}^{rel}/E_{rt}}{E_{i.t}^{rel}/E_{..t}}$	How overrepresented are related industries in the region?	$\widetilde{LQ}_{irt}^{rel} = \frac{LQ_{irt}^{rel}-1}{LQ_{irt}^{rel}+1}$	[0, ∞) norm.: [-1,1)
coherence	region	$C_{rt} = \sum_i \frac{E_{irt}}{E_{.rt}} \widetilde{LQ}_{irt}^{rel}$	How related are a region's industries on average to the regional economy as a whole?		
coherence baseline	region	$C_{rt}^{base} = \sum_i \frac{E_{i.t}}{E_{..t}} \widetilde{LQ}_{irt}^{rel}$	How related are the industries in the national economy to the regional economy?		[-1,1)
structural change	region	$S_{rt,T} = \sum_i \frac{E_{irt}}{E_{.rt}} \widetilde{LQ}_{irT}^{rel}$	How related are a region's current activities to the region's industry mix of year T?		[-1,1)
structural change by agent type	agent-region	$A_{rt,T}^{a} = \sum_i \frac{\Delta E_{irt,T}^{a}}{\Delta E_{.rt,T}^{a}} \widetilde{LQ}_{irT}^{rel}$	How related are the industries in which a given agent type creates or destroys employment to the region's industry mix of year T??	$\tilde{A}_{rt,T}^{a} = A_{rt,T}^{a} - C_{rT}$	[-1,1) norm.: (-2,2)

Table 3: Agent types

Agent type	Description	ΔE	Effect on resource base if match is below average	Effect on resource base if match is above average
incumbent establishments	*existing establishments that* ...			
growing	expand their workforce	+	diversify	specialize
shrinking	reduce their workforce	-	specialize	diversify
closing	close down	-	specialize	diversify
industry switchers	*existing establishments that* ...			
into the industry	switch into the industry	+	diversify	specialize
out of the industry	switch out of the industry	-	specialize	diversify
New establishments	*new establishments set up by* ...			
local expanding firms	pre-existing firm with main employment concentration inside the region	+	diversify	specialize
non-local expanding firms	pre-existing firm with main employment concentration in another region	+	diversify	specialize
local entrepreneurs	new firm created by entrepreneur from inside the region	+	diversify	specialize
non-local entrepreneurs	new firm created by entrepreneur from outside the region	+	diversify	specialize

Column ΔE indicates whether the employment change associated with a given agent type is positive or negative. The final two columns indicate which effect this employment change has on the regional resource base if the change takes place in industries that are less (column 4) or more (column 5) strongly matched to the region than the average existing local industry in the region (*i.e.*, if the match is below or over the region's coherence).

Table 4: Agent types: employment, number of establishments and new local industries

Agent type	# establishments			employment		% creating new local industries
	entry yr	after 1 yr	after 10 yrs	after 1 yr	after 10 yrs	
Growth, decline and exit						
Incumbent growth		17,507	9,933	75,851	122,359	
Incumbent decline		12,494	8,031	46,577	77,776	
Incumbent exit		10,420	45,268	29,794	270,030	
Industry switching						
Entered industry		1,708	3,643	32,629	107,652	
Exited industry		1,708	3,643	30,812	93,492	
New establishments						
All expanding firms	2,249	1,809	666	38,419	21,449	4.09%
All entrepreneurs	51,806	35,307	10,206	63,166	37,992	2.38%
Local expanding firms	557	435	152	13,263	7,562	1.97%
Non-local expanding firms	1,692	1,374	514	25,156	13,887	4.79%
Local entrepreneurs	42,993	29,617	8,644	53,741	32,798	2.01%
Non-local entrepreneurs	8,813	5,690	1,562	9,425	5,194	4.20%

Table 5: Establishments' 10-year survival rates

Dep. var.: ≥10 yr survival (0/1)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Non-local agent	-0.021***	0.02				
	(0.004)	(0.018)				
Firm agent			0.073***	0.209***		
			(0.009)	(0.047)		
Local firm					0.041**	0.148
					(0.016)	(0.094)
Non-local firm					0.074***	0.191***
					(0.01)	(0.056)
Non-local entrepreneur					-0.037***	-0.009
					(0.004)	(0.019)
Local X ln(rel. emp.)		0.017***				
		(0.005)				
Non-local X ln(rel. emp.)		0.013***				
		(0.005)				
Firm X ln(rel. emp.)				0.004		
				(0.007)		
Entrepreneur X ln(rel. emp.)				0.017***		
				(0.005)		
Local Firm X ln(rel. emp.)						0.006
						(0.01)
Non-local firm X ln(rel. emp.)						0.004
						(0.007)
Local entrepr. X ln(rel. emp.)						0.017***
						(0.005)
Non-local entrepr. X ln(rel. emp.)						0.014***
						(0.005)
Constant	0.157***	-0.053	0.153***	-0.057	0.156***	-0.042
	(0.005)	(0.057)	(0.005)	(0.057)	(0.005)	(0.057)
Entry-year FEs	yes	yes	yes	yes	yes	yes
Industry FEs	yes	yes	yes	yes	yes	yes
Region FEs	yes	yes	yes	yes	yes	yes
Number of observations	54,055	54,055	54,055	54,055	54,055	54,055
R^2	0.0254	0.0257	0.0265	0.0270	0.0280	0.0284

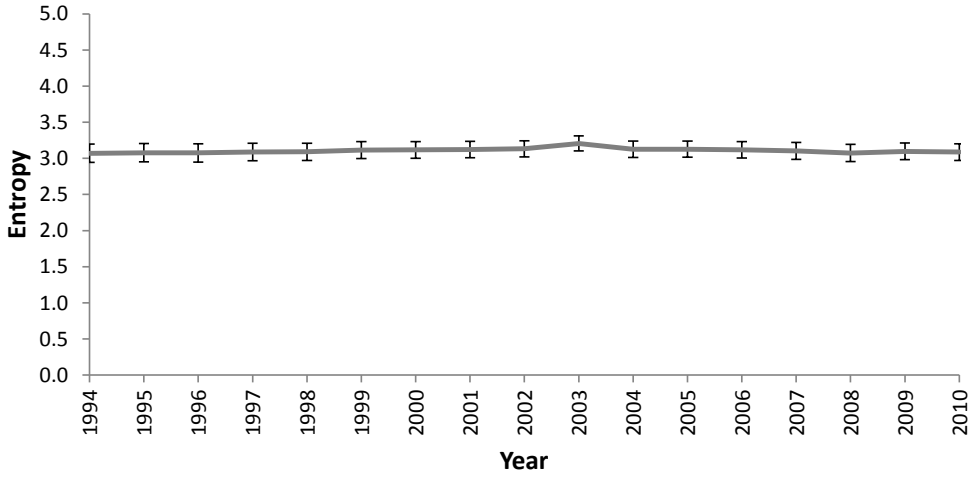
The reported outcomes are of linear probability models of 10-year survival rates for new establishments that enter the Swedish economy in traded, private sector, non-resource based industries between 1994 and 2000. Robust standard errors are shown in parenthesis below the point estimates. Stars indicate significance levels: ***: p<.01, **: p<.05, *: p<.10. The unconditional average 10-year survival rate for the establishments in the sample is 0.201.

