Regional labour flows between manufacturing and business services. Reciprocal integration and uneven geography.

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Paper to be presented at the Regional Studies Association Annual Conference 2018, Lugano, Switzerland

FUNDING ACKNOWLEDGEMENT
This work was supported by Länsförsäkringars forskningsfond, grant 'Svensk regionalekonomisk utveckling och omvandling' and CRA Centre for Regional Analysis, School of Business, Economic and Law, University of Gothenburg.

ABSTRACT
This paper uses Statistics Sweden's full-population geo-coded register data for Swedish workers and their labour market moves in the period 2010-2014 to analyze regional flow patterns of employees between manufacturing, general business services and knowledge-intensive business services. Our findings suggest that in general, labour flows between manufacturing and services has important bidirectional features, even as manufacturing generally declines. There is not a staff exodus from manufacturing to services, but rather an exchange suggesting large skill interdependencies. Skill dependency links are especially strong between high tech manufacturing and KIBS. However, there are strong geographical dimensions to this, emphasizing a reinforcement of spatial division of labour patterns. In trend terms, the decline of manufacturing is rather similar in all regional types. The labour flow between manufacturing and KIBS has a higher chance to take place in metropolitan regions, but far more often also involve a shift in the place of work, between or towards the metropolitan regions. The major challenge for less dense or peripheral regions is therefore not necessarily the decline of manufacturing per se, but rather that the low levels of transition into high value added and rapidly growing and related knowledge intensive business services are insufficient to make up for employment losses in manufacturing.

Introduction – patterns of structural and regional change

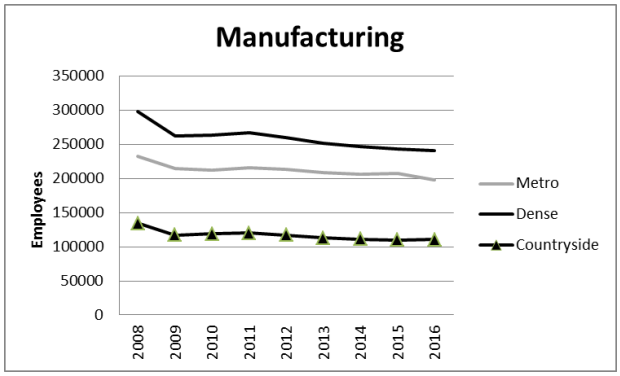
This paper is concerned with how and where workers change jobs between manufacturing and business services, and the geographical patterns of these changes. This is an important topic, because structural change since the 1970s has for many economies in Europe and North America concentrated around the decline of manufacturing and growth of business services. In traditionally manufacturing-heavy Sweden, for example, manufacturing employed 40 percent of the about 2 million employees in the private sector in 1985. In 2004, manufacturing employed only 31 percent, and it has declined even more since. On the other hand, business services went from employing 13 percent of the workforce in 1985, to 25 percent in 2004 (Lundquist et al. 2008a).

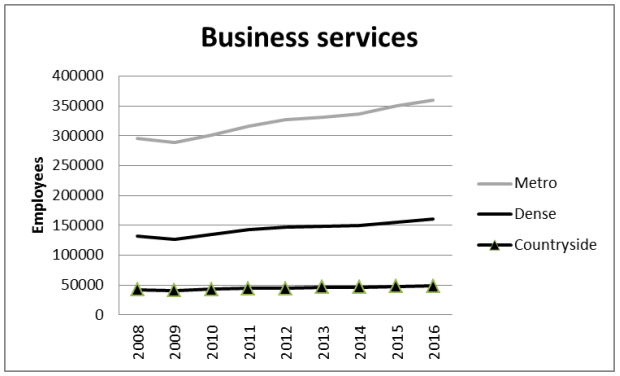
This transition from manufacturing to services may at first sight seem as not much of an issue. The prime reason for this is the increasing integration of manufacturing and business services, and the prominent position that business services today take in economic growth. What Lundquist et al. (2008a) call the total "manufacturing-related economy", in fact increased its share of employees in Sweden from 53% to 56% between 1985 and 2004, increasing employment numbers by about 40,000. Also, researchers have abandoned the outmoded view that services are merely complementary and subordinate to manufacturing, and realized that services can nowadays be a part of the economic export base of regions, and themselves motors of structural change (Stabler and Howe 1988; Hansen 1990, 1994; Begg 1993; Muller and Doloreux 2009). Furthermore, after all, many researchers agree that the shift is partly a statistical artifact, created by outsourcing of previous in-house service activities.

However, for geographical reasons, it is not quite that simple. Today's structural change towards services is associated with dramatic changes in the location patterns of economic activities. Within many European countries, a new period of increasing regional disparities took off around 1990, or slightly earlier (European Parliament 2007). For example, Enflo and Henning (2016) describe how the Swedish regional divergence-era since the 1980s replaced a strong and long post-war convergence period. It has so far has taken Sweden back to level of regional inequalities last observed before the Second World War.

When structures change, an important part of regional resilience (Martin 2011, Boschma 2015) is associated with the ability of regions to put labour, embodying the stock of regional skills, to use in growing activities (Neffke et al. 2011a, Neffke et al. 2018). Consequently, in order not to lag behind and become the losers in the new regional divergence era, one of the most important factors of regional success today is arguably for regions to be able to accommodate the shift from manufacturing to business services.

This creates a huge conundrum for some regions. Figures 1 and 2 below illustrate the employment development of manufacturing and business services, respectively, in three types of regions – metropolitan, dense (mid-sized) and countryside regions – in Sweden during the period 2008 to 2016. While manufacturing is slowly declining in all parts of the regional system, business services have both a far higher share, and higher expansion rate in the metropolitan regions. Mid-sized and smaller regions seem not to be particularly successful in any of the sectors, not manufacturing, nor business services.





Figures 1 and 2: Employment in Sweden in manufacturing and business services 2008-2016 by three regional categories. Own elaboration of employment data from Statistics Sweden (www.scb.se). Regional categories from Swedish Agency for Economic and Regional Growth (2011 p. 19), industries are standard NACE categories.

In the research literature, many ideas about how manufacturing and business services are linked, and how they benefit each other in terms of regional growth, have circulated in recent years (Garcia-Milà and McGuire 1998, Muller and Doloreux 2009, Brenner et al. 2018). However, recent literature investigating the integration between manufacturing and service, has stayed surprisingly silent on the issue of what kind of similar inputs or resources, where the most important one arguably is experienced labour, the sectors jointly require (Bryson and Daniels 2010). Also, few if any studies have mapped how movements of employees between manufacturing and business services contribute to the current regional divergence process. But new advances open opportunities to investigate this. A better conceptualization and measurement of structural change and the importance of labour flows is being assembled in geography (Power and Lundmark 2004, Martynovich and Lundquist 2016, Eriksson et al. 2018), and labour and skills are now increasingly emphasized as key factors in enabling regional change (Boschma et al. 2008, Timmermans and Boschma 2013).

The aim of this paper is to investigate to what extent manufacturing and producer services are integrated by being dependent on the same types of labour, and what consequences this has for regional development. To study this empirically using Swedish data, we focus on regional aspects of manufacturing ↔ business services labour flows. We ask the following operational questions. First, how strong is the integration between manufacturing and producer services, measured as dependence on the same type of worker skills through inter-industry labour flows? Second, which regional consequences does this integration have for regional divergence, studied by regional labour flows?

We use high-resolution Swedish employee-employer matched micro data between 2010 and 2014 to answer these questions. This is a recent period and admittedly short, but it importantly enables us to keep regional and industry definitions stabile. We start the paper with a summary of the literature on the links between manufacturing and business services, and the spatial implications from the different arguments in the literature. Thereafter, we move on to

describe the empirical data, and the strategies we employ for analyzing it. On this follows a section where we account for the empirical results. Overall, we find reciprocal labour flow links between manufacturing and business services, but dependence on partly the same labour resources is particularly the case for high-skill manufacturing and KIBS. With the transition to services comes a different economic geography, not only in terms of growth but also in terms of labour flows between regions. The labour flows between manufacturing and KIBS has a higher chance to take place in metropolitan regions, but often also involve a shift in the place of work between or towards the metropolitan regions. The paper is ended by concluding comments, where we specify how the findings contribute both to the business service literature, labour mobility literature and the emerging literature on long-term regional growth.

Literature background: integration of manufacturing and business services and its spatial implications

The links between manufacturing and business services

Whereas manufacturing activities have been meticulously defined in the industry statistics since the breakthrough of the Second industrial revolution (Enflo et al. 2014), the precise definition of business services is rather more recent. Despite the importance of services in today's regional economies, both data and theoretical development to understand their role has lagged behind that of manufacturing for a long time (Glasmeier and Howland 1994). While we note that the exact definitions and roles of especially KIBS in the current economy is debated (Shearmur and Doloreux 2017), we define business services as those services serving a business-to-business market (see discussion in Lundquist et al. 2008a)[1]. This is largely consistent with the idea of Hansen (1994): "Producer services are intermediate functions that serve as inputs into the production of goods or other services." (Hansen 1994:189). These services may be of a general kind, and not necessarily high-tech, or come in the form of knowledge intensive-business services (KIBS: Muller and Doloreux 2009). Of course, the clients of today's business service firms do not consist of only manufacturing firms, but just as well service firms or even other business services.

The academic view on the interaction and integration between manufacturing and services can be understood from a long-term perspective, which also explains why evidence on this is much better understood today than during previous eras of growth. In fact, the role of services has been misinterpreted for some time, and services were for long considered as unimportant both from a theoretical and empirical point of view (Hansen 1994). This does of course not mean that the idea about of strong and increasing interdependence between services and manufacturing is completely new in our time (Glasmeier and Howland 1994, Garcia-Milà and McGuire 1998). In the scientific literature however, scholars became widely interested in the role of business services starting in the 1980s (Illeris and Philippe 1993, Wood 1991). This also meant that the debate about the blurring of sector boundaries between manufacturing and

[1] We make no distinction between producer services and business services, but we prefer the term business services.

services, and what they mean for our understanding of how economic development works, became important (Begg 1993, Bryson and Daniels 2010).

Since the acknowledgement that services play an important role in economic development, a subtle progression in the research about the relationships between manufacturing and services can be identified. One line of research into this field looks specifically at the empirical links between manufacturing and service industries – for example input-output linkages and knowledge flows – but still from the point of view that manufacturing and services are essentially distinct industries or sectors, with different roles in the growth process (Garcia-Milà and McGuire 1998, Castellacci 2008, Lundquist et al. 2008a, Brenner et al. 2017, Capasso et al. 2017). While theories about competitiveness creation in clusters have long made this point (Porter 1990), the studies of manufacturing-business services interaction have made their interdependencies immediately apparent, especially in innovation processes (Muller and Zenker 2001, Howells 2004).

But empirical trends since the 1980s have added to the confusion around the distinction between manufacturing and services. While outsourcing and externalization is a well-known explanatory factor for the growth of business services during the last decades (Glasmeier and Howland 1994), mere reference to outsourcing as explanation for this does not suffice for many economies. Additionally, increasing complexity in production and economic transactions have been argued to provide reasons for the increasing demand for specialized service (Hansen 1990, 1994, Glasmeier and Howland 1994). More advanced transactions create new markets for targeted business services. In this way the service shift, or integration, is also of importance to issues about firm strategies, as the changing relationship between manufacturing and services can be seen as a consequence of changing business practices (Hansen 1990). New technologies also matter. For example, the introduction of IT also quickly created a demand for IT services, causing the employment numbers to virtually explode during the 1990s (Glasmeier and Howland 1994, Martynovich and Henning 2018).

New views on the go-betweens between manufacturing and service are now complementing previous findings (Bryson and Daniels 2010). Summarizing the literature on KIBS, Muller and Doloreux (2009) conclude that whereas KIBS previously were seen as deliverer of specialized services, they are now regarded as co-businesss in interaction with their clients. In essence, KIBS have been upgraded from followers to actually proponents of change themselves, for example when it comes to innovative activities (Simmie and Strambach 2006, Shermur and Doloreux 2017). With speed, this literature is moving away from the passive role given to services in early accounts. Also, very recent research stresses how manufacturing and service are *related* in sharing the same or similar resources (Neffke and Henning 2013, Nikulainen and Pajarinen 2013). This research not only suggests that there are strong and even integrative empirical links in terms of resource dependence between manufacturing industries and their business service counterparts. In an economy where skills, knowledge and human capital is commonly seen as a key resource to the success of firms and regions (Florida 1995, Neffke et al. 2018), the essential theoretical differences between manufacturing and services seem to be eroding as well.

Location and co-location

In contrast to the, at least historically, rather dispersed location patterns of manufacturing industries (Lundquist et al. 2008b, Berger et al. 2012), the centralization and limited propensity of services to grow in rural and peripheral locations was noted early in geography (Wood 1991, Glasmeier and Howland 1994). Keeble and Nachum (2002), for example, document the high concentration of business services in Great Britain to London. Though London serves as a world capital for some varieties of business services, similar patterns of regional dominance, especially in KIBS, can be seen in other economies, such as Sweden, too (Hermelin 2007). In the literature about locational factors of business services, aspects that are mentioned as exerting a pull on location include market size, client proximity and access to qualified labour. Larger markets will provide more opportunities to achieve division of labour among firms benefiting business services (Hansen 1990), but business services firms also need knowledge about client needs, which is facilitated by geographical proximity (Illeris and Philippe 1993, Keeble and Nachum 2002). Many accounts also describe the access to various skills and knowledge diffusion via labour mobility as being of central importance to business services. This provides arguments for the overall importance of agglomerations to these industries (Illeris and Philippe 1993, Glasmeier and Howland 1994, Keeble and Nachum 2002, Power and Lundmark 2004, Simmie and Strambach 2006).

However, these arguments do not go completely unrivalled. Some business services are clearly successfully exported and do not require immediate geographical access to markets (Illeris and Philippe 1993). Also, especially niched business service firms may have opportunities to decentralize to locations outside major agglomerations. In this way, they can take advantage of lower costs and beneficial lifestyle conditions, while though often drawing on links to the larger urban agglomerations (Keeble and Nachum 2002).

In contrast to the rather recent literature on business service location, the locational choices of manufacturing industries has been one of the more seminal issues of economic geography throughout its history, building much of the identity of the discipline (Wood and Roberts 2011). Explanatory factors for different industries have ranged from the factor access costs of Weberian location theory via emphasis on agglomerations and clusters (Porter 2000, Rosenthal and Strange 2003, Buenