Employment growth and inter-industry job reallocation: spatial patterns and relatedness

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ABSTRACT

Employment growth and inter-industry job reallocation: spatial patterns and relatedness. *Regional Studies*. The nature of employment reallocation between industries is assessed using rich register data for the Netherlands. It is found that employment decline in some industries is countered, in a communicating vessels fashion, by employment growth in other industries, which is primarily driven by the availability of released skilled labour. These labour demand interactions are predominantly local and stronger between related industries. In addition, the inter-industry labour reallocation has a distinct geographical character in which the location of employment creation depends primarily on the residential location of the released employees rather than on the location of the job destruction.

KEYWORDS

job reallocation; labour pooling; spillovers; inter-industry flows; growth

摘要

就业成长与产业间的工作再配置：空间模式与关联性。区域研究。 本研究运用丰富的登录数据，评估荷兰产业间的就业再配置。研究发现，部分产业的就业缩减，透过连通的方式，与其他产业的就业增加相互抵消，而这主要是由释出的技术劳工的可得性所驱动。这些劳动需求的互动绝大部份是在地的，并且在相关产业之间更为强健。此外，产业间的劳动再配置具有特殊的地理特征，其中就业创造的地点，主要取决于释出的工作人员的居住地，而非工作消失的地点。

关键词

工作再配置; 劳动汇集; 外溢; 产业间的流动; 成长

RÉSUMÉ

La croissance de l'emploi et la redistribution interindustrielle du travail: des répartitions et des connexités spatiales. *Regional Studies*. À partir de riches données de registres pour les Pays-Bas, on évalue le caractère de la redistribution interindustrielle des emplois. Il s'avère que la baisse de l'emploi dans certaines industries est contrebalancée, comme des vases communicants, par la croissance de l'emploi dans d'autres industries, ce qui est piloté principalement par la disponibilité de la main-d'oeuvre qualifiée libérée du travail. Ces interactions concernant la demande de main-d'oeuvre sont principalement locales et sont plus fortes entre des industries apparentées. Qui plus est, la redistribution interindustrielle des emplois présente des caractéristiques géographiques distinctes; à savoir la localisation de la création d'emplois dépend essentiellement du lieu de résidence des salariés libérés du travail plutôt que de la localisation de la suppression d'emplois.

MOTS-CLÉS

redistribution des emplois; mise en commun de la main-d'oeuvre; retombées; flux interindustriels; croissance

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ZUSAMMENFASSUNG

Beschäftigungswachstum und Neuaufteilung von Arbeitsplätzen zwischen Branchen: räumliche Muster und Verwandtheit. *Regional Studies*. Wir untersuchen die Beschaffenheit der Neuaufteilung von Arbeitsplätzen unter verschiedenen Branchen mithilfe von erweiterten Registerdaten für die Niederlande. Es zeigt sich, dass ein Rückgang des Beschäftigungsniveaus in einigen Branchen nach Art der kommunizierenden Röhren durch Beschäftigungswachstum in anderen Branchen ausgeglichen wird, was in erster Linie auf die Verfügbarkeit freigewordener qualifizierter Arbeitskräfte zurückzuführen ist. Diese Wechselwirkungen bei der Nachfrage nach Arbeitskräften sind überwiegend lokaler Natur und zwischen verwandten Branchen stärker ausgeprägt. Zusätzlich weist die Neuaufteilung von Arbeitsplätzen zwischen Branchen deutlich geografische Züge auf, wobei der Ort der Arbeitsplatzschaffung statt vom Ort des verlorenen Arbeitsplatzes vor allem vom Wohnort der freigewordenen Arbeitskräfte abhängt.

SCHLÜSSELWÖRTER

Neuverteilung von Arbeitsplätzen; Bündelung von Arbeitsplätzen; Übertragungseffekte; Ströme zwischen Branchen; wachstum

RESUMEN

Crecimiento de empleo y reasignación laboral entre las industrias: patrones espaciales y relaciones. *Regional Studies*. Evaluamos la naturaleza de la reasignación laboral entre las industrias mediante un nutrido grupo de datos de registros para los Países Bajos. Observamos que el declive del empleo en algunas industrias se compensa, a modo de vasos comunicantes, mediante el crecimiento del empleo en otras industrias, que viene impulsado principalmente por la disponibilidad de personal cualificado despedido. Estas interacciones de demanda laboral son sobre todo de ámbito local y más fuertes entre industrias relacionadas. Además, la reasignación laboral entre las industrias tiene un carácter geográfico propio en el que la ubicación de la creación de empleo depende principalmente del lugar de residencia de los empleados despedidos más que del lugar de la destrucción de empleo.

PALABRAS CLAVES

reasignación laboral; concentración laboral; efectos indirectos; flujos entre industrias; crecimiento

INTRODUCTION

This paper assesses several aspects of job reallocation. Specifically, it looks into the co-location of industries with growing and declining employment and interactions between their labour demands.

The literature on job reallocation observes job flows of remarkable magnitude between plants and industries, but concludes that this results in much more stable aggregate patterns. Also with the presence of growth differentials among industries, for many of the jobs destroyed in some industries there are jobs created in other industries in a communicating vessels fashion, as well as the other way round with employment creation leading to the loss of jobs elsewhere (Haltiwanger & Schuh, 1999; Martin & Scarpetta, 2012). This suggests that there is some self-correcting mechanism to employment decline/growth that coordinates this creative destruction. One can think of several possibilities that function on different geographical levels. Financial capital can be reallocated on national and international scale to more profitable uses, new employment creation can be instigated on the local level by the presence of infrastructure, networks of suppliers, supporting business services and physical resources released as employment declines in other industries (Evans and Siegfried, 1992). Another possibility, which is the focus of this paper, is the presence of a released workforce that can be then employed in other industries, mostly on a local scale and in industries requiring similar skills. This is not to say that job creation and destruction always go hand in hand: in the literature on restructuring old industrial regions, it is argued that declining mature industries can generate negative externalities for other industries in the region (Grabher, 1993). In addition, positive and negative shocks can both propagate through input–output linkages in a self-reinforcing manner.

This paper assesses the nature of the interactions between the labour demands of industries and finds that they are predominantly local, stronger between related industries, and that the decline in some industries tends to be countered by employment growth in others and that this is primarily driven by the availability of skilled labour released by declining industries. In addition, it is shown that the inter-industry labour reallocation has a distinct geographical character with the location of employment creation depending primarily on the residential location of the released employees rather than the location of job destruction.