Table 6: Average resource match of non-local agents to home and host region

Agent type	Resource match to:		p-value
	home region	host region	
Non-local expanding firms	0.072	-0.019	0.000
	(0.004)	(0.004)	
Non-local entrepreneurs	0.001	-0.019	0.000
	(0.002)	(0.002)	

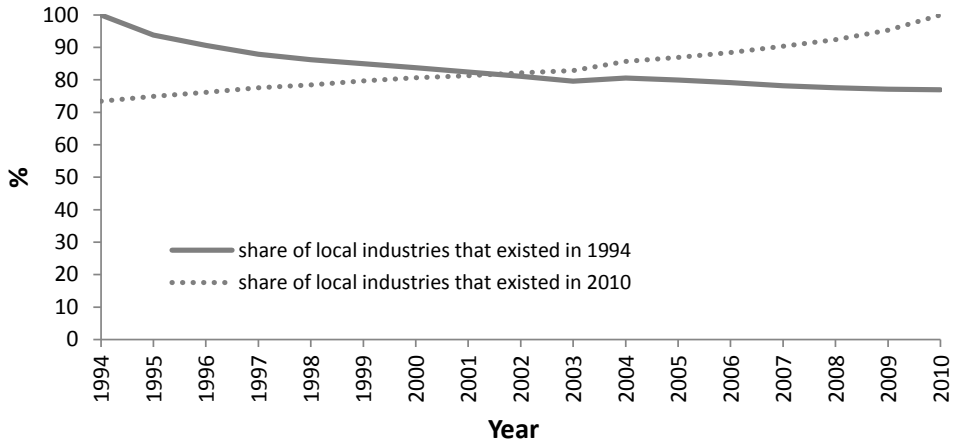
Average resource match of a non-local agent to home and host region (standard error in parentheses). The home region is defined as the region in which the new establishment's parent firm employed most of its workers (non-local firms) or as the region in which the new establishment's entrepreneur was employed in the year prior to opening up the new establishment (non-local entrepreneurs). p-value refers to a test of equal means for the agent's resource match to the home versus to the host region.

Figure 1: Average entropy of the employment composition of labor market regions



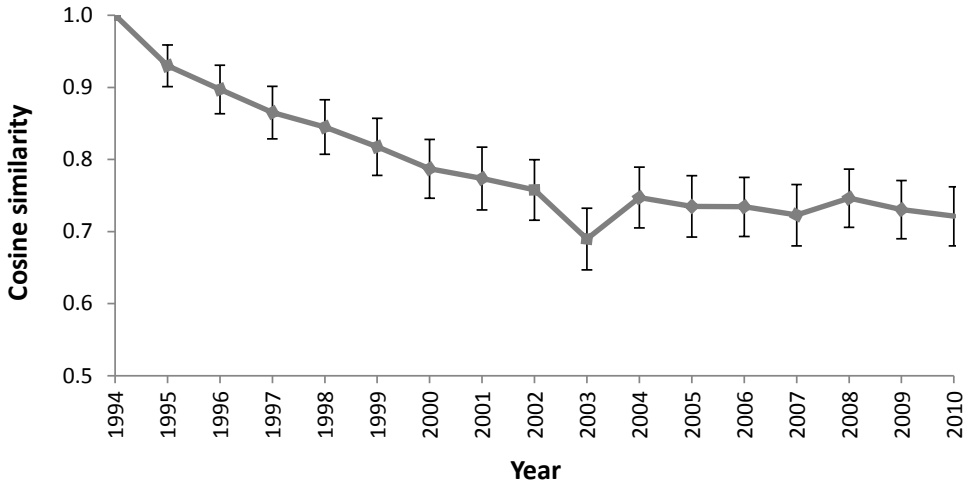
The figure graphs the development of the average employment entropy of Swedish regions over time. Employment entropy is a measure of how diversified a local economy is and is calculated as $entropy_{rt} = -\sum_{i=1}^{N} \frac{E_{irt}}{E_{.rt}} \ln \frac{E_{irt}}{E_{.r}}$, where E_{irt} denotes the employment in industry i, region r and year t, and $E_{.rt}$=$\sum_i E_{irt}$. It varies from zero when all employment is concentrated in a single industry, to $\ln N$ when all local industries have equal employment shares. The error bars depict a 95% confidence interval calculated as ±1.96 times the standard deviation of the entropy's mean across regions.

Figure 2: Turnover of local industries



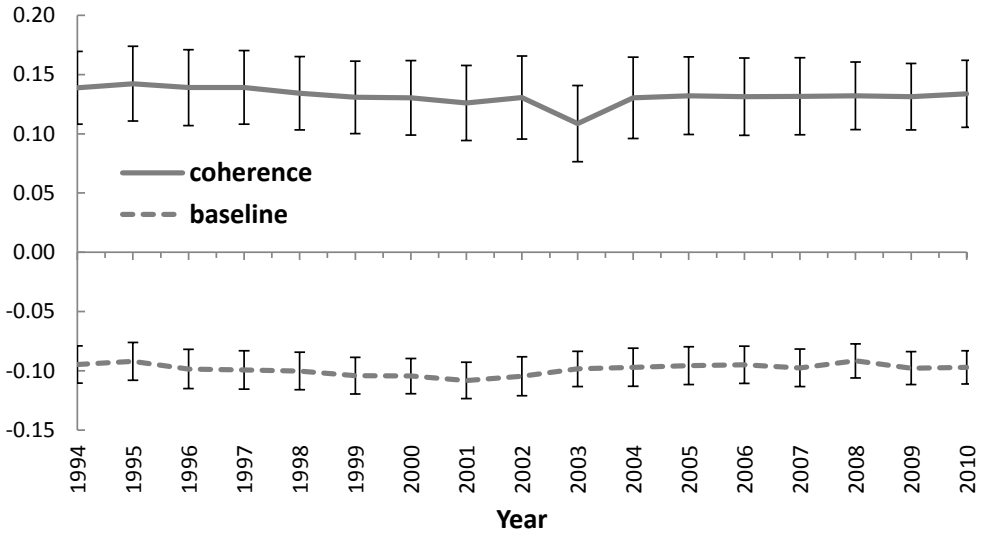
The solid blue line depicts the share of local industries (region-industry combinations) existing (*i.e.*, with non-zero employment) in Sweden in 1994, that survived to at least year 1994 + t. The dotted red line depicts the share of local industries existing in 2010 that had existed already in year 2010 - t.

