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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 nonlocal establishment founders create most novelty in a region? We develop a theoretical framework that focuses on the roles different agents play in regional transformation. We then apply this framework, using Swedish matched employer–employee data, to determine how novel the activities of new establishments are to a region. Incumbents mainly reinforce a region's current specialization: incumbent's growth, decline, and industry switching further align them with the rest of the local economy. The unrelated diversification required for structural change mostly originates via new establishments, especially via those with nonlocal 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.

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Key words:
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entrepreneurship
diversification
relatedness
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capability base

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The underlying research materials (STATA code) for this article can be accessed at https://scholar.harvard.edu/mattehartog/do-files-agents-structural-change

Supplemental data can be accessed here.

> 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, 49)

Penrose (1959) famously argues that firms can only sustain growth if they expand, not just the scale of production but also its scope. What is true for firms holds at the aggregate level of the economies of cities (Jacobs 1969) as well: unless they diversify into new activities, cities will be unable to prosper in a changing competitive landscape. However, unlike a firm, a city and its surrounding region do not act for themselves, but, instead, ultimately depend on firms and entrepreneurs to introduce new activities.[1] At the same time, a region's *capability base*, that is, the capabilities that emerge from a region's resources and sustain its economic activities, will influence which type of activities local firms will develop. In this article, we study how such regional capability bases evolve, asking the following questions: Who induces the most salient structural change in a region? In particular, are entrepreneurs or existing firms the most important agents of change? Does novelty arise from local entrepreneurs and firms, or is it introduced by actors from outside the region?

To answer these questions, we, first, propose a theoretical framework that highlights the role of agency in regional diversification, a hitherto underdeveloped aspect in the emerging empirical literature on this topic (e.g., Hidalgo et al. 2007; Neffke, Henning, and Boschma 2011). This framework builds on the resource-based view of the region, which views regions as endowed with capability bases (Lawson 1999; Boschma 2004) to which only local firms have easy access and that grow with their use (Penrose 1959). Although largely compatible with classical notions of spillovers, agglomeration externalities, and clusters, this approach has two distinctive features. First, a resource-based

[1] That is not to say that only private-sector actors matter. The actions of local firms are typically influenced by institutional and political actors. However, given our focus on the private sector, any changes in private-sector composition will ultimately have to rely on actions by firms.

view's (RBV's) explicit acknowledgment that many strategic resources are inherently specific to economic activities shifts the focus from *how much* a region produces to *what* it produces. Second, although the RBV's emphasis on rents to firm-owned resources would seem to preclude its application to regions—which do not *own* resources—the notion of rents can help understand which agents will be most likely to change the local capability base. This adds a hitherto undertheorized aspect of agency to the aforementioned literature on regional related diversification.

Informed by this theoretical framework, we, second, develop a quantitative methodology to measure structural change. In this empirical methodology, we view structural change as going beyond mere industrial change, since it implies a transformation, not just of the local industry mix but also of the local capability base sustaining this mix. The key insight of the methodology is that structural change can be inferred from how *unrelated* new activities are to existing ones.

Third, we apply this quantitative framework to employer–employee linked data covering every worker in the Swedish economy between 1994 and 2010 to ask which types of economic agents induce most structural change in a region. We find that incumbent establishments reinforce a region's existing capability base, whereas new establishments tend to induce structural change. Moreover, although most short-run structural change can be ascribed to activities of start-ups (i.e., entrepreneur-owned establishments), these entrepreneurs find it hard to survive in industries unrelated to a region's core activities. As a consequence, in the longer run, new subsidiaries of existing firms increasingly assume the role of main agents of change.

Finally, we observe that, although nonlocal founders create only one-third of all new-establishment employment, they create 56 percent of such employment in industries that are most unrelated to the existing local economy. Hence, radical structural change depends predominantly on nonlocal firms and entrepreneurs.

Theory: A Resource-based View of the Region?

The RBV of the firm (Wernerfelt 1984; Barney 1991) conceptualizes firms as bundles of resources. The RBV identifies four characteristics of resources that are of particular interest to our theoretical framework. First, if resources are valuable, rare, inimitable, and nonsubstitutable (VRIN), they confer sustained competitive advantage to their owners (Barney 1991). Second, resources are often highly specific, because the productive services they yield (Penrose 1959) can be applied in only a limited number of activities. Third, as firms become better at exploiting the resources they use, more of these resources are left idle. This yields incentives to search for alternative applications for these resources (Montgomery and Wernerfelt 1988; 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, Pisano, and Shuen 1997).

Following Lawson (1999), we argue that the notion of a resource base at least partially carries over from firms to regions, since each of the four aforementioned resource characteristics has regional parallels like: (1) firm-internal resources, regional resources, such as infrastructure, knowledge institutions, and specialized labor markets, can exhibit VRIN characteristics; (2) such local resources are often specific to an economic activity; (3) some resources generate local capabilities that grow with use; and (4) because some capabilities inevitably become obsolete with changes in technologies and final demand, regions decline if their capability bases are not updated. The implication of observations (1) to (3) is that, like firm diversification, regional diversification is likely to be a path-dependent process, whereas

observation (4) suggests that, to avoid decline, regions must renew their capability bases just like firms have to reinvent themselves from time to time.

However, unlike firms, regions do not act themselves. Instead, their economies change as a result of the actions of the firms they host. At the same time, firms' development paths are conditioned by the opportunities and challenges created by the regional context. This notion that firms codevelop with their local economies is by no means new. So what do we gain from bringing resource-based thinking to the regional context? Below, we will argue that the RBV offers a way to theorize regional *diversification*, a topic current urban economic theories only address imperfectly. In fact, although the agglomeration literature differentiates between benefits of local specialization (MAR [Marshall–Arrow–Romer] externalities) and of local diversity (Jacobs externalities), absent additional assumptions, it typically remains agnostic about when and which new activities will arise in a region. Consequently, the topic of diversification plays a relatively minor role in economic geography and urban economics,[2] compared to strategic management.

Recently, however, these issues have attracted more attention. For instance, Frenken and Boschma (2007) and Boschma and Frenken (2011) argue that regions develop according to a branching process in which new activities spin out of existing activities. Empirical support for this conjecture is growing. At the national level, Hidalgo et al. (2007) show that countries diversify their export portfolios in accordance with such a branching logic, whereas Neffke, Henning, and Boschma (2011) show that similar processes are at work in Swedish regions, a finding that has been replicated in numerous studies (Boschma, Minondo, and Navarro 2013, ; Colombelli, Krafft, and Quatraro 2014; Essletzbichler 2015; Rigby 2015; Tanner 2016). Although these articles often implicitly acknowledge the importance of regional capabilities,[3] they typically do not provide a thorough theoretical framework for how local capabilities constrain firms' production choices.

Regional Capability Bases

We regard regional capabilities as derived from resources that can be exploited by multiple firms, but that can only be (readily) accessed from within the region. Typical examples are access to skilled local labor markets, specialized suppliers and local knowledge (Glaeser et al. 1992; Henderson, Kuncoro, and Turner 1995; Almeida and Kogut 1999; McCann and Simonen 2005; Faggian and McCann 2006), elements of Porter's (1990) diamond, *untraded interdependencies* (Storper 1995), *localized capabilities* (Maskell and Malmberg 1999), local knowledge bases, and institutions and networks (Cooke and Morgan 1998; Boschma 2004; Asheim and Gertler 2005).