The findings are important for several reasons. Firstly, they contribute to an understanding of the role of people in job creation. In recent decades, claims that human capital has become the most important factor in production have become commonplace (e.g. Drucker, 1993; Moretti,

2012, pp. 215–249) and it has been argued that the presence of skilled professionals attracts jobs. An attractive location in which to live has thus come to be seen as a more important factor in job creation that the traditional firm location factors (Florida, 2003, 2005). This argument has been mostly limited to creative jobs, although the role of human capital has also been shown to have increased in low-tech industries (Hansen, Winther, & Hansen, 2014). While the claims that the presence of people is able to attract jobs have remained controversial (Scott, 2006; Storper and Scott, 2009; Peck, 2005), the findings of this research lend them support as it is shown that the availability of skilled people, released from declining industries, does generate employment in their residential locations in other industries.

Secondly, the findings shed some light on the patterns of labour pooling. The possibility of sharing a labour force, or one-sidedly drawing a labour force from elsewhere, has been shown to be an important consideration in co-locating economic activities (Ellison, Glaeser, & Kerr, 2007; Rosenthal and Strange, 2001; Bresnahan, Gambardella, & Saxenian, 2001). Labour pooling is often seen as primarily taking place within an industry (Rosenthal and Strange, 2001; Overman and Puga, 2010) as hiring from an intra-industry generally generates better skill matches. However, it can also be a risky strategy if firm employment growth within an industry is correlated. This paper shows that cross-industry flows are also prominent in hiring. Conversely, the geographical pattern is somewhat different: for a firm interested in cross-industry hiring it is more important to be close to where the employees live than where their previous employers are.

This paper firstly elaborates on industry decline and its consequences for a region. Hypotheses are then formulated and the empirical strategy to test them is laid out. A descriptive outline of the sources of regional employment growth is presented that illustrates the interactions between declining and growing industries and is instrumental in developing the regression analyses. Subsequently, the specifications and results of the regression analyses are presented. Following this, the paper ends by drawing conclusions.

INDUSTRY SHIFTS AND EMPLOYMENT REALLOCATION

As industries downsize or disappear completely, various resources that they have been using are released. There is no clear-cut answer as to what happens with those resources and whether they are valued by other potential users in the locality; and different scenarios of regional renewal strategies have been conceptualized (Boschma and Lambooy, 1999; Trippl and Tödtling, 2008). While the resources from declining industries are relatively easy for other industries to obtain, one can question how transferable and applicable those resources are to new uses. Only negative externalities of decline are suggested by the old industrial regions restructuring research. Conversely, some case studies suggest that the decline of an industry or a firm does not necessarily signal inherent flaws in

their resources: they can still be successfully reused elsewhere. Buenstorf and Fornahl (2009) discuss the case of Intershop, a German maker of e-commerce software, that saw enormous falls in both its stock value and its employment over the period 2000–05, but still had a huge positive influence on its home region through numerous spin-offs that successfully applied the knowledge they had acquired at Intershop. Hoetker and Agarwal (2007) show, for the disk-drive industry in the United States, that the diffusion of the knowledge accumulated in firms is somewhat negatively affected by their exit, but nevertheless remains at a relatively high level compared with the pre-exit knowledge diffusion. Hanson and Pratt (1992) cite employers mentioning that the availability of the labour force from closed-down firms as a reason for opening a new branch in the region. Bathelt and Boggs (2003) analyse an industry shift in Leipzig, Germany, and conclude that 'crises give agents the chance for interactive learning geared toward rebundling local capital, spurring growth and change in formerly peripheral or entirely novel industries' (p. 288).

At the firm level, a consistent empirical finding is of a correlation between entries and exits, suggesting that exiting firms make room and release resources for others (Evans and Siegfried, 1992; Kleijweg and Lever, 1996; Arauzo, Manjón, Martin, & Segarra, 2007; Manjón-Antolín, 2010), although recent research has also stressed the role of incumbents (Agarwal, Audretsch, & Sarkar, 2007; Brown, Lambert, & Florax, 2013). This leads to the first hypothesis:

Hypothesis 1: Nationally growing industries grow more rapidly in regions where there is more decline in other industries (growing and declining industries refer here to industries with declining and growing employment).

The most straightforward mechanism for employment reallocation is the local job changes of those employees who are spatially restricted but able to apply their skills and knowledge in other industries. Indeed, employees more often respond to changes in labour demand by switching industry than moving to another region (see Neffke and Henning, 2013; and Weterings, Diodato, & Van den Berge, 2013, on the prevalence of inter-industry and interregional changes).

In this paper, the reallocation of a labour force between declining and growing industries is conceptualized as a dynamic cross-industry labour pool that enables the absorption of industry shocks. Generally, one of the benefits of labour pooling is that a fluctuating firm's labour demand can be more easily accommodated. Overman and Puga (2010) show empirically that industries in which firms are more prone to idiosyncratic volatility are more likely to agglomerate. That is, a firm experiencing fluctuating labour demands benefits from being close to other firms in the same industry provided the labour demand fluctuations are not correlated. However, it is not uncommon for an entire industry to see simultaneous employment fluctuations. If many firms in the same industry experience simultaneous labour demand growth, the intra-industry labour pool soon becomes exhausted

and the firms have to compete for human capital. In such situations, the negative effects of labour poaching dominate the positive effects of absorbing the idiosyncratic volatility (Combes and Duranton, 2006), and labour pooling within an industry becomes harmful rather than advantageous to hirers.

In other words, it is not advantageous for firms to be close to firms that use the same labour skills, as suggested by Marshallian labour pooling argument. Although the presence of other firms indirectly enables a larger labour pool to be generated, these other firms are also direct competitors for the labour force. Essentially, firms would benefit from being close to a labour force but far from other firms. In general, the magnitude of the relevant labour pool and the number of firms competing for it might be in equilibrium most of the time. However, discrepancies, often temporary, are bound to arise if there are patterns in the labour demand growth of the firms located close to each other. The focus here is the idiosyncratic volatility absorption function of labour pooling, rather than other reasons for changing local employment such as better job matches.

In order to address the issue that labour demand changes are often correlated across firms and to a large extent also dependent on the broader economic environment, an argument similar to that of Overman and Puga (2010) has been developed for industries. Pasinetti (1993) argues that, due to technological change, certain industries inevitably experience declining employment. One way of dealing with technological unemployment is increasing diversity by creating new goods and services to absorb redundant employees. Applying Overman and Puga's (2010) findings to industries is meaningful in several ways. Firstly, the magnitude of inter-industry labour flows suggests that labour pooling is by no means limited to single industries. Secondly, industry shifts can be more important than relatively short-lived and unpredictable idiosyncratic fluctuations in establishment level labour demands. These observations lead to the second hypothesis:

Hypothesis 2: The more rapid growth of nationally growing industries in regions where there is significant decline is explained by the greater labour force availability.

The magnitude of resource flows between declining and growing industries depends on the relatedness of those industries: the similarity of the skills and knowledge they use. Consequently, the influence of the presence of related and of unrelated declining industries is analysed separately. It is hypothesized that greater relatedness enables easier inter-industry flows between declining and growing industries:

Hypothesis 3: The relationships in Hypotheses 1 and 2 are stronger for the growing industries located in regions with related rather than non-related declining industries.