Figure 3: Average cosine similarity to the base year 1994 of regional employment profiles



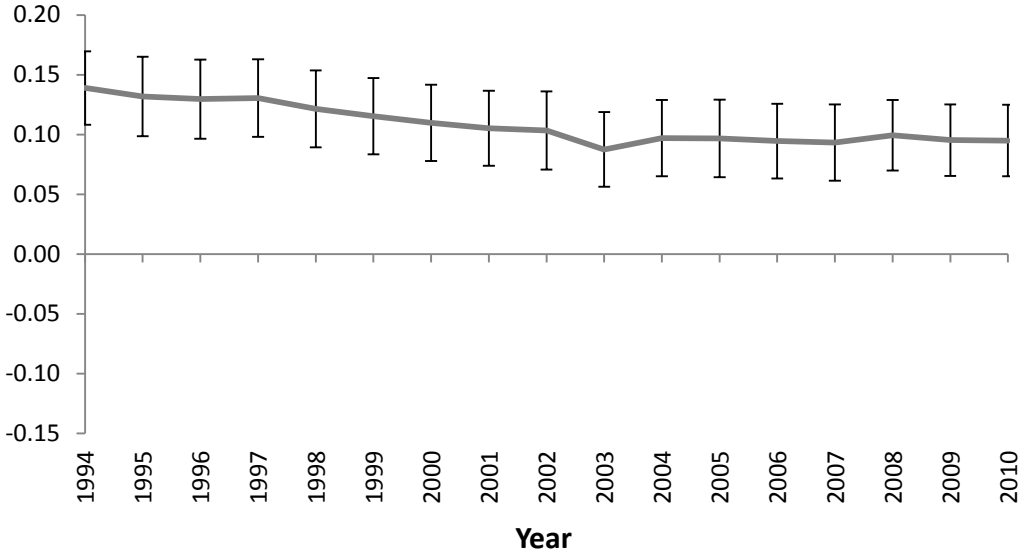
The graph depicts the development of the average cosine similarity between a region's current industrial employment mix and the industrial employment mix of the base year 1994. The cosine similarity measures the similarity of two vectors, in this case, the region's employment profile at two different points in time: $cos\_sim_{rt,T} = \frac{e_{rt} \cdot e_{rT}}{\sqrt{|e_{rt}||e_{rT}|}}$, where $e_{rt} = (E_{1rt} \dots E_{Nrt})'$ a vector whose elements correspond to region r's employment in industry i in year t. The cosine distance ranges from -1 (opposite profiles) through 0 (unrelated profiles) to +1 (same profile). The error bars depict a 95% confidence interval calculated as ±1.96 times the standard deviation of the mean of the cosine similarity across regions.

Figure 4: Coherence of labor market regions' resource bases



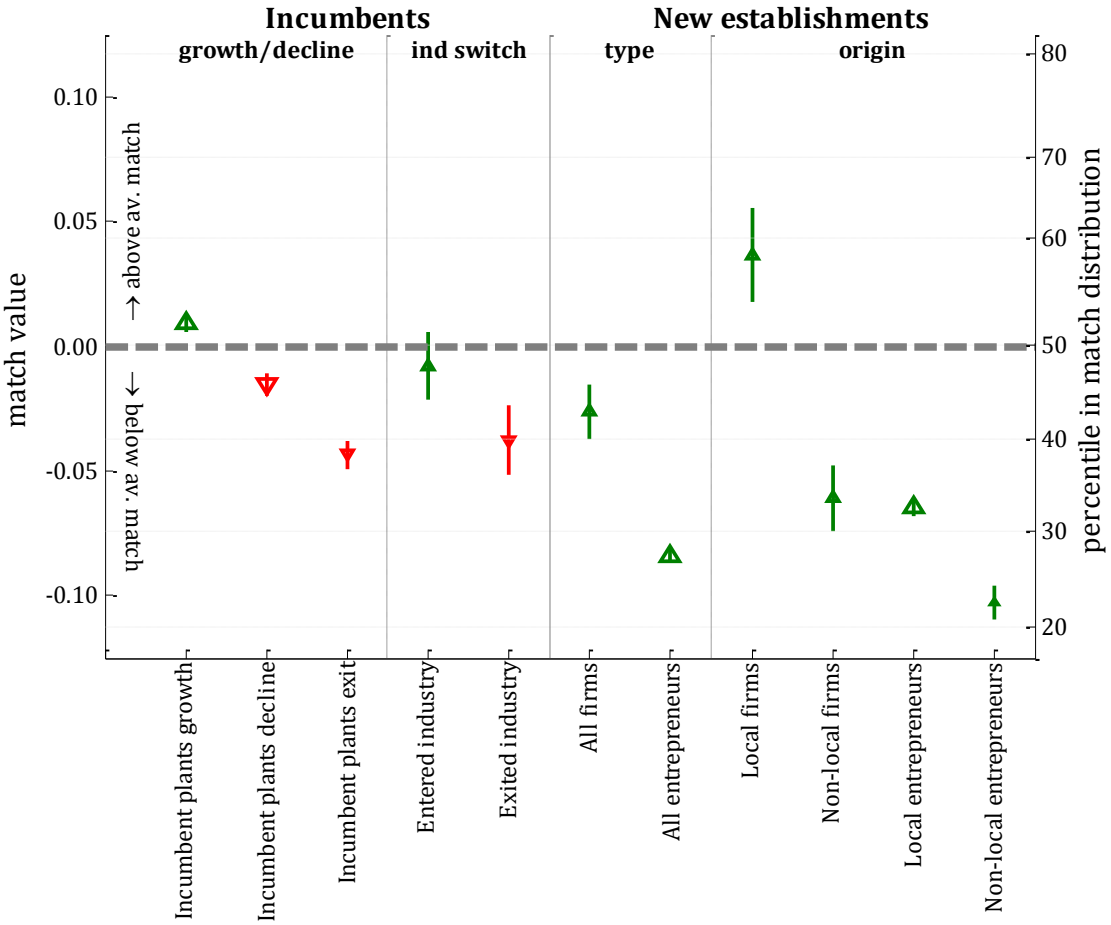
The upper line depicts the development of the average coherence of a regions' resource base. It is measured by its local industries' employment-weighted average resource match to the regional economy as a whole ($C_{rt} = \sum_i \frac{E_{irt}}{E_{.rt}} \widetilde{LQ}_{irt}^{rel}$). As a baseline, the lower line depicts the development of the average resource match of Sweden's aggregate, national industries to the region's resource base ($C_{rt}^{base} = \sum_i \frac{E_{i.t}}{E_{..t}} \widetilde{LQ}_{irt}^{rel}$). The error bars depict a 95% confidence interval calculated as ±1.96 times standard deviation of the mean across regions.