Do regional capabilities help local firms compete in global markets? From a resource-based perspective, these resources would need to be valuable, rare, inimitable, and nonsubstitutable. Many of the regional resources described above fit this definition. First, that regional resources are often valuable and nonubiquitous is all but beyond dispute. Second, analogous to the inimitability requirement, regional resources are often highly localized, because they tend not to be tradable across places (Markusen 1996). However, regional resources are not necessarily nonsubstitutable, especially not

[2] The importance of related industries per se has not remained unnoticed as evidenced in cluster research (Porter 2003; Maskell 2005; Delgado, Porter, and Stern 2014) and urban economics (Dauth 2010; Ellison, Glaeser, and Kerr 2010).

[3] Boschma and Frenken (2011) refer to regional *knowledge bases*, Hidalgo and coauthors (2007) to *national capabilities*.

if establishments have access to firm-internal resources, a particularity to which we return later.

Apart from satisfying VRIN conditions, regional resources are often specific to the economic activities that use them. For instance, suppliers of car parts are of as little use to pharmaceutical firms as skilled actuaries are to operators of spas. However, just like firm-internal resources, regional resources are often somewhat fungible (Teece 1982). For example, although skilled mechanical engineers may not be useful to all economic activities, their services are valued in various manufacturing and business services.

Finally, firms are not just passive consumers of regional capabilities. Some firms actively try to foster or curb the emergence of local capabilities. For instance, some firms try to restrict local spillovers by enforcing noncompete clauses in labor contracts (Marx, Singh, and Fleming 2015). Another strategy, employed by some technologically advanced multinational enterprises (MNEs), is avoiding the vicinity of competitors altogether (Alcácer and Chung 2007). In contrast, as documented in the literature on untraded interdependencies and regional innovation systems (Cooke and Morgan 1998), other firms thrive in high-trust environments and purposefully participate in the creation of local capabilities. Consequently, the capability configurations that ultimately arise in a region will depend on a complex interplay of institutional and economic factors. That is, the capability base of a region emerges from but also constrains local economic activity.

Finally, in the same way that, with time, firms learn to extract more services from their resources, some capabilities that arise from regional resources grow as more firms start using them. The underlying cumulative causation processes, like the self-reinforcing agglomeration tendencies of skilled workers with firms that require their skills and of specialized suppliers with their customers, are well-documented in the agglomeration literature (Duranton and Puga 2004).

Taken together, these considerations suggest that regions grow for similar reasons that firms do: regions host resources, which yield capabilities that expand with their use, that are valuable, rare, specific to economic activities, and hard to access from outside the region. As a consequence, regions tend to grow through incremental, that is, related, diversification.

Industrial Change Versus Structural Change

Economic environments are not static, and changes in technologies and demand can render existing capabilities obsolete, eroding incumbent firms' competitive advantage (Tushman and Anderson 1986). This has raised interest in so-called dynamic capabilities, capabilities that not just help firms diversify into new products but also rearrange the underlying capability configurations (Henderson and Cockburn 1994; Teece, Pisano, and Shuen 1997; Eisenhardt and Martin 2000).

Such capability obsolescence also affects regions (Grabher 1993; Pouder and St. John 1996; Glaeser 2005). Once existing regional capabilities become insufficient for local firms to compete on global markets, the regional capability base must be renewed or lose its attraction. Just as *new resource configurations* (Eisenhardt and Martin 2000) go beyond changing a firm's product portfolio, a renewal of the regional capability base goes beyond a mere change in the region's industry mix. Therefore, we distinguish between regional diversification that merely changes the local industry composition, which we will call industrial change, and the unrelated regional diversification that requires a transformation of the local capability base. It is this latter type of diversification that we term structural change.

Reliance on, and Access to, Regional Capabilities

In spite of their commonalities, regional and firm capability bases differ in two important ways. First, regional capability bases do not develop by the volition of a central actor. Instead, a region depends on firms and entrepreneurs to introduce new productive capabilities and retire old ones. Other actors, like universities and governments, are important in facilitating this process. However, ultimately, it is firms that introduce new and abandon old industries. 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 *regional* resources, which, in principle, are available to all local firms. Therefore, although local firms may gain a competitive advantage over firms outside the region, a priori, firms in the same region should be at a "competitive parity" (Pouder and St. John 1996, 1203). Consequently, if firms can freely enter a region to access the regional capability base, the rents of a superior regional capability base do not necessarily accrue to local firms. Instead they may end up with the owners of local production factors with a relatively inelastic supply, such as labor or land.[4]

However, the assumption of competitive parity is unlikely to hold perfectly. In particular, economic agents differ in the extent to which they (1) can access regional resources and (2) have to rely on regional resources.

Access to regional resources depends on how well an agent is embedded in the local economy. That is, it depends on the economic, social, and trust relations with governments, institutions, and other firms in the region (Grabher 1993; Storper 1995; Cooke and Morgan 1998; Saxenian 2007). These relations typically need time to become established. For instance, preferred access to local suppliers often requires long-standing relationships (Ghemawat 1986), as does access to local knowledge networks (Giuliani and Bell 2005; Boschma and Ter Wal 2007; Giuliani 2007). Similarly, to tap into the capabilities that reside in the local labor force, firms often use their local social networks (Sorenson and Audia 2000), which take time to form. As a result, regional resources tend to become more available as firms grow deeper roots in a region (Pouder and St. John 1996; Storper and Venables 2004).

An agent's reliance on regional resources depends on the agent's access to alternative resources. For instance, establishments of larger firms can utilize a wide array of firm-internal resources, such as internal knowledge bases, supply chains, and labor markets. In other instances, establishments may access resources in other regions, relying for instance, on diaspora (Saxenian 2007) and social networks (Breschi and Lissoni 2005; Agrawal, Cockburn, and McHale 2006). In fact, successful MNEs derive some of their competitive strength from their capacity to integrate the regional resources in different locations through their networks of subsidiaries (Alcácer and Chung 2007; Iammarino and McCann 2013).

Agents of Structural Change

The more an economic agent can access, and relies on, regional capabilities, the more likely this agent is to create economic activities that are related to existing activities in terms of the capabilities they use. However, structural change requires that local economies develop activities that utilize *new* capabilities that, with time, become accessible to other

[4] 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).

local firms.[5] Consequently, an agent's access to, and reliance on, regional capabilities will affect its capacity (or willingness) to induce structural change in a region.

This insight allows us to formulate a number of hypotheses. To do so, we choose agents that, first of all, differ in their access to, and reliance on, regional capabilities. Because we focus on changes in a local economy's private sector, these agents should, second, directly impact the composition of private-sector employment. Third, for pragmatic reasons, we choose agents that can be unambiguously categorized in Sweden's administrative records. Given these considerations, we (1) distinguish a region's existing establishments from its new establishments, (2) differentiate between new establishments of existing firms (*subsidiaries*) and those that belong to entrepreneurs (*start-ups*), and (3) split new establishments into those whose founders have local versus nonlocal origins.

Our first hypothesis concerns existing establishments. Because of the long time such incumbents had to develop local ties, they will, on average, be better embedded in the local economy than firms that are new to the region. The greater access to the local capability base this embeddedness awards makes it less likely that incumbents will stray far from the current economic structure, suggesting the following hypothesis[6]:

> **H_1**: Incumbent establishments are less likely to induce structural change in the region than new establishments.