DATA AND APPROACH

This paper uses unique rich register data provided by Statistics Netherlands. The datasets contain detailed information on employment histories as well as characteristics of firms (industry, location, size), jobs (location, wage, workload) and employees (residential location). The constructed dataset covers all the jobs in the Netherlands over the period 2007–11 (data from 2006 are also used to calculate certain inputs for later years).

The datasets used have several peculiarities. First, job locations are recorded only once a year in December. Therefore, the focus is exclusively on jobs observed on 31 December of any year. Second, some firms have been assigned to different industries at various points in time. In order to eliminate false dynamics, changes in industry are rejected where there is no change of job: thus, the industry assigned to a firm remains fixed in the dataset at the value given when it first enters the dataset. Third, workers employed through temporary employment agencies are assigned to NACE rev. 2 category 78.2. *Temporary employment agency activities* (henceforth referred to as TEAA) in the dataset, regardless of where the work is carried out. A consequence of this is that employment changes in the TEAA category are somewhat atypical: TEAA labour demand is not determined in the industry itself but rather by the labour demand in other industries. Several measures to address the exceptional position of TEAA are discussed below.

In addition to the register data provided by Statistics Netherlands, other publicly available data it provides on housing growth, investments in fixed assets and working-age population density are also used. In addition, aggregate business area size in the regions is obtained from the IBIS database.

This paper follows Menzel's (2008) line of reasoning in seeing the regional development of an industry as a reflection of the national development of the entire industry, but 'biased by geographical proximity and the specific regional context'. The most rapidly growing industries are identified at the national level annually. These industries seemingly find themselves in favourable national and global conditions and have consequently carried out the most hiring. Their regional variations in employment growth rates are explored depending on the magnitude of employment decline in other industries in the region. The main specification focuses on the top 30% (weighted by employment size) industries with the most rapidly growing employment. Growing industries are defined after excluding the TEAA category.

The regions are defined on the NUTS-3 level, which is also traditionally conceptualized as the reach of a local labour market. Industries are defined based on NACE rev. 2 at the three-digit level. Industries are considered to be related if the first two digits of their NACE codes are the same. While many other approaches for determining the relatedness of industries have been proposed, they were not considered suitable for this analysis. A typical shortcoming is that they do not suit all industries equally well and thus can be used only selectively. For instance, one prominent approach builds on the idea of economies of scope as a driver for firms to diversify into related industries but this is typically only used selectively (for example, Teece et al., 1994, and Bryce and Winter, 2009, apply it

only to manufacturing industries). Indeed, empirical data including all industries suggest that organizational needs rather than possessing related capabilities often drive the diversification into different sectors. For instance, two of the most common secondary (by employment size) industries in the firms are 64.2 *Activities of holding companies* and 69.2 *Accounting, bookkeeping and auditing activities, tax consultancy*. Similar criticisms apply to relatedness measures that build on input–output similarities (Fan and Lang, 2000) since such measures best fit manufacturing industries, on co-occurrence in patent data (Breschi, Lissoni, & Malerba, 2003) as such measures are best suited to knowledge-intensive industries and on co-occurrence in export data (Hidalgo, Klinger, Barabási, & Hausmann, 2007) since this entirely excludes industries providing local services. Approaches that build on skill relatedness such as those based on the frequency of inter-industry flows (Neffke and Henning, 2013) or on similarity of skill profiles (Farjoun, 1998) are more promising. Unfortunately, however, the approach of Neffke and Henning (2013) introduces an endogeneity bias in an analysis that itself tests the presence of certain cross-industry flows and data availability does not enable Farjoun's (1998) approach to be used at the three-digit NACE rev. 2 level.

In addition, while various other approaches do measure some more nuanced aspects of relatedness, there is typically substantial overlap between the relatedness found using NACE rev. 2 categories and relatedness measured using other approaches (Farjoun, 1998; Fan and Lang, 2000; Neffke, Henning, & Boschma, 2011; Neffke and Henning, 2013). Also, the explanatory power of measures based on the NACE hierarchy has been established by Frenken, Van Oort, and Verburg (2007) and Boschma and Iammarino (2009).

The present analysis distinguishes between locations where the economic activities that lose jobs are located and where the people who lost those jobs live. This makes it possible to identify the effects of being close to firms in declining industries and of being close to a potential labour pool. The concept of labour pooling rests on an implicit assumption that employees adjust their residential location to that of the firm that employs them and, therefore, when changing jobs, they will prefer employers close to their previous work location. However, as the following section shows, this is not supported by the empirical evidence.

DESCRIPTIVE FINDINGS

In order to gain a better understanding of the interactions through employee reallocation between growing and declining industries, the new inflows to the most rapidly growing industries are, in this section, broken down in terms of the geographical locations and industries in which the employees previously worked. The previous residential and work locations are treated separately. Any resulting differences will form a rationale for using both residential and working location variables in the subsequent regression analysis in attempting to distinguish between the

effects of jobs being lost in a region and the effects of employees becoming available in the region.

For industries experiencing positive labour demand shocks, there are a number of strategies for attracting inflows: engaging in wage competition to attract workers from the same or other growing industries, targeting employees in other regions or industries when there are regional/industry differentials in wages or unemployment rates, targeting potential employees that are not active in the labour market or focusing on attracting those working for temporary employment agencies. Not all of these inflows are a source of growth: for instance, job transitions within the most rapidly growing sectors result in a higher turnover but not more employment growth. The growth must come from other industries or from inflows that did not previously participate in the labour market.

Figures 1 and 2 show the composition of the inflows to the most rapidly growing industries where the location and the industry are known (98.8% of inflows). The new inflows are categorized by previous employment status (had another job one year earlier; did not have a job one year earlier); those who were previously employed are further divided depending on whether they were previous employed in the same region or elsewhere. The previously employed inflows are subsequently further categorized based on the growth status and relatedness of their former industry with the hiring industry. Figures 1 and 2 are analogous except that the distinction between inflows from the same as against a different region is based on previous job location in Figure 1 and on residential location in Figure 2.

The job statuses compared are those as of 31 December each year. As such, a new job is one that existed as of that date in year T but not in year $T-1$. Similarly, a previous job is one held at the end of year $T-1$ but not at the end of year T. If an employee previously had multiple jobs, then the one with the highest part-time factor is used. Here the industries with the most rapid national employment growth accounting for 30% of all employment are referred to as growing, the industries with the lowest employment growth accounting for 30% of employment are referred to as declining, and the industries in between (40% of all the employment) are referred to as stable; the growth status is allocated after having excluded the TEAA. Inflows from the same industry and from TEAA (which is considered a special case of inter-industry flow) are presented separately. Transitions from TEAA to other industries, although technically inter-industry moves, are different in that temporary employment agencies supply labour to other industries rather than perform industry-specific work themselves. Consequently, transitions from them are indicated by a legally different job contract even if the industry (or even the firm) in which the actual work is performed remains the same.