Figure 5: Structural change in Sweden's labor market regions



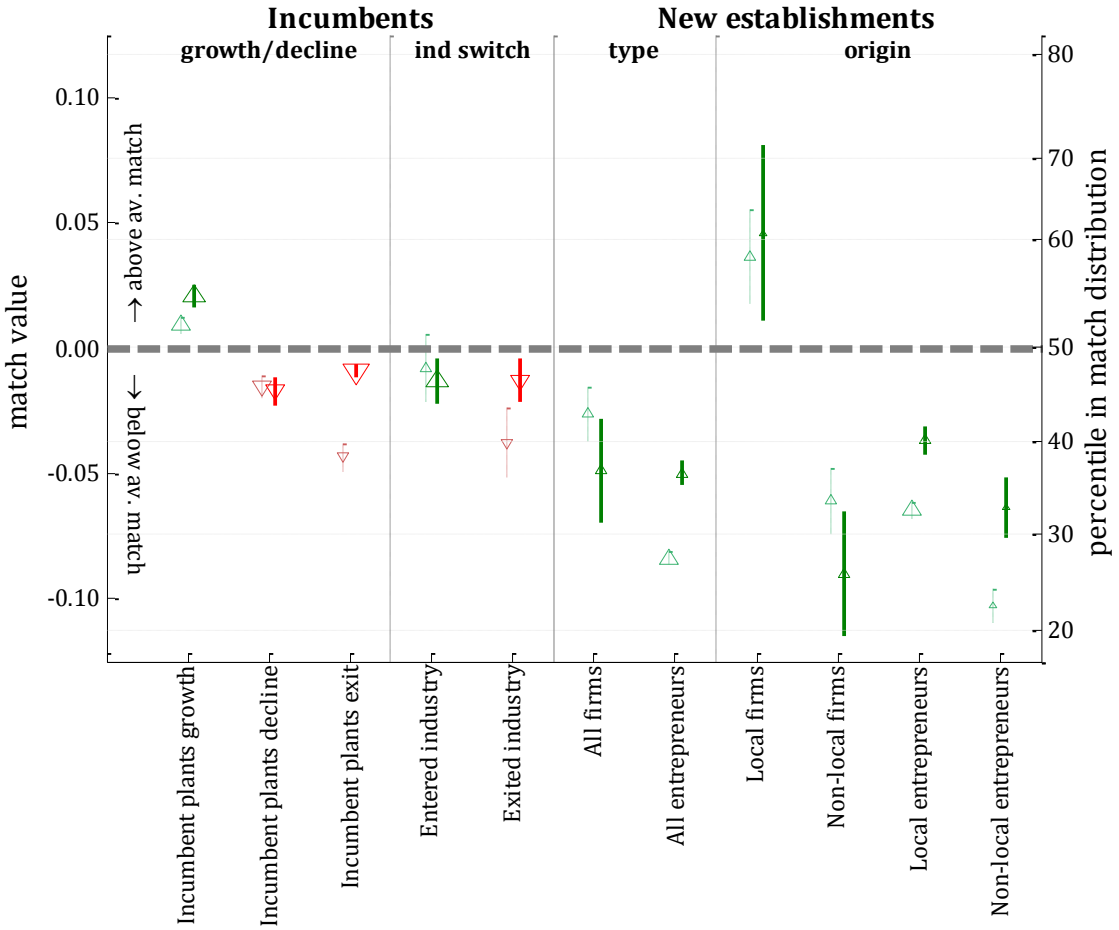
The graph depicts the development of the average resource match of a regions' local industries to the local economy of the base year 1994 ($S_{rt,1994} = \sum_i \frac{E_{irt}}{E_{.rt}} \widetilde{LQ}_{ir1994}^{rel}$), including 95% error bars. In the presence of structural change, $S_{rt,1994}$ should fall (diversification) or rise (increasing of existing focus) over time. The error bars depict a 95% confidence interval calculated as ±1.96 times the standard deviation of the mean structural change across regions

Figure 6: Structural change by agent type over a 1-year horizon



The markers shows for each agent type the employment weighted average resource match of the local industries in which the agent type creates or destroys employment within one year after being founded, averaged across all establishments of the agent minus the region's coherence. That is, the graph shows by how much an agent's average resource match exceeds the region's coherence. As a consequence, employment created (destroyed) at $\tilde{A} > 0$ corresponds to a diversification (further focusing) of the regional resource base. Employment-creating agents are denoted with a green, upward pointing arrow, employment-destroying agents with a red downward-pointing arrow. The error bars depict a 95% confidence interval, based on the standard deviation of the mean resource match across all establishments of a given agent type. To facilitate interpretation of $\tilde{A}$-values, the right most vertical axis provides the corresponding percentiles of a resource match value in the overall distribution of the 1994 economy.

Figure 7: Structural change by agent type over a 10-year horizon



The markers shows for each agent type the employment weighted average resource match of the local industries in which the agent type creates or destroys employment within ten years after being founded, averaged across all establishments of the agent minus the region's coherence. That is, the graph shows by how much an agent's average resource match exceeds the region's coherence. As a consequence, employment created (destroyed) at $\tilde{A} > 0$ corresponds to a diversification (further focusing) of the regional resource base. Employment-creating agents are denoted with a green, upward pointing arrow, employment-destroying agents with a red downward-pointing arrow. The error bars depict a 95% confidence interval, based on the standard deviation of the mean resource match across all establishments of a given agent type. To facilitate interpretation of $\tilde{A}$-values, the right most vertical axis provides the corresponding percentiles of a resource match value in the overall distribution of the 1994 economy. The one-year figures reported in Figure 6 are provided as a reference with lighter markers and dotted confidence intervals.