Our second hypothesis concerns new subsidiaries of existing firms. Unlike start-ups, subsidiaries can substitute parent-firm capabilities for regional capabilities. Consequently, subsidiaries can rely less on regional resources,[7] which allows them to more readily develop activities that require capabilities that are still absent from the region. If these capabilities diffuse within the region, the regional capability base expands. However, the consequent conjecture that subsidiaries induce more structural change than start-ups runs against a long history of thought going back to Schumpeter (1934), which has associated entrepreneurship with new combinations, innovation, and economic renewal. For instance, scholars have shown that entrepreneurs are typically more risk taking (Cramer et al. 2002) and creative (Zhao and Seibert 2006) than the average individual. Taking these considerations together, both (contradictory) hypotheses are justifiable:

> **H_{2a}**: New establishments of entrepreneurs are less likely to induce structural change in the region than new subsidiaries of existing firms.

> **H_{2b}**: New subsidiaries of existing firms are less likely to induce structural change in the region than new establishments of entrepreneurs.

Our third and fourth hypotheses both relate to the difference between local and nonlocal agents. Several scholars (e.g., Storper 1995; Pouder and St. John 1996; Lawson and Lorenz 1999; Gertler 2003; Boschma 2004) have argued that local firms often follow the same dominant logic or even get locked into local *groupthink* (Grabher 1993). This would imply that local agents are weak agents of structural change.

[5] For instance, if a firm hires workers with skills that had hitherto not been available in the region, after some time, these workers—or the co-workers they trained—may be poached by other local firms.

[6] Incumbents' reluctance to pursue major transformations is amplified by the organizational ecology literature's (Hannan and Freeman 1984) contention that incumbents are characterized by inertia due to entrenched routines (e.g., Nelson and Winter 1982).

[7] Henderson (2003) provides empirical support for this claim, showing that subsidiaries draw fewer externalities from the local environment than stand-alone establishments do.

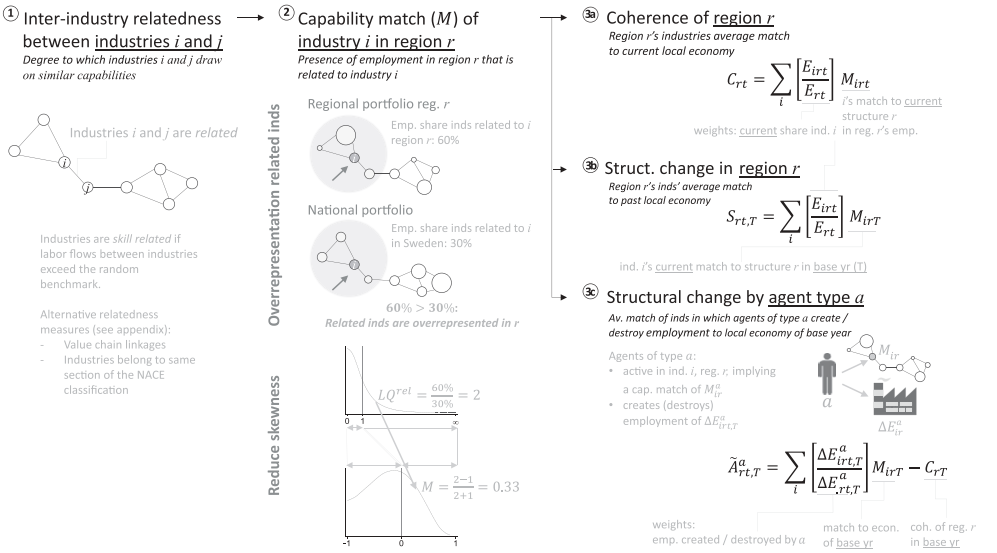

Figure 1. Diagrammatic overview measurement methodology.

However, following the argumentation laid out in the previous section, local and nonlocal agents also differ in the extent to which they can access regional capabilities. In particular, agents from outside the region may, at least temporarily, lack access to their new region's local capabilities. Moreover, the ties such agents have to the social and economic networks in their home regions may allow them to tap their home region's capability base and develop activities that would otherwise be hard to sustain in their new host region. All of these considerations make nonlocal agents less likely to perpetuate the existing capability base. Thus,

H$_3$: New establishments of *local* agents are less likely to induce structural change in the region than new establishments of *nonlocal* agents.

In fact, when nonlocal agents infuse their new region with ideas and skills from other regions, these agents transplant capabilities from their former home region and become a conduit of *capability diffusion*. To test this conjecture, we propose the following hypothesis:

H$_4$: Nonlocal agents help capabilities diffuse from home to host region by introducing activities that are relatively unrelated to their (new) host region's activities but strongly related to their (old) home region's activities.

Data

We test these hypotheses on data derived from the administrative records of Sweden for the years 1994 to 2010.[8] These records contain information on wages and private

[8] Access to these data was provided by Statistics Sweden (SCB). For a detailed documentation of these data, we refer to the SCB website (Statistics Sweden 2011).

business income for all individuals working in Sweden. Individuals are linked to establishments, which are linked to their parent firms. For establishments, we know their industry affiliations and in which of Sweden's 110 labor market areas they are located. We define industries at the four-digit level (which distinguishes over seven hundred different industries) of the European NACE classification.

An important assumption in this article is that local capabilities influence firms' location strategies. However, in some industries, location choice is severely restricted because of the need to be close to natural resources or to the large numbers of customers in urban agglomerations. Therefore, when defining a region's industry mix, we exclude nontraded services (e.g., retail stores and restaurants), government activities and natural resource–based activities (e.g., mining and agriculture).[9] This leaves us with 259 industries, which, on average, represent 29.8 percent of all private-sector employment in Sweden in the period of our study.

Measurement

When evaluating a region's diversification trajectory, it is important to explain what exactly we mean by diversification. First, diversification can be static (How diversified is a region?) or dynamic (By how much did the portfolio of local economic activities change?). Second, diversification can occur at the level of economic activities, or at the deeper level of capabilities. This yields four concepts (see Table 1) to be quantified. First, the static concept of *industrial diversity* can be measured by, for instance, counting how many different industries exist in a region or assessing how equally employment is distributed across industries. The latter can be assessed by, for instance, entropy or Herfindahl indices. Second, the dynamic notion of diversification as *industrial change* refers to shifts in a region's industrial composition, as captured in regional industry entry and exit rates, or, for instance, the cosine distance of a region's industrial employment vector at two different points in time. Moving from industries to capabilities, the static notion of diversification refers to a lack of *coherence* of economic activities in terms of shared capability requirements. Similarly, its dynamic counterpart, which we will call *structural change*, refers to the change in the capability requirements that arises with a change in economic activities (i.e., that underlies industrial change).

Quantifying capability-based notions of diversification is challenging, because we typically cannot comprehensively and reliably observe regions' capability bases, let alone changes therein. However, an important insight from the RBV is that a product mix can be regarded as an expression of the capabilities it requires. Consequently, a region's industry mix—which *is* readily observable—should reflect which capabilities are used in the local economy. Furthermore, despite the exact nature of these capabilities being unknown, by measuring the relatedness among industries, we can assess which industries require *similar* capabilities.[10] In reverse, by assessing how *unrelated* new activities are to a region's current portfolio of industries, we can estimate to what extent local firms need to access new capabilities. In as far as these new capabilities spill over to the local economy through the cumulative causation process discussed in the section on regional capability bases, their introduction will expand the regional capability base. That is, even absent concrete information on

[9] See Appendix A, in the online materials, for details.

[10] Indeed, many authors *define* industries to be related if they require similar resources (Farjoun 1994; Teece et al. 1994; Bryce and Winter 2009).

Table 1

Diversity, Industrial Change, Coherence, and Structural Change

	Static	Dynamic
Industries	*Diversity* Measured by: entropy Underlying question: How many different industries are there and how equal is their size distribution?	*Industrial change* Measured by: cosine distance Underlying question: How fast are new industries introduced and how much does the size distribution of activities change?
Capabilities	*Coherence* Measured by: see Figure 1 Underlying question: How similar are the capabilities used by the various industries in the region? That is, how related are the industries in a region to one another?	*Structural change* Measured by: see Figure 1 Underlying question: To what extent does the capability 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?

capabilities, we can quantify structural change in an indirect way as *unrelated diversification*. Similarly, regional coherence can be quantified as how *related* a region's activities are to one another.

This indirect measurement strategy involves four steps: (1) determining how related industries are to one another in terms of their capability requirements. This industry-to-industry relatedness can then be used to calculate (2) how related an industry is to the region's overall industry mix. We call this an industry's *regional capability match* or simply its *match* of to a region. Next, regional coherence is quantified as (3) the average capability match of all industries in a region, and structural change is defined as (4) the match of a region's current industry mix to its past capability base. This procedure is laid out in the diagram of Figure 1 and explained in detail in the subsequent sections. An overview of definitions of variables and derived quantities is provided in Appendix G.

Interindustry Relatedness

Interindustry relatedness can be measured in several ways (see Neffke and Henning 2013). In the main text, we will show results based on relatedness in terms of skill requirements or *skill relatedness*. We focus on skills for two reasons. First, human capital is among the most valuable resources of a firm (Grant 1996), and the skills embedded in a firm's workforce have been shown to condition corporate diversification paths (Porter 1987; Neffke and Henning 2013). Second, because human capital can be —and is—shared among firms in a region, it acts as an important conduit of knowledge exchange and local externalities (Almeida and Kogut 1999).

To quantify similarities in industries' skill requirements, we follow Neffke and Henning (2013). The logic behind this approach is that, because workers will be reluctant to accept jobs where their skills are not valued (and firms unwilling to hire workers without relevant work experience), the largest labor flows should occur among industries that value similar skills. Using a simplified index proposed in Neffke, Otto, and Weyh (2017), we measure the skill relatedness between two industries, i and j, as the ratio of observed to expected labor flows, where expectations are based on aggregate mobility rates in i and j:

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

F_{ij} represents the observed labor flow from i to j. Whenever the index i or j is replaced by a dot, flows are summed over this omitted category, such that $F_{i.} = \sum_{j} F_{ij}$, $F_{.j} = \sum_{i} F_{ij}$ and $F_{..} = \sum_{i,j} F_{ij}$.[11] This skill-relatedness index has been used in several recent articles in economic geography (Boschma, Eriksson, and Lindgren 2014; Timmermans and Boschma 2014; Diodato and Weterings 2015). It has been proved to be highly predictive of corporate diversification (Neffke and Henning 2013), stable over time, and similar for workers in different wage categories and occupations (Neffke, Otto, and Weyh 2017). However, all our findings can also be derived from alternative relatedness measures: Appendix D, in the online materials, replicates our full set of empirical results when skill relatedness is replaced by industries' proximity in the industrial classification system and by their proximity in terms of value chain linkages.

Industry–Region Capability Match

The next step uses the skill relatedness links between *industry–industry* pairs to characterize *industry–region* pairs by how related an industry is to a region's overall industry mix. There are several ways to do this. Hidalgo et al. (2007) calculate the average relatedness of a product to all products that are overrepresented in a country's export basket, and Teece et al. (1994) calculate the employment-weighted average relatedness of an activity to all other activities of a firm. Instead, we follow articles on regional diversification (e.g., Neffke, Henning, and Boschma 2011; Delgado, Porter, and Stern 2014) and quantify this relationship as how much of a region's overall employment is related to an industry. In particular, let E^{rel}_{irt} be all employment in industries related to industry i in region r in year t[12]:

$$E^{rel}_{irt} = \sum_{j} I(SR_{ij} > 1) E_{jrt} \tag{2}$$

where E_{jrt} represents the employment of industry j in region r in year t and $I\left(SR_{ij} > 1\right)$ 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:

$$LQ^{rel}_{irt} = \frac{E^{rel}_{irt} / E_{.rt}}{E^{rel}_{i.t} / E_{..t}} \tag{3}$$

where $E_{.rt}$ is region r's total employment in year t, $E^{rel}_{i.t}$ the total employment in related industries in Sweden, and $E_{..t}$ total national employment.

Unfortunately, LQ^{rel}_{irt} has a strongly asymmetric distribution: an overrepresentation of related industries can range from 1 to infinity, whereas an underrepresentation of related industries can only vary between 0 and 1. To prevent this asymmetry from

[11] We average yearly skill-relatedness matrices from 1994 to 2010 to reduce measurement error. See Appendix B in the online materials.

[12] Related employment includes employment in related nontraded, public-sector, and natural resource–based industries. Moreover, although this does not affect our findings, we consider employment in the same industry (but, where relevant, excluding an agent's own establishment) as related employment.

skewing further derived quantities, we calculate an industry's match to a region using the following monotone transformation:

$$M_{irt} = \frac{LQ^{rel}_{irt} - 1}{LQ^{rel}_{irt} + 1} \tag{4}$$

This maps over- and underrepresentation of related activities symmetrically around 0, such that M_{irt} ranges from −1 (no related employment) to +1 (all related employment is concentrated in region r).[13]

Regional Coherence and Structural Change

Whereas the capability match is a characteristic of a local industry, that is, of an *industry–region pair*, coherence reflects how well all of a region's industries fit together, that is, coherence is a *regional* characteristic. Hence, we define coherence as the employment-weighted average capability match among a region's industries:

$$C_{rt} = \sum_i \frac{E_{irt}}{E_{.rt}} M_{irt} \tag{5}$$

Coherence tells us how related a region's industries are to one another. As a baseline, we also calculate how well a hypothetical region's industry mix, in which each industry's employment is proportional to the national size of that industry, matches region r's capability base:

$$C^{base}_{rt} = \sum_i \frac{E_{i.t}}{E_{..t}} M_{irt} \tag{6}$$

where the weights, $\frac{E_{i.t}}{E_{..t}}$, represent industry i's share of national employment.

Structural change is measured analogously. Yet, instead of asking how related a region's *current* industries' are to the *current* local industry mix, we ask how related these industries are to the industry mix of *a base year*, T:

$$S_{rt,T} = \sum_i \frac{E_{irt}}{E_{.rt}} M_{irT} \tag{7}$$

Structural Change by Agent Type

A regional industry mix changes when local economic agents create or destroy employment. Whether or not this translates into a change in the underlying regional capability base depends on the exact industries in which this happens. Employment created in local industries that are strongly matched to the wider local economy reinforces the focus of that capability base, whereas the destruction of employment in such industries erodes central capabilities and shifts the capability base's focus.