A total of 61.6% of all new full-time equivalents (FTEs) in the most rapidly growing industries were previously employed. The remaining 38.4% were unemployed, engaged in activities other than paid employment (such as studying, retirement) or worked outside the Netherlands. Cross-industry changes are more common than
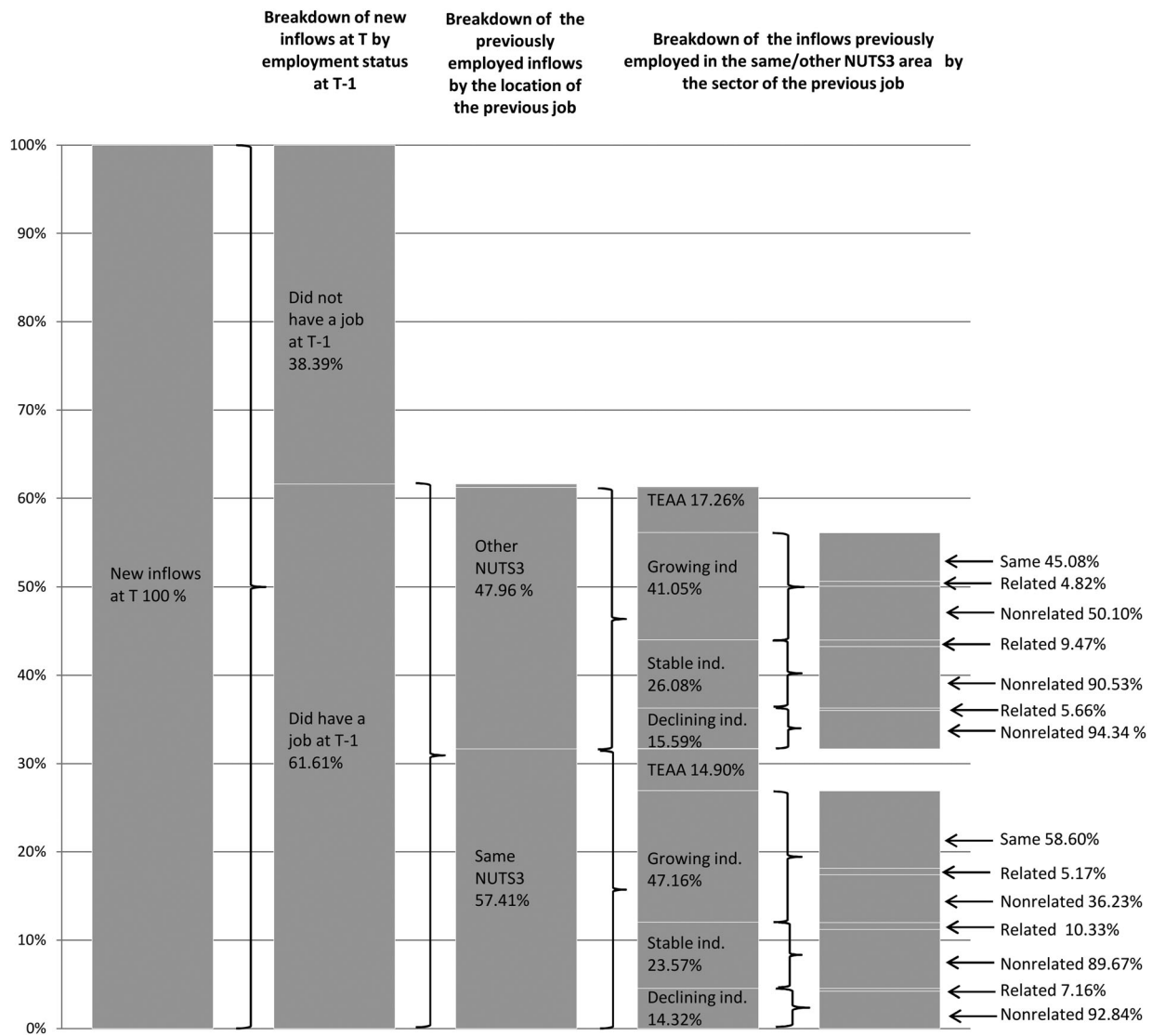
Figure 1. Composition of the inflows of the most rapidly growing industries (in full-time equivalents – FTEs), 2007–11, by location and industry of the previous job. The job statuses are compared on 31 December of every year. Percentages refer to the previous category in the column on the left; TEAA refers to NACE rev. 2 category *78.2 Temporary employment agency activities.* Unlabelled sections refer to inflows for which a value is unknown.

interregional flows: 77% of those previously employed had switched industries and 48% had changed the region in which they worked (of all employees for whom the previous industries and work location were known, weighted by FTEs). The proportion of inter-industry changes is high compared with other estimates (for example, see Neffke and Henning, 2013, for Sweden). This is probably related to the high level of inter-industry transitions from TEAA employment in the Dutch labour market.

In practice, the definition of NUTS-3 area, traditionally conceptualized as the local labour market area, does not define the geography of job transitions that well since only 51.4% of employees were previously employed in the same NUTS-3 area (51.7% of those for whom the previous job location is known). The industries that are growing do engage in wage competition to some extent: whilst the growing industries contain 30% of all employment, the inflows from other growing industries

constitute 47.2% of all inflows hired from within the same NUTS-3 area and 41.1% of those hired from further afield. However, the corresponding figures are only 27.0% and 27.7% for inter-industry flows. Perhaps surprisingly, inflows from the same industry are especially prevalent among those recruited locally. The salience of intra-industry moves among the intraregional inflows can probably be explained by the presence of intra-industry agglomerations. The employees will build up networks within their own industry within a limited geographic area, enabling such transitions between jobs.

Relatedness also plays an important role: while there are 88 two-digit categories within NACE rev. 2, 9.3% of all inter-industry inflows, excluding those from TEAA, are within the same two-digit category. As already noted, the TEAA industry is a significant source of potential recruits, and accounts for 16.0% of all the inflows for which both industry and region are known.
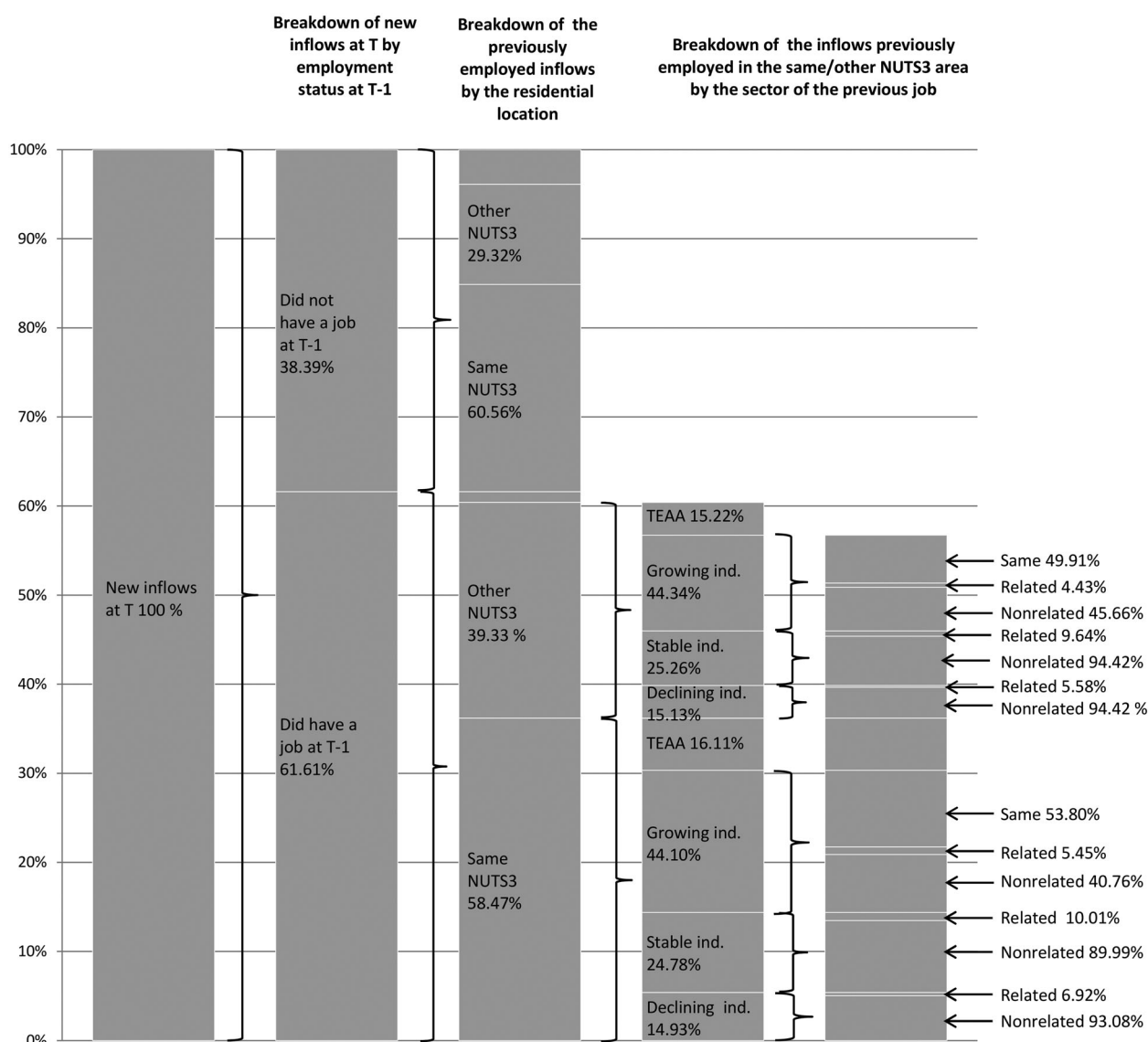
Figure 2. Composition of the inflows of the most rapidly growing industries (in full-time equivalents – FTEs), 2007–11, by employees' residential location and the industry of the previous job. The job statuses are compared on 31 December of every year. Percentages refer to the previous category in the column on the left; TEAA refers to NACE rev. 2 category *78.2 Temporary employment agency activities.* Unlabelled sections refer to inflows for which a value is unknown.

Figure 2 presents inflows in a similar way to Figure 1, but the location measures here are based on residential locations rather than on the previous work locations of the employees (again only those inflows for which the industry of the new job and the residential location are known are included in the analysis). This shows that more of the previously employed find employment in the NUTS-3 area where they already live (58.7%, or 59.9% if only the inflows with known residential location are considered) than in the area of their previous employer (51.4% and 51.7% respectively in Figure 1). However, now the breakdown by previous industry is fairly similar for inflows from the same NUTS-3 area and from elsewhere. That is, the local intra-industry inflows do not retain the salient position shown in Figure 1. From this, it can be concluded that the intra-industry network plays an important role in enabling job seekers to find a job in the same industry, but only within a limited

geographical reach from the workplace, and that those looking for a job close to home tend to switch industries more often. Thus, it seems that spatial mobility and cross-industry mobility are, to some extent, substitutable adjustment mechanisms.

To summarize, inter-industry flows are more prevalent than interregional flows or flows of the previously unemployed into the labour market. Among inter-industry transitions, moves between related industries are relatively common. Geographical proximity is sought when seeking labour matches, especially when being open to cross-industry switches. This suggests a certain trade-off between geographical and skill distance. Geographical proximity seems to have greater importance in the sense of a new job being close to where one lives rather than in the sense of nearness between old and new firm, as in the traditional sense of agglomeration. Contrary to an implicit assumption of the

Table 1. Intraclass correlation (ICC) coefficients of the dependent variable across different dimensions of the panel for all industries, not weighted.

Dimension	ICC coefficient for employment growth (%)
Industry	6.52
Region	0.00
Year	0.00
Industry–year interaction	42.10
Region–year interaction	0.00
Industry–region interaction	3.30

labour pooling concept, spatial mismatches do exist between workplaces and residential places, and job switchers strive to reduce the distance to work. Relating this back to the initial research questions, it appears that the residential location of potential employees is more important than their previous job location in absorbing labour demand shocks through inter-industry flows.

REGRESSION ANALYSIS

The underlying structure of the data

The dataset consists of industry–region–year records. Table 1 presents the intraclass correlation (ICC) coefficients of employment growth (dependent variable) along various dimensions of the dataset for all industries.

The main conclusions drawn from Table 1 are as follows. First, it seems reasonable to treat the regional development of industries as a reflection of the development of the whole industry nationally as the employment growth in the same industry fluctuates together across the regions (ICC coefficient in industry–year interactions equals 42.11%). Second, there is little consistency in employment growth rates over time (ICC coefficient in industry–region interactions is only 3.31%), indicating that employment growth depends more on unstable supply and demand factors than on fixed industry or regional characteristics. This also means that the direction and intensity of labour demand interactions between industries are constantly changing. Third, regions do not have consistent positive or negative effects on all the industries located within them, as reflected in the low ICC coefficients in region and in region–year interactions (0.00% for both).

Regression Model

The aim of the regression analysis is to assess how growing industries are affected by being co-located with declining industries. In addition, an attempt is made to identify the channels through which the interactions between growing and the declining industries take place. Two sets of variables are included, one reflecting the magnitude of job losses in a region, the other the scale of the labour force that becomes available in the region. The local availability of labour is determined from the residential location of potential employees regardless of where they previously worked, and so the study also addresses the spillover effects

between regions through labour force mobility. The ability to establish these two sets of variables is facilitated by the significant mismatches between residential and working locations as shown above. The remainder of this section elaborates on the operationalization of the variables.

The dependent variable is:

- Annual employment growth in the region–industry combination of the identified nationally most rapidly growing industries (in FTEs, *EMPLGROWTH*).

The main independent variables are:

- The relative loss of related and unrelated jobs in a region (in FTEs, *REL_JOBLOSS* and *NONREL_JOBLOSS*). These are operationalized as the regional loss of employment in industries other than those defined as growing, relative to the size of the growing industries in the region:

$$\text{DECL}_{R,t} = -\frac{(E_{R,t,L70} - E_{R,t-1,L70})}{E_{R,t-1,U30}} \quad (1)$$

where $\text{DECL}_{R,t}$ is the decline in employment in region R in year t; $E_{R,t,L70} - E_{R,t-1,L70}$ is the absolute annual growth of employment (in FTEs) in region R in industries in the lowest 70% percentile of employment growth nationally; and $E_{R,t-1,U30}$ is the employment (in FTEs) in region R at the beginning of period t in industries in the upper 30% percentile of employment growth nationally.

- The magnitude of job loss is calculated for related and unrelated employment separately. Industries sharing the first two digits in NACE rev. 2 are considered related. The 30% most rapidly growing industries are selected after having excluded the TEAA. The TEAA industry is included with the remaining 70% and a variable (*SHARETEAA*, see below) is created to capture the TEAA share of regional job loss.

- The related and unrelated labour force released (*REL_RELEASEDEMPLOYEES* and *NONREL_RELEASEDEMPLOYEES*). These are operationalized in a similar fashion to the magnitude of the job loss in a region, but based on people who lose jobs, rather than jobs lost, in industries other than those defined as growing in the region. This captures the magnitude of the labour force that becomes available to other industries in the region. Such a measure is facilitated by the discrepancies between where people live and where they work. Since not everyone is willing to supply the same quantity of labour, people are also assigned weights depending on the FTE of their previous job.

The selection of control variables is largely based on Frenken, Van Oort, Verburg, and Boschma (2004) and Frenken et al. (2007) and includes the following:

- Natural logarithm of mean wages in the region–industry combination (*WAGE*). A high wage level is expected to

affect growth negatively since, to the extent that wages reflect labour costs, regions with higher wages are less attractive for job creation. To the extent that wages reflect skill levels, higher wages indicate a higher barrier to enter from another industry.

- Business area growth and dwellings growth in the region (*BUSINESSAREA* and *DWELLINGS*). They could be expected to facilitate and attract economic activities and hence have a positive effect on employment.
- The natural logarithm of working age- (15–65 years) population density in the region (*POPDENS*). This controls for urban economies.
- Location quotient (*LQ*) to account for localization economies. It measures the concentration of an industry in a region relative to the national level.
- Related and unrelated variety in the region (*RELVAR* and *UNRELVAR*). In addition to splitting the job loss/released employees variables by the level of relatedness, these variables are also included to reflect the general relationships among industries in a region. For more information on the calculation of the variables and their conceptualization, see Frenken et al. (2007).
- Natural logarithm of the investment in fixed assets in the region per FTE (*INVESTMENT*). Both positive and negative effects are possible depending on whether the investments are in job creation or in decreasing labour intensity.
- Mean establishment size in the region–industry combination (*ESTABLISHMENTSIZE*) as a proxy for competition.
- Decline in TEAA (*SHARETEAA*). As shown in the 'Descriptive findings' section, growing industries hire many workers from the TEAA branch. However, the transitions from TEAA to growing industries should be viewed as different to other inter-industry transitions. Therefore, a variable is added to reflect the share of the regional job loss that is in the TEAA industry. It is operationalized as the ratio between the regional annual changes in FTEs in the TEAA category and in other non-growing industries.
- Regional human capital (*EDUCATION*). The proxy used for human capital is the proportion of a region's population who are highly educated (in the Dutch system those with higher vocational or university education). Regions with higher levels of human capital can be expected to be better able to find new niches and reinvent themselves, thus stimulating labour reallocation (Glaeser and Saiz, 2014; Glaeser, 2005; Heuermann, 2013).

Ordinary least squares (OLS) regression is conducted with a set of dummies for industry–year interactions. In the regression models presented below, only the 30% (weighted by employment size) most rapidly growing industries are included. Given that the focus of this paper is on how hiring behaviour is determined by external limiting factors, such as the availability of labour, the interest is not only in industry growth in the relative sense but also in its link to the local labour market. Therefore, the regressions are weighted by the size of the region–industry

combinations. This limits the influence of observations where a small growth in employment in absolute numbers leads to a large relative change.

REGRESSION RESULTS

Table 2 presents the results of the regression analysis. Column (1) shows the results with the job loss in the region as the main independent variable. For purposes of comparison, column (2) presents the results of a similar regression, but with the variables estimating the magnitude of job loss in the region replaced with variables estimating the magnitude of the released labour force in the region. In column (3), both the job loss variables and the released labour force variables are included in the regression. Multicollinearity is not encountered (the variance inflation factors are below 2 and the weighted correlation coefficients between the job loss variables and released labour force variables are 61% and 71% for the related and unrelated decline respectively). Column (4) adds the spillover effects through labour mobility of employees who have not previously worked/lived in the region. They are operationalized as spatially lagged magnitudes of job loss and of released labour force (based on a first-order queen spatial weight matrix, not subdivided by relatedness).

The main findings are as follows. Columns (1) and (2) indicate that the regional employment growth in the nationally most rapidly growing industries is not statistically significantly affected by the relative regional job loss in other industries although the availability of employees that have lost their jobs in other industries in the region does contribute. Column (3) shows that these results do not change if job loss and released labour force variables are both included. The effect is much stronger for the labour force released from related industries. As such, it seems that spillovers between co-located industries are dominated by local labour force reallocation, and particularly between related industries. The effects of a released labour force are local as the spatially lagged variables are not statistically significant (column 4). Also, adding the spatially lagged variables does not change the effects of other variables and, therefore, the spatially lagged variables are not included in the further analyses.

The analysis also shows that a high level of investment in fixed assets in a region stimulates employment reallocation. Job creation is also associated with the growth of the housing stock. Perhaps surprisingly, industries tend to experience less employment growth in regions where they initially had high employment. It could be that where conditions conducive to growth are experienced by a relatively large industry that the competition for local resources is more intense within that industry and that this hinders growth. In addition, unrelated variety has a statistically significant positive effect.

ADDITIONAL ANALYSES

Several issues are addressed in more detail in this section. Firstly, even though the industries that are growing the

Table 2. Regressing employment growth in growing industries on the job loss and magnitude of released labour force in the region.

Dependent variable: regional employment growth in nationally growing industries, $N = 12\ 923$				
	(1)	(2)	(3)	(4)
REL_JOBLOSS	0.6434 (0.4455)		0.0551 (0.3993)	0.0498 (0.4061)
NONREL_JOBLOSS	0.0897 (0.0698)		–0.0675 (0.0609)	–0.0784 (0.0592)
REL_RELEASEDEMPLOYEES		2.0121** (0.8214)	1.9558** (0.7869)	1.9578** (0.7815)
NONREL_RELEASEDEMPLOYEES		0.5625** (0.1745)	0.6414** (0.1978)	0.6849*** (0.1983)
JOBLOSS, spatially lagged				–0.0449 (0.0928)
RELEASEDEMPLOYEES, spatially lagged				–0.2720 (0.2110)
WAGE	–0.0173 (0.0448)	–0.0143 (0.0443)	–0.0140 (0.0441)	–0.0144 (0.0444)
BUSINESSAREA	0.0170 (0.0457)	0.0330 (0.0359)	0.0359 (0.0357)	0.0373 (0.0366)
DWELLINGS	0.5752 (0.6845)	1.3883** (0.6833)	1.4216** (0.6880)	1.4393 (0.7004)
POPDENS	3.90 e–6 (6.75 e–6)	4.32 e–6 (5.22 e–6)	4.71 e–6 (5.29 e–6)	1.64 e–6 (5.20 e–6)
RELVAR	–0.0380 (0.0315)	–0.0572* (0.0311)	–0.0606* (0.0312)	–0.0725** (0.0339)
UNRELVAR	0.0509* (0.0254)	0.0491** (0.0217)	0.0494** (0.0225)	0.0460** (0.0219)
INVESTMENT	0.0344** (0.0156)	0.0349*** (0.0133)	0.0327** (0.0141)	0.0312** (0.0140)
LQ	–0.0105*** (0.0029)	–0.0104*** (0.0029)	–0.0104*** (0.0029)	–0.0104** (0.0029)
PLANTSIZE	–9.25 e–7 (5.29 e–6)	–5.39 e–7 (5.11 e–6)	–6.45 e–7 (5.04 e–6)	–6.40 e–7 (5.00 e–6)
SHARETEAA	0.00002 (0.003)	0.0003 (0.0003)	0.0003 (0.0004)	0.0003 (0.0004)
EDUCATION	–0.0184 (0.0544)	–0.0156 (0.0423)	–0.0149 (0.0425)	0.0044 (0.0408)
Industry–year interactions	+	+	+	+
R^2	0.2528	0.2531	0.2532	0.2532
R^2 adjusted	0.2262	0.2266	0.2265	0.2264

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; standard errors (in parentheses) are clustered by NUTS-3 area.

most rapidly nationally have been selected, and even though the employment growth is quite strongly correlated in industry–year interactions, as many as 34.0% of the values in the final dataset (of the 30% most rapidly growing industries nationally) are negative. That raises the question as to whether the limiting factors for employment growth (such as labour force availability) vary depending on how rapid the growth is. That is, does the model fit equally well in all growth stages? In addition, even though 30% (weighted by employment) of the nationally most rapidly growing industries were selected in the main specification, there is no clear distinction between industries releasing labour force and industries absorbing labour force, especially considering the large regional variations in employment growth.

Given these uncertainties, additional analyses addressing these issues were carried out. Firstly, quantile regression is conducted to see how the availability of labour force influences the growth at the different centiles of it.[1] Secondly, the regressions are conducted on 20%, 40% and 50% of nationally the most rapidly growing industries. All of the changes are applied to specification (3) from Table 2.

Figure 3 demonstrates the results of the quantile regression for the main variables. The effects of most of the variables show a fairly consistent upward trend, the exception being for the magnitude of the released related labour force where no clear trend is discernible. Especially

in the case of the magnitude of job loss, both related and unrelated, the effects are negative and statistically significant in the lower quantiles.

Table 3 demonstrates that the findings are robust with different dividing points between growing and non-growing industries.

Lastly, the current model restricts employment reallocation to the same year. Empirically, the main variables lagged in time have no statistically significant effects.[2] Possibly, this is because most job reallocations are completed within the same calendar year. The actual duration of a job reallocation is difficult to determine, as job changes motivated by decline of an industry cannot be readily identified, although this type of transitions is likely to take longer than with other job changes. It is known that graduates who find themselves in a similar position typically take relatively little time to find a job (Berkhout and Van der Werff, 2014). Also the instability in employment growth rates over time could be a factor in the lack of statistical significance of the lagged values. In this analysis, the division between growing and non-growing industries relates to a fixed point in time and it is possible that the relationships between the industries placed in the two will change if employment growth is unstable over time. This is maybe why the correlation coefficients are weak, and sometimes even negative, between the dependent variable, the main independent variables and their lags in time.
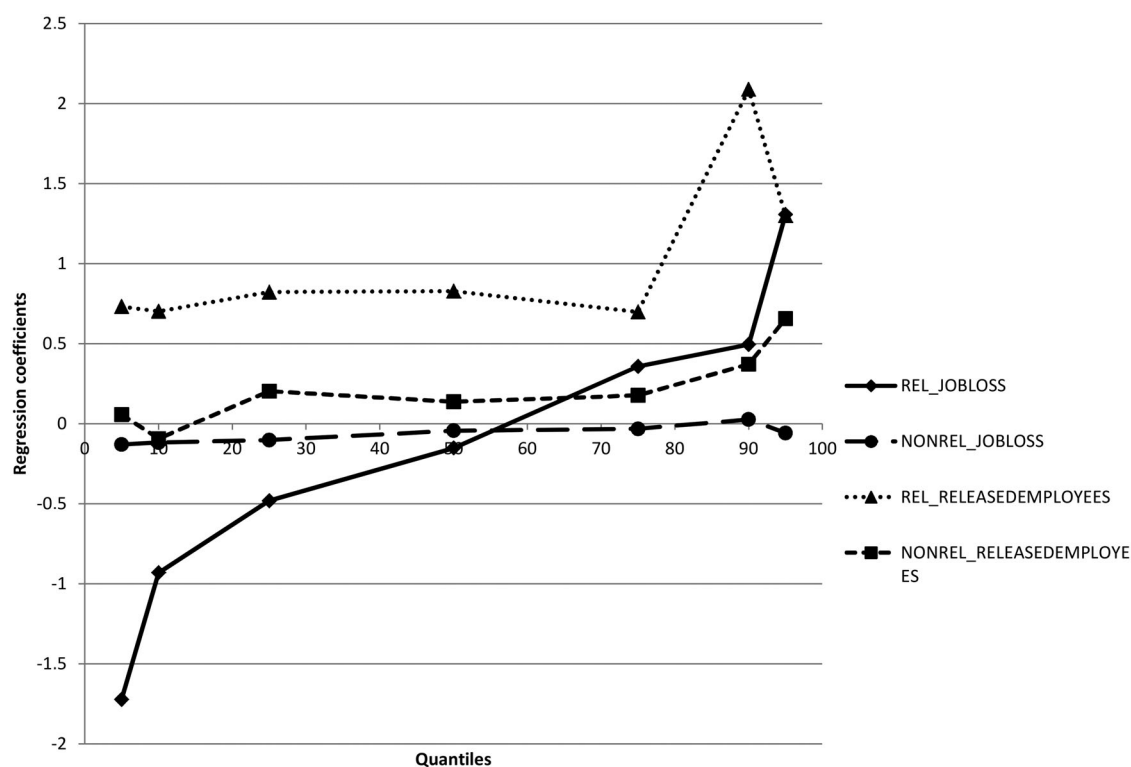
Figure 3. Quantile regression coefficients regressing employment growth in growing industries on the job loss and magnitude of released labour force in the region. All coefficients are statistically significant at least at 0.05 level (the standard errors are not clustered).