Appendix A: Classification of industries

Table A1: Industries included in the analyses

Industry codes	Description	Definition industry	Included
0000 - 1499	Agriculture, hunting and forestry + Fishing + Mining and quarrying	Traded, resource-based	no
1500 - 3999	Manufacturing	Traded, not resource-based	yes
4000 - 4999	Electricity, gas and water supply + Construction	Non-traded	no
5000 - 5199	Wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods	Non-traded	no
5200 - 5299	Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods	Non-traded	no
5500 - 5599	Hotels and restaurants	Non-traded	no
6000 - 6420	Transport, storage and communication	Non-traded	no
6500 - 6999	Financial intermediation, except insurance and pension funding	Traded, not resource-based	yes
7000 - 7199	Real estate + Renting activities	Non-traded	no
7200 - 7399	Computer and related activities + Research and development	Traded, not resource-based	yes
7400 - 7499	Other business activities	Traded, not resource-based	yes
7500 - 7599	Public administration and defense, compulsory social security	public sector	no
7600 - 8599	Education, Health and social work	public sector	no
8600 - 9999	Other community, social and personal service activities + Activities of households + Extra-territorial organizations and bodies	public sector	no

Appendix B: Measuring skill relatedness

Our data refer to all individuals between the age of 18 and 65. We measure skill relatedness among industries by assessing the labor flows between industry pairs. In the period 1994 to 2010, about 4.5 million workers in Sweden switched jobs among different 4-digit industries. To avoid problems with missing industries, we keep only those industries that have nonzero employment in each year. First, we use equation (1) to calculate skill relatedness for every year between 1994 and 2010. Letting years be indexed by t and summation over omitted categories indicated by '.' this yields:

$$SR_{ijt} = \frac{F_{ijt}}{(F_{.jt}F_{i.t})/F_{..t}} \quad \text{(B1)}$$

Because this measure is highly asymmetric, we use the same transformation as in equation (4) to map it SR_{ijt}onto the interval [-1, 1):

$$\widetilde{SR}_{ijt} = \frac{SR_{ijt}-1}{SR_{ijt}+1} \quad \text{(B2)}$$

Hence, industry i is skill related to industry j if $\widetilde{SR}_{ijt} > 0$. Then, for every industry pair, we average $\widetilde{SR}_{ijt}$ over all yearly flows between 1994 and 2010:

$$M\widetilde{SR}_{ij} = \frac{1}{16}\sum_{t=1994}^{2009}\widetilde{SR}_{ijt} \quad \text{(B3)}$$

Finally, we symmetrize the measure so that $S\widetilde{SR}_{ij}$= $S\widetilde{SR}_{ji}$:

$$S\widetilde{SR}_{ij} = \frac{M\widetilde{SR}_{ij}+M\widetilde{SR}_{ji}}{2} \quad \text{(B4)}$$

The actual condition for two industries to be skill related that we evaluate in the indicator function in equation (2) is therefore $S\widetilde{SR}_{ij} > 0$.

Appendix C: Determining the founders and geographical origins of new establishments

To identify the origins of each establishment, we first determine whether a new establishment is an entrepreneurial entry or an entry by an existing firm. Every establishment has a unique establishment identifier and a firm identifier (see Andersson and Arvidsson, 2006), which enables us to follow establishments over time regardless of changes in ownership or legal status. Entrepreneurial entries are new establishments that create new firms (i.e., both the establishment and the firm identifiers did not exist before year t). New establishments of existing firms arise when the establishment identifier is new in year t but the establishment's firm identifier already existed in year $t - 1$.

Geographical origins of new establishments are determined as follows. For every new establishment of pre-existing firms, the origin is the region where the parent firm employed most of its workers in the year prior to the new establishment's creation. To identify the origins of entrepreneurial entries, we take a number of steps. Firstly, Statistics Sweden supplies information on workers who derive income from a private venture, which we use as an indicator of entrepreneurship. If there is only one entrepreneur in the new establishment, we take that person as the establishment's entrepreneur. The region where he or she was employed in the previous year is now used as the geographical origin of the new establishment. If a new establishment employs multiple entrepreneurs, and if all these entrepreneurs used to work in the same region, we take this region as the geographical origin. If no entrepreneur is found but the new establishment has only one employee, we assume this is the founder and we take the region in which that person worked in the previous year as geographical origin. If no entrepreneur is found and if the new establishment has multiple employees, and if all these entrepreneurs worked in the same region the year before, we take this region as the establishment's geographical origin. This way, we were able to trace the origins of 35,000 new establishments that did not belong to pre-existing firms. All other new establishments were dropped from the analyses.

Appendix D: Alternative relatedness measures

We repeated all analyses reported in the main text with two alternative relatedness indicators. The first is based on the industry classification system (*NACE-relatedness*). The second relatedness index is based on input-output relations among industries. Below we describe how each relatedness measure is constructed and then replicate Figures 4, 5 and 7 and Tables 5 and 6 based on the described index.

Industry-classification-based relatedness (NACE)

To measure NACE-relatedness, we classify the 4-digit industries in the European NACE classification as related when they belong to the same 2-digit sector. For instance, 'Manufacture of cast iron tubes' (industry code 2721) and 'Manufacture of steel tubes' (industry code 2722) are related because they belong to the same 2-digit sector 27 'Manufacture of basic metals'. The corresponding tables and graphs are shown below.

Table D1: Average resource match of non-local agents to home and host region (NACE-relatedness)

Agent type	**Resource match to:**		**p-value**
	home region	**host region**	
Non-local expanding firms	0.113	-0.089	0.000
	(0.007)	(0.007)	
Non-local entrepreneurs	-0.043	-0.081	0.000
	(0.003)	(0.003)	

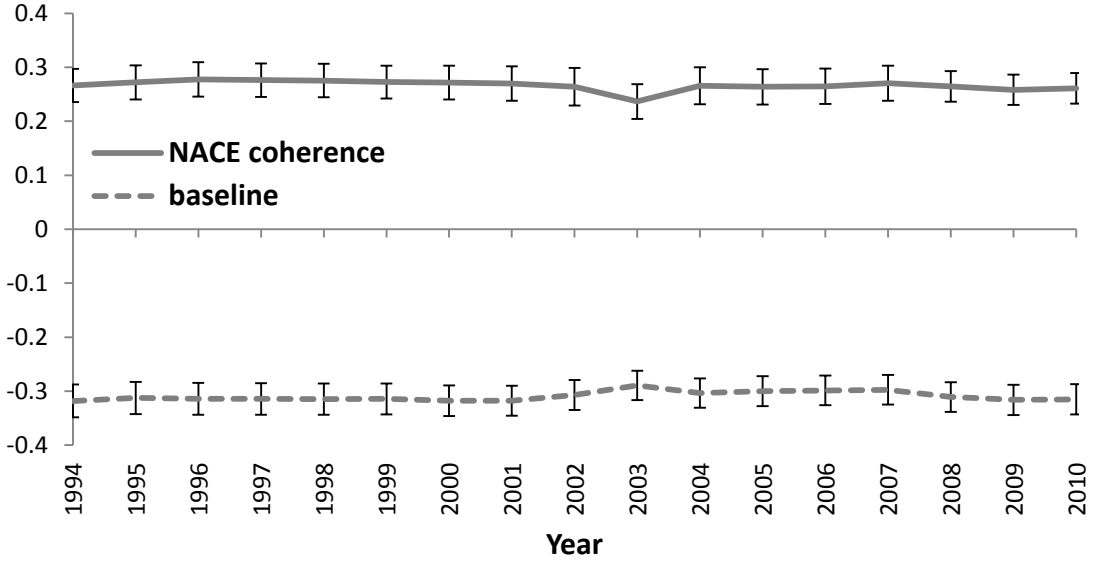
See Table 6

Table D2: Establishments' 10-year survival rates (NACE-relatedness)

Dep. var.: ≥10 yr survival (0/1)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Non-local agent	-0.021***	0.015				
	(0.004)	(0.013)				
Firm agent			0.073***	0.179***		
			(0.009)	(0.034)		
Local firm					0.041**	0.109
					(0.016)	(0.075)
Non-local firm					0.074***	0.170***
					(0.01)	(0.039)
Non-local entrepreneur					-0.037***	-0.016
					(0.004)	(0.013)
Local X ln(rel. emp.)		0.007***				
		(0.003)				
Non-local X ln(rel. emp.)		0.002				
		(0.003)				
Firm X ln(rel. emp.)				-0.007		
				(0.005)		
Entrepreneur X ln(rel. emp.)				0.007***		
				(0.003)		
Local Firm X ln(rel. emp.)						-0.002
						(0.009)
Non-local firm X ln(rel. emp.)						-0.006
						(0.005)
Local entrepr. X ln(rel. emp.)						0.006**
						(0.003)
Non-local entrepr. X ln(rel. emp.)						0.004
						(0.003)
Constant	0.157***	0.088***	0.153***	0.085***	0.156***	0.09***
	(0.005)	(0.027)	(0.005)	(0.027)	(0.005)	(0.027)
Entry-year Fes	yes	yes	yes	yes	yes	yes
Industry Fes	yes	yes	yes	yes	yes	yes
Region Fes	yes	yes	yes	yes	yes	yes
Number of observations	54,055	54,055	54,055	54,055	54,055	54,055
R^2	0.0254	0.0257	0.0265	0.0269	0.0280	0.0283

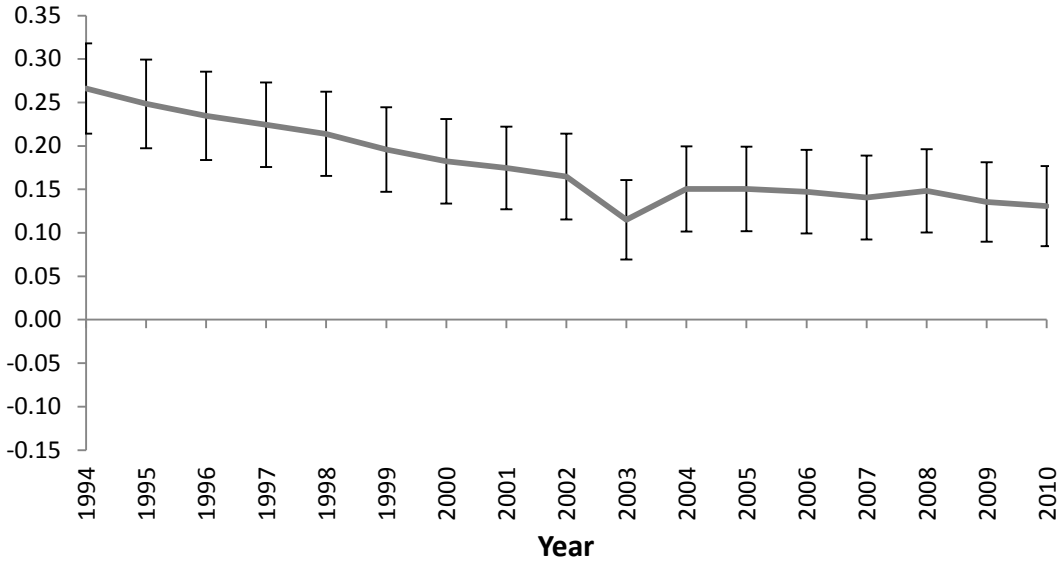
See Table 5.

Figure D1: Coherence of labor market regions' resource bases (NACE-relatedness)



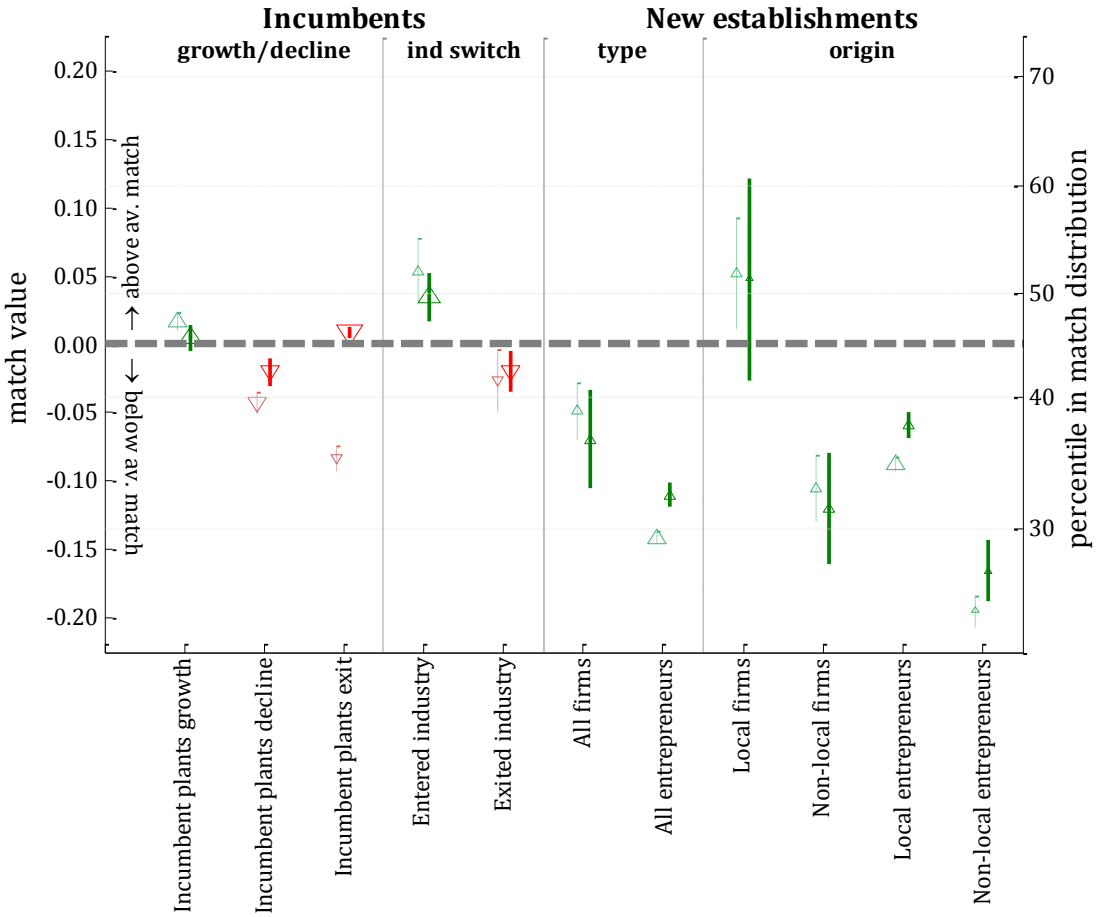
See Figure 4.

Figure D2: Structural change in Sweden's labor market regions (NACE-relatedness)



See Figure 5.

Figure D3: Structural change by agent type (NACE-relatedness)



See Figure 7.

Input-output relatedness

Input-output linkages are derived from the Swedish input-output table of 1995, which is available from Statistics Sweden. For every pair of industries, (i, j), we calculate the share of industry i's inputs that are sourced from industry j and the share of industry i's output that is consumed by industry j. We then average both numbers to arrive at a measure of input-output relatedness between the two industries. If CF_{ij} represents the value of the commodity flow of industry i to industry j, then the input-output relatedness between industries i and j, IOR_{ij}, is given by:

$$IOR_{ij} = \frac{1}{2}\left(\frac{CF_{ij}}{\sum_k CF_{ik}} + \frac{CF_{ji}}{\sum_l CF_{li}}\right) \quad \text{(D1)}$$

Input-output data are only available at the 2-digit level. Because we use industries at the 4-digit level, we assume that the input-output linkages that exist between two 2-digit sectors are representative of the linkages that exist among the 4-digit industries of which these sectors comprise. We choose the threshold value when two industries are related in such a way that the same number of industry-pairs are input-output related as skill related. Below, we present the outcomes when IOR is used as the relatedness measure:

Table D3: Average resource match of non-local agents to home and host region (input-output relatedness)

Agent type	Resource match to:		p-value
	home region	host region	
Non-local expanding firms	0.096	-0.075	0.000
	(0.007)	(0.007)	
Non-local entrepreneurs	-0.029	-0.058	0.000
	(0.003)	(0.003)	

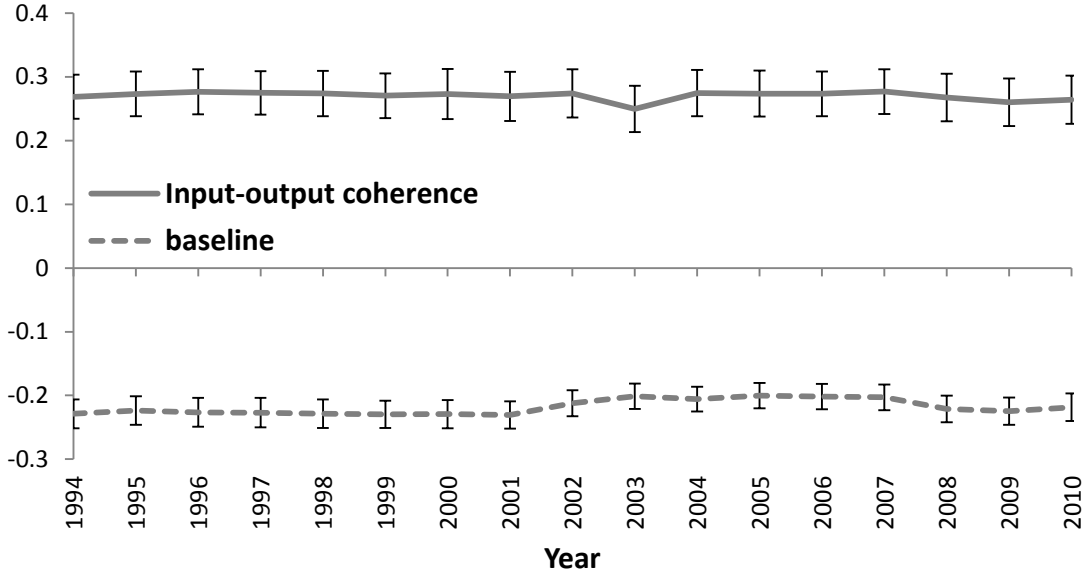
See Table 6.

Table D4: Establishments' 10-year survival rates (input-output relatedness)

Dep. var.: ≥10 yr survival (0/1)	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Non-local agent	-0.021***	-0.002				
	(0.004)	(0.012)				
Firm agent			0.073***	0.13***		
			(0.009)	(0.028)		
Local firm					0.041**	0.113*
					(0.016)	(0.061)
Non-local firm					0.074***	0.108***
					(0.01)	(0.032)
Non-local entrepreneur					-0.037***	-0.03**
					(0.004)	(0.012)
Local X ln(rel. emp.)		0.008***				
		(0.003)				
Non-local X ln(rel. emp.)		0.005*				
		(0.003)				
Firm X ln(rel. emp.)				0.001		
				(0.004)		
Entrepreneur X ln(rel. emp.)				0.008***		
				(0.003)		
Local Firm X ln(rel. emp.)						-0.001
						(0.007)
Non-local firm X ln(rel. emp.)						0.003
						(0.004)
Local entrepr. X ln(rel. emp.)						0.007***
						(0.003)
Non-local entrepr. X ln(rel. emp.)						0.006**
						(0.003)
Constant	0.157***	0.073**	0.153***	0.067**	0.156***	0.078**
	(0.005)	(0.031)	(0.005)	(0.03)	(0.005)	(0.031)
Entry-year Fes	yes	yes	yes	yes	yes	yes
Industry Fes	yes	yes	yes	yes	yes	yes
Region Fes	yes	yes	yes	yes	yes	yes
Number of observations	54,055	54,055	54,055	54,055	54,055	54,055
R^2	0.0254	0.0256	0.0265	0.0268	0.0280	0.0282

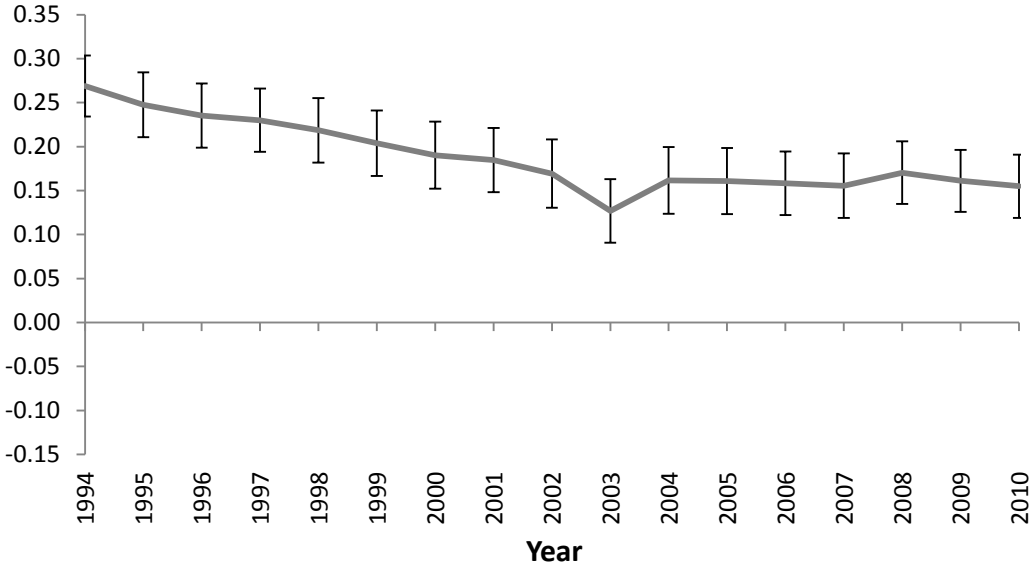
See Table 5.

Figure D4: Coherence of labor market regions' resource bases (input-output relatedness)



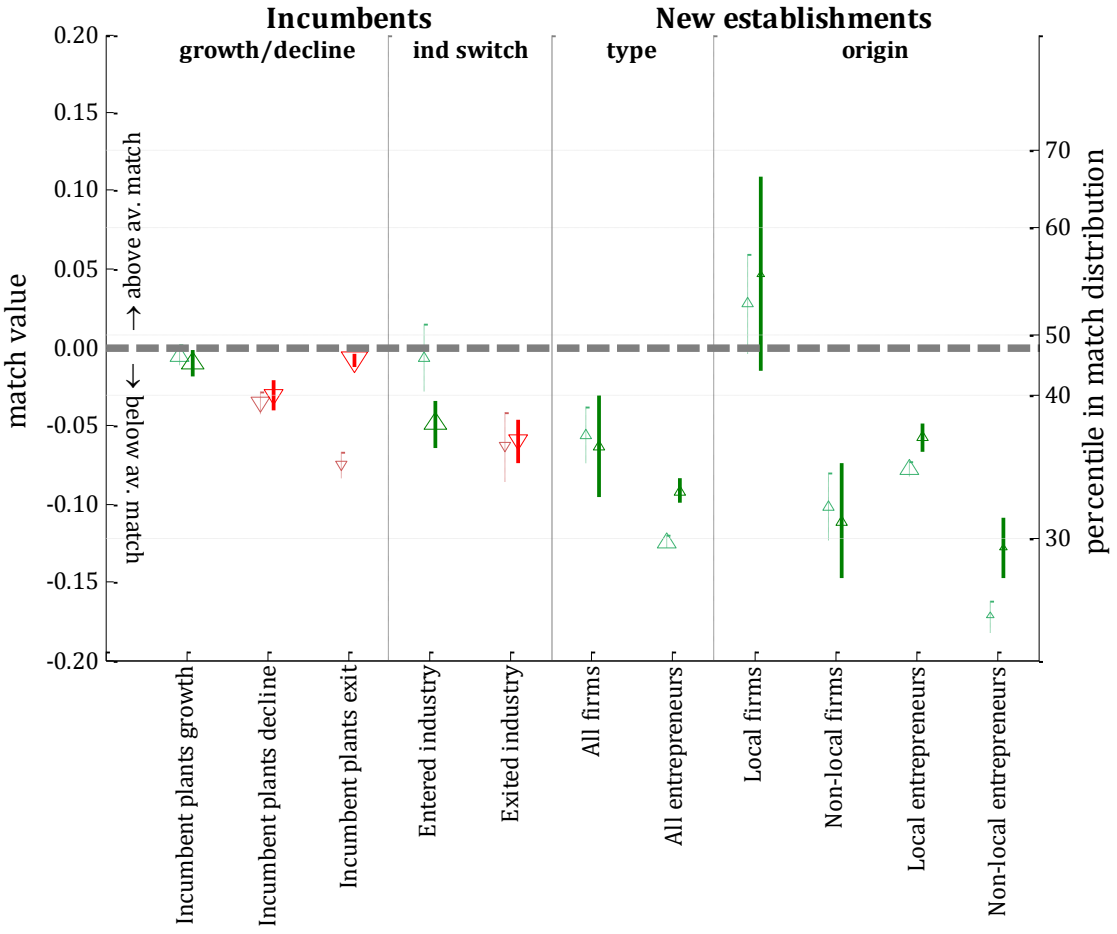
See Figure 4.

Figure D5, Structural change in Sweden's labor market regions (input-output relatedness)



See Figure 5.

Figure D6: Structural change by agent type (input-output relatedness)



See Figure 7.