[13] Note that $\frac{LQ^{rel}_{irt}-1}{LQ^{rel}_{irt}+1} = -\frac{\left(1/LQ^{rel}_{irt}\right)-1}{\left(1/LQ^{rel}_{irt}\right)+1}$. Consequently, a given level of overrepresentation of related employment has the same magnitude but opposite sign as the same level of underrepresentation. For instance, if $LQ^{rel}_{irt} = 2$, $M_{irt} = \frac{1}{3}$, whereas $LQ^{rel}_{irt} = \frac{1}{2}$ implies $M_{irt} = \frac{1}{3}$.

Conversely, for local industries that are only weakly related to other local industries, employment creation expands the capability base, and employment destruction tightens the capability base by eroding peripheral capabilities.

How much structural change an agent type induces depends on the average capability match of the industries in which an agent type is active to the region's original (i.e., base year) industry mix. That is, structural change induced by agent a in region r between the base year T and the current year t is defined as the following weighted average:

$$A^a_{rt,T} = \sum_i \frac{\Delta E^a_{irt,T}}{\Delta E^a_{.rt,T}} M_{irT} \tag{8}$$

where the weights, $\frac{\Delta E^a_{irt,T}}{\Delta E^a_{.rt,T}}$, are an industry i's share of all employment created or destroyed by agent type a in region r, and M_{irT} is the capability match of this industry i to r's regional economy of the base year T. In other words, $A^a_{rt,T}$ quantifies how closely an agent type's new (or destroyed) employment matches the *past* local economy. Furthermore, we subtract the average match of existing local industries in year T (i.e., a region's base year coherence) from this:

$$\tilde{A}^a_{rt,T} = A^a_{rt,T} - C_{rT} \tag{9}$$

Because employment creation has different consequences than employment destruction, we distinguish incumbents, that is, establishments already in existence in 1994, into three groups: growing, declining, and exiting incumbents. Growing incumbents create employment, whereas declining and exiting incumbents destroy employment. Furthermore, incumbents that switch industries are split into two artificial types: *out-switching* incumbents, which destroy employment in the old industry; and *in-switching* incumbents, which create employment in the new industry.[14]

Additionally, new establishments are split into four groups: new subsidiaries of (1) local firms and (2) nonlocal firms, and new establishments set up by (3) local and (4) nonlocal entrepreneurs. Subsidiaries of the same (multiestablishment) firms are identified through their common firm identifier. Furthermore, a subsidiary belongs to a *local* firm if, in the previous year, its parent firm employed most of its employees in the new subsidiary's labor market area, whereas in all other cases, it belongs to a *nonlocal* firm. Entrepreneurial start-ups are establishments for which not just the establishment identifier but also the firm identifier is new to the data. Entrepreneurs in such establishments are identified as workers who draw income from a private business. Similarly, local start-ups are those whose entrepreneurs had previously been employed in the local labor market area, whereas start-ups are nonlocal if their entrepreneurs came from outside the labor market area. This procedure allows us to identify the origins of all new subsidiaries and of some 35,000 out of about 60,000 entrepreneur-owned establishments. Establishments with unknown origins are hereafter dropped.[15]

[14] Because establishments rarely relocate to another region, we ignore such events.

[15] See Appendix C, in the online materials, for details. Separate analyses of these establishments show that they play no role in structural change; they neither create structural change nor deepen a region's focus.

Results

Diversity and Industrial Change in Swedish Regions

The Swedish regional system consists of three metropolitan regions (Stockholm, Gothenburg, and Malmö), and a range of medium-sized and small regions. The main urban agglomerations are located in mid- and southern Sweden. North of Stockholm, the geographic distances between population centers are usually vast, and population densities are low. In recent decades, the metropolitan regions have successfully transitioned to new industries. For instance, Malmö, historically a manufacturing center, suffered strongly when its manufacturing base, and in particular its shipyards, collapsed in the 1980s and early 1990s. However, after Sweden's financial crises of the early 1990s, the city successfully reinvented itself and became host to a number of modern, knowledge-based manufacturing and services activities. In contrast, many peripheral and semiperipheral regions never recovered from their own structural declines (Svensson Henning 2009; Holm et al. 2013).

Our analyses start after the decline in manufacturing. Figure 2 depicts the average employment entropy of regions' industry mixes between 1994 and 2010 to show how the diversity of Swedish regions evolved since then. Throughout this period, diversity stays constant, implying that, on average, Swedish regions did neither become more nor less specialized. However, as shown in Figure 3, this apparent stability masks significant changes in regions' industrial composition: by 2010, 27 percent of the local industries that had existed in 1994 have disappeared, and 23 percent of all local industries that existed in 2010 only appeared after 1994. This high turnover is accompanied by a gradual but persistent shift in regional employment composition (Figure 4).

Coherence and Structural Change

Because different industries can rely on similar capabilities, these changes in industry composition may be of little consequence for regional capability bases. Figure 5, therefore, depicts regions' average *coherence*.

Regional coherence exceeds the random benchmark substantially, showing that a region's industries are rather closely related among one another. This suggests that

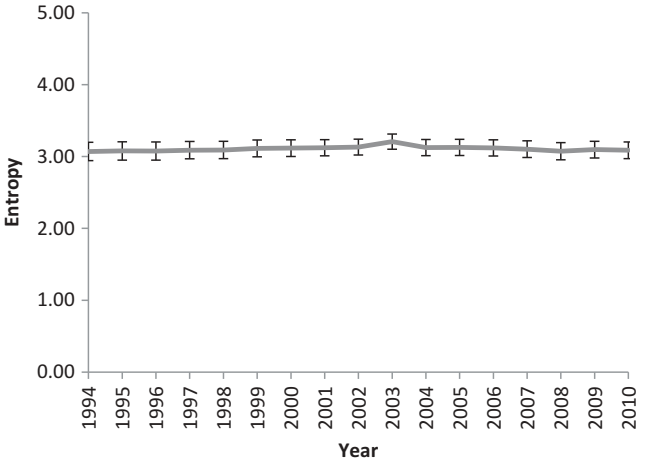

Figure 2. Average entropy of the employment composition of labor market regions.

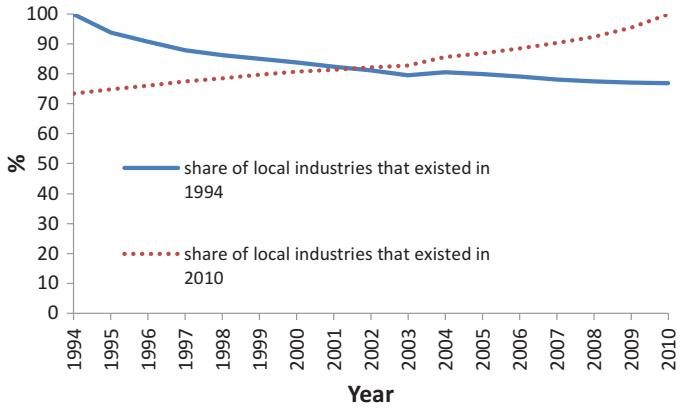

Figure 3. Turnover of local industries.

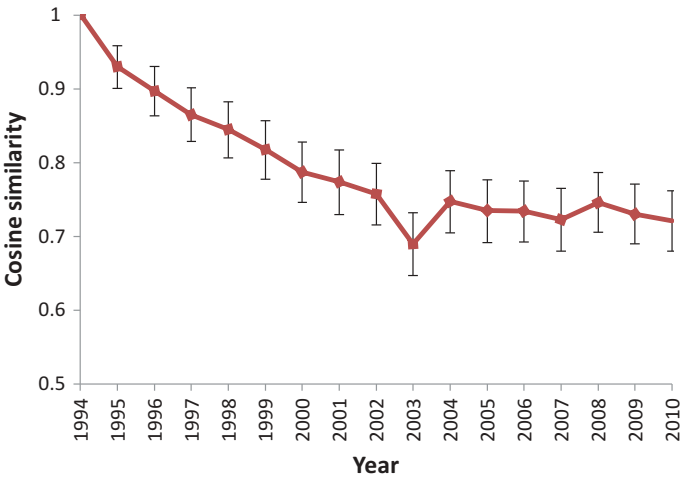

Figure 4. Average cosine similarity to base-year local industry mix.

these industries share a relatively narrow set of regional capabilities, just like how a firm's product portfolio is often organized around some core competences. However, in spite of the significant entry and exit of local industries, there are no strong shifts in average regional coherence. What is more, the downward-sloping line in Figure 6, which shows the average structural change in Swedish regions, implies that, although local economies do drift away from their original capability bases, this process unfolds very slowly. The point estimate of the figure's slope of −0.0029 (t-statistic: −3.76) implies that it would take the average region over fifty years to move one standard deviation away from its base-year position. If a region were to converge to the national industrial structure, at this speed, this would take, on average, over fifty years.

These findings show that regional capability bases change much more slowly than the industry mixes they support. However, it is important to note that neither regional coherence nor structural change are necessarily desirable. For instance, coherent regions' compact capability bases may be easier to maintain, but this compactness also limits

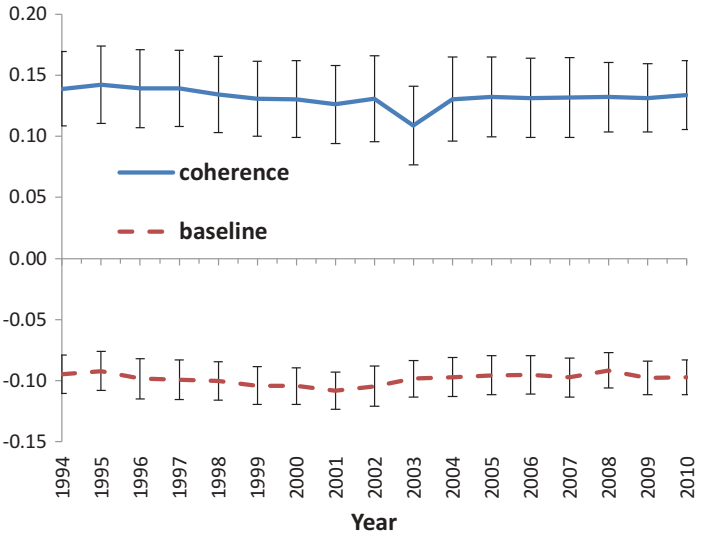

Figure 5. Coherence of labor market regions' capability bases.

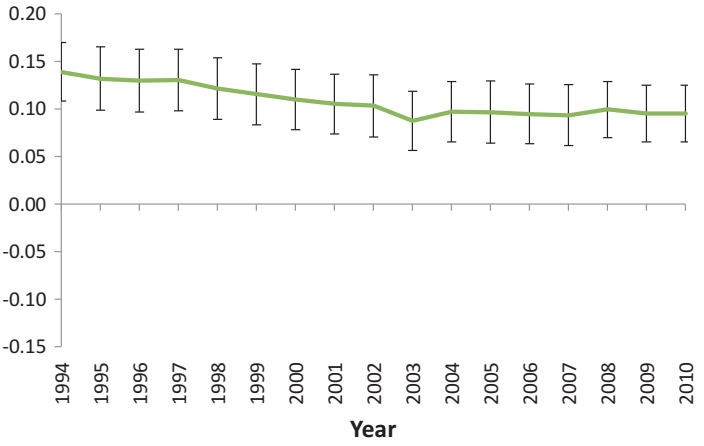

Figure 6. Structural change in Sweden's labor market regions.

diversification options. In the long run, therefore, intermediate levels of coherence may be optimal in the same way that there is an optimal level of diversification for firms (Palich, Cardinal, and Miller 2000). Similarly, whereas in some regions, rapid structural change means that new capabilities are acquired that can be exploited for further diversification and growth, in other regions, structural change may reflect an erosion of valuable capabilities. In fact, in Appendix F, in the online materials, we show that there is no strong relation between regions' structural change and changes in regional wage residuals (which can be regarded as a proxy for labor productivity).

Agents of Structural Change

Table 2 summarizes how much employment each agent type creates or destroys. To increase the sample of new establishments and industry-switching incumbents, we pool

Table 2

Agent Types

Agent Type	# Establishments: Entry Year	# Establishments: After 1 Year	# Establishments: After 10 Years	Employment: After 1 Year	Employment: After 10 Years	% Creating New Local Industries
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 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 firms	557	435	152	13,263	7,562	1.97
Nonlocal 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
Nonlocal entrepreneurs	8,813	5,690	1,562	9,425	5,194	4.20

Note: New establishments and industry switching establishments and their employees refer to the sum over establishments that were founded or switched industries in the six years between 1994 and 2000. Incumbents are establishments that existed already in 1994.

all establishments that enter or switch industries between 1994 and 2000. Incumbents are establishments that existed already in 1994. Growing incumbents create about 76,000 jobs a year (i.e., from 1994 to 1995), whereas new establishments create about 17,000 jobs in the first year of their existence.

New establishments seldom introduce new industries to a region, but the exact rate at which they do differs markedly by agent type. For instance, 4 percent of new subsidiaries create new local industries compared to about 2 percent for entrepreneur-owned establishments. However, this difference is mostly due to new subsidiaries more often having nonlocal owners. In fact, whereas local-industry formation rates are very similar for local firms and local entrepreneurs (around 2 percent), they are much higher for new subsidiaries of nonlocal firms (4.8 percent) and for start-ups by nonlocal entrepreneurs (4.2 percent). These results foreshadow our findings on structural change, which will take into account that some new industries imply bigger shifts in capability bases than others.

Short-Term Structural Change

Figure 7 summarizes how much structural change each agent type induces over a one-year period.[16] Agent types are listed along the horizontal axis, and the agents' capability match to their regions (the average $\tilde{A}^{a}_{rt,T}$) along the vertical axis, with vertical lines representing 95 percent confidence intervals. Agent types that *generate* employment are depicted by green, upward-pointing arrows, and those that *destroy* employment by red, downward-pointing arrows. Arrow sizes vary with the total employment an agent represents. Positive values of $\tilde{A}$ indicate that the local industries in which an agent is active match the region, on average, better than the preexisting industry mix. Negative values signal the opposite. To help interpret the numerical estimates, a secondary axis expresses $\tilde{A}^{a}_{rt,T}$ as the percentile in the overall capability match distribution of existing local

[16] Structural change by incumbents refers to the period 1994–95, by industry switchers and new establishments, to the change in the year of the switch or establishment founding.

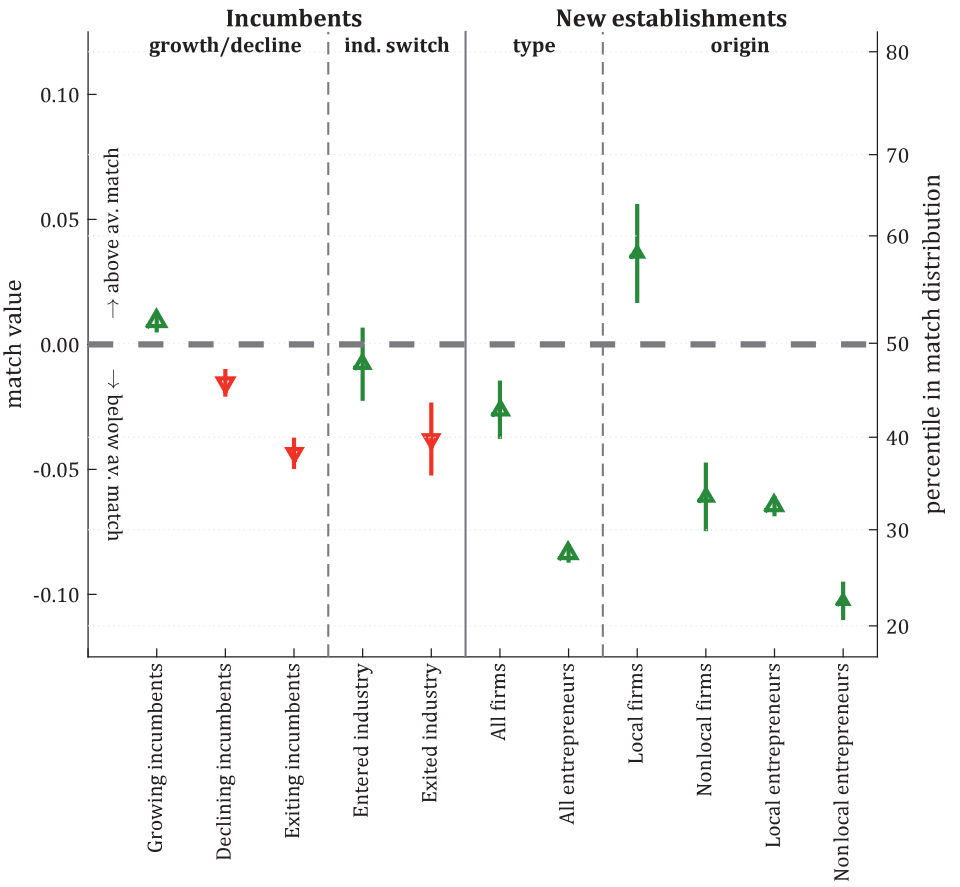

Figure 7. Structural change by agent type (one-year horizon).

industries' in 1994. For instance, nonlocal entrepreneurs' average capability match of $\tilde{A} = -0.10$ corresponds to the twenty-second match percentile. This means that this agent type created employment in local industries that were, on average, in the bottom 22 percent in terms of how well they matched the local economy.

Different agents change regions in different ways. For instance, incumbents tend to reinforce current specializations. They predominantly grow in well-matched industries but shrink and close down in relatively poorly matched industries. Moreover, when incumbents switch industries, they tend to move to industries that match their regions better: on average, they abandon industries in the fortieth and enter industries in the forty-seventh match percentile.

In contrast, almost all new-establishment types display below-average $\tilde{A}$-values and thus tend to widen a region's capability base. This supports H_1: incumbents induce less structural change than new establishments. The only exception is new subsidiaries of local firms, which tend to reinforce existing local capabilities. Although this, strictly speaking, contradicts H_1, such subsidiaries simply represent incumbent growth in new facilities. It is therefore not surprising to find that, like growing incumbents, these new subsidiaries tend to increase a region's focus.

All other new establishments induce structural change, albeit to different extents. For instance, new subsidiaries of existing firms are typically found in more closely

Table 3

Average Capability Match of Nonlocal Agents to Home and Host Region

	Capability Match to:		
Agent Type	Home Region	Host Region	*p*-Value
Nonlocal expanding firms	0.072	−0.019	0.000
	(0.004)	(0.004)	
Nonlocal entrepreneurs	0.001	−0.019	0.000
	(0.002)	(0.002)	

Note: Average capability match to home and host region (standard errors in parentheses). p-value for equality-of-means test for capability match to home versus host region.

matching industries (forty-second match percentile), than those of entrepreneurs (twenty-ninth match percentile). This supports H_{2b} over H_{2a}: entrepreneurs induce more structural change than expanding firms. Furthermore, in line with H_3 (nonlocal agents induce more structural change than local agents), agents 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 thirty-second match percentile, against the twenty-second for nonlocal entrepreneurs, an economically and statistically significant difference. The difference between new subsidiaries of local (fifty-ninth match percentile) and of nonlocal (thirty-third percentile) firms is even larger.[17]

Spatial Diffusion through the Mobility of Firms and Entrepreneurs

Do nonlocal agents help capabilities diffuse? For this to be true, it is not enough that activities of nonlocal agents are relatively *unrelated* to their *host* regions' industry mix but should also be *related* to the industry mix of their *home* regions. Table 3 shows that this is indeed the case: industries of nonlocal entrepreneurs, and even more so of nonlocal firms, match their home regions' capabilities much better than their host regions' capabilities. This corroborates H_4, and implies that the mobility of firms and entrepreneurs is an important vehicle for the spatial diffusion of capabilities.

Long-term Structural Change

Structural change is typically associated with a time horizon well beyond the one-year changes depicted in Figure 7. Long-lasting structural change requires that establishments created in unrelated industries survive and grow. Figure 8, therefore, repeats the analyses of Figure 7 for changes over ten years.

Over this longer period, almost all arrows move up. This means that, in line with studies showing that firms benefit from nearby related economic activity (Delgado, Porter, and Stern 2010; Neffke, Henning, and Boschma 2012), establishments grow faster and/or survive longer in local industries that are better matched to their regional economies. As a result, structural change attenuates. However, apart from this attenuation, long-term structural-change patterns are quite similar to short-term ones. Incumbents still (weakly) reinforce a region's focus, whereas new establishments mostly create employment in unrelated industries. The main qualitative change is that, whereas entrepreneur-owned establishments' match values shift upward, the

[17] Figure 7 is constructed using a weighted regression design. Although our interest in *who* changes a region suggests one should compare *unconditional* means as in Figure 7, it is straightforward to add control variables. Appendix E, in the online materials, reports results that control for region fixed effects and establishment size. This does not meaningfully alter any of our findings.