Table 3. Regressing employment growth in growing industries on the job loss and magnitude of released labour force in the region, different specifications.

Dependent variable: regional employment growth in nationally growing industries				
	(1)	(3)	(4)	(5)
	Main specification as presented in Table 1, column (3)	20% of nationally most rapidly growing industries	40% of nationally most rapidly growing industries	50% of nationally most rapidly growing industries
REL_JOBLOSS	0.0551 (0.3993)	0.0313 (0.3058)	0.0867 (0.5718)	−0.5111 (0.8585)
NONREL_JOBLOSS	−0.0675 (0.0609)	−0.0117 (0.0504)	−0.1516 (0.0932)	−0.1975* (0.1049)
REL_RELEASEDEMPLOYEES	1.9558** (0.7869)	1.7801** (0.6488)	3.6814** (1.1260)	4.7803** (1.7847)
NONREL_RELEASEDEMPLOYEES	0.6414** (0.1978)	0.4894** (0.1722)	0.7437*** (0.1758)	0.8619*** (0.1936)
Other variables as in specification (3) from Table 1	+	+	+	+
R^2	0.2528	0.2569	0.2466	0.2365
R^2 adjusted	0.2262	0.2287	0.2205	0.2107
N	12923	8861	15598	18453

Note: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; standard errors (in parentheses) are clustered by NUTS-3 area.

CONCLUSIONS

The main findings of the paper are as follows. Firstly, and consistent with earlier findings in the labour reallocation literature, it is shown that decline in some industries is countered by growth in others. Thus, at least to some extent, decline is a self-correcting rather than a self-reinforcing process. In terms of employment, industries can be primarily seen as competitors: the growth of some is enabled by extracting the resources of others in a communicating vessels fashion. Further, these interactions between industries' labour demands are shown to be localized: evidence is found that decline is countered by growth in other industries within the same NUTS-3

region, but not even between neighbouring NUTS-3 regions.

Secondly, the interactions between industries' labour demands depend on their relatedness. In line with the proposition that spillovers are easier between related industries (Boschma and Iammarino, 2009; Frenken et al., 2007), the analysis shows that related industries are the most capable of recycling, re-bundling and transforming the resources from declining industries. However, for this to happen, related industries in a region need to be resizing in opposite directions, and this does not happen very often. Although employment growth rates of all industries in the same region in the same year are uncorrelated (ICC coefficient of 0.00%), the growth rates of related industries in the same region in the same year are positively correlated (ICC coefficient of 18.49%).

Thirdly, a distinct geographical pattern can be observed in which new jobs are created in the residential locations of people who have lost their jobs in other industries rather than where the jobs were lost. This pattern of job reallocation indicates that it is people rather than other released resources who drive job creation elsewhere. The discrepancies between the locations where people live and people work are, however, facilitated by overlapping local labour markets in the Netherlands and this might be less the case in countries where the local labour markets are more clearly separated.

A simple and attractive interpretation of this association is the reabsorption of the labour force released from industries with decreasing labour demand. It is, however, possible that rather than this reallocated labour force being predominantly released through having their job relationship terminated; they have been attracted to more efficient industries. This could be attributable to greater efficiency in resource use in the growing industries. However, for this to be true in the fixed-effects model, some of the same industries in the same year would have to be more efficient in using the resources across the regions. The efficiency would also have to vary significantly from year to year, as do the employment growth rates, and not be captured by the wages variable. Although all this is possible, it seems very unlikely. Alternatively, it could be that the relationship depends on some underlying regional characteristics that stimulate employment reallocation. It is possible that such characteristics exist beyond those controlled for (human capital levels, investment levels) but they are not straightforward, especially since the same labour market regulations apply to the whole of the Netherlands. Given the present evidence, a causal relationship where decline in some industries leads to job creation in others seems quite plausible.

These findings have several implications. They show that the quantity and quality of inflows to an industry depend on the performance of industries close to them. As such, the development paths of industries are influenced by their local environment (for other empirical evidence, see Rigby and Essletzbichler, 2006; and Izushi and Aoyama, 2006). In addition, the findings illustrate the importance of people in job creation. Probably with the exception of very rapid and extreme transformations in an economy, people remain the most valuable resource of declining industries who can be transformed and reused elsewhere. This is in line with Florida's (2003, 2005) argument that skilled people attract jobs to the locations where they choose to live.

Further, this paper outlines a more nuanced picture of labour pooling. While there is a documented tendency of firms with similar labour skills to be close to each other both within (Rosenthal and Strange, 2001; Overman and Puga, 2010) and across industries (Ellison et al., 2007), this research indicates that there are substantial geographical discrepancies between where people live and where they work. When it comes to switching jobs, residential location is more important than the location of the previous job, especially in the case of cross-industry switches. As such, the location of firms is not sufficient when defining the labour pool. Growth differentials are also an important dimension of labour pooling as there are substantial fluctuations in employment growth rates in region–industry combinations that greatly affect the availability of labour with specific skills.

The results indicate that policy-makers need to be aware that while regions are capable of creatively transforming and reinventing themselves, most transformations are gradual rather than radical. Potential regional development paths need to be well understood by policy-makers. If the aim of regional policies is to reduce the influence of negative labour demand shocks, policy-makers, when trying to stimulate new job creation, should distinguish between potential industries and encourage those that can absorb the region's skill base. However, it must be kept in mind that many directions for new job creation might be not viable due to shocks being correlated in related industries.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

SUPPLEMENTAL DATA

Supplemental data for this article can be accessed at http://10.1080/00343404.2016.1153800

NOTES

1. Quantile regression is conducted on all the variables including the dummy set, not accounting for the autocorrelated nature of the data.
2. Even though industries that are growing are re-identified each year, the lags are calculated so that the relatedness and definitions of growth refer to the same industries as in non-lagged variables. Full results are available from the authors upon request.

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