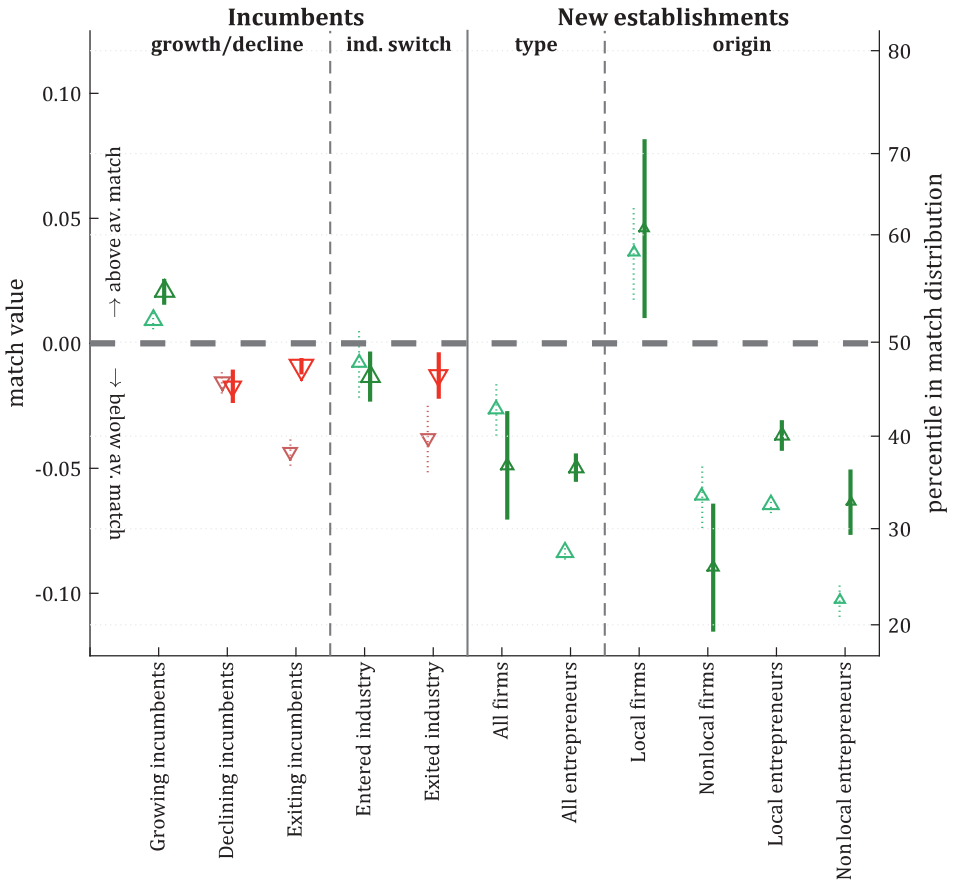

Figure 8. Structural change by agent type (ten-year horizon).

new subsidiaries of existing firms either remain at the same match value (local firms) or move even further down (nonlocal firms). Apparently, unlike new establishments of entrepreneurs, subsidiaries of nonlocal firms grow more and/or survive longer in low-match local industries.[18] As a result, nonlocal firms just surpass (although not to a statistically significant extent) entrepreneurs as the main agents of structural change.

Aggregate Structural Change

So far we have determined the *average intensity* with which an agent type induces structural change, not the *amount* of change. However, local entrepreneurs outnumber nonlocal entrepreneurs five to one and new subsidiaries of nonlocal firms twenty to one. Therefore, even though, *individually*, local entrepreneurs typically are not important contributors to structural change, they may well be *as a group*.

To analyze this, we study who is responsible for most of the employment created in the most unrelated local industries (i.e., the bottom fifth match percentile) over a ten-year period. Although nonlocal firms create about 23 percent of all new-establishment

[18] Survival analyses confirm this conjecture (see Appendix H in the online materials). Whereas start-ups struggle to survive when they are set up in regions with little related employment, no such effects are found for new subsidiaries.

employment, they create 27 percent of new employment in these unrelated industries. More strikingly, nonlocal entrepreneurs produce 29 percent of new-establishment employment in the fifth match percentile, even though they create just 9 percent of all new-establishment employment. Taking all new establishments with nonlocal origins together, these outsiders create 56 percent of such unrelated new-establishment employment but just a third of overall new-establishment employment. This once more confirms nonlocal agents' role as key actors in regional structural change.

Conclusion

We have sketched a theoretical framework that helps understand the mounting evidence on related diversification of regional economies. Accordingly, regions are endowed with capabilities that emerge from, as well as constrain, the activities in which local firms engage. This highlights that a region's current industrial structure is just one of many industry configurations that are compatible with its underlying capability base. We center this theoretical discussion on the role of agency, arguing that the less access economic agents have to and the less they rely on a region's established capabilities, the more likely they are to introduce unrelated activities that expand the region's capability base and, therewith, induce structural change.

Based on these theoretical considerations, we develop an empirical methodology to measure structural change by equating structural change to unrelated diversification. In particular, we use interindustry relatedness measures to assess who introduces unrelated activities in a region and, therewith, expands the regional capability base.

In an application to Swedish regions, we find that, in spite of substantial turnover of local industries, structural change is a slow process that is affected differently by different agents. Incumbents reinforce the current focus of a region's capability base, whereas entrepreneurs widen it. Moreover, most structural change is induced by establishments of firms and entrepreneurs from outside the region.

Regional renewal ranks high on the agenda of local policy makers and is an important goal of the European Union's smart specialization agenda. Such policy frameworks typically place high expectations on entrepreneurs to discover which new activities can be developed 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 Schumpeterian entrepreneur as the prime transformative force in local economies. Although there undoubtedly are local entrepreneurs that shake up a region's status quo, we found them to be rather the exception. Instead, our analyses point to mobility as an important factor in regional transformation: unrelated activities are often transferred from elsewhere by economic agents from outside the region, implying that the diffusion of capabilities and regional diversification are greatly facilitated by the mobility of entrepreneurs and firms.

Our study has a number of limitations. First, we do not observe capabilities directly, but rather infer structural change from how unrelated a region's diversification is. It would, therefore, be interesting to interpret our results in light of a more detailed analysis of regions' institutional and economic layout. Second, we asked *who* introduces unrelated economic activities in a region. This question is descriptive, not causal. Consequently, we remain agnostic about whether the reported differences among agent types reflect different intrinsic capacities for structural change or, for instance, differences in location choices and spatial sorting (e.g., Combes, Duranton, and Gobillon 2008). Third, we only discuss the role of private-sector agents. Although structural

change (in the private sector) ultimately has to be reflected in jobs created by firms, other authors have highlighted how the way to the structural change we have described is paved by local agents (private and public) who transform institutions through collective action that mobilizes knowledge, resources, and public opinion (Strambach 2010; Sotarauta and Pulkkinen 2011). Moreover, richer data sets (like citation patterns as in Cantwell and Mudambi 2008), may provide better ways to assess which firms have access to and rely on (local) knowledge networks. Fourth, ours is just one way to measure unrelated diversification. For instance, a local industry's capability match can also be assessed using Hidalgo et al.'s (2007) density measure, and one can imagine network science–based alternatives to measure coherence and structural change such as the average path length between a region's industries and minimum-spanning trees. Similar in spirit, such modifications would provide interesting avenues for future research.

Our study also raises a number of new questions. For instance, the fact that firms switch industry affiliations such that they better fit the regional economy suggests that firm strategies interact with regional capabilities in ways that are still poorly understood. Furthermore, we studied regions in Sweden, a wealthy, industrialized nation, where structural change is both less prevalent and less pressing than in, for instance, emerging economies. Finally, we have mainly focused on the diversification aspect of structural change. However, structural decline presents a number of additional questions: What does structural change look like when a region's core industry collapses and local capabilities are eroded (e.g., Grabher 1993)? Who introduces structural change in regions when the leading techno-economic paradigms (Freeman and Perez 1988) are running out of steam? We hope that the theoretical and empirical approach we presented here will prove useful in tackling these important issues.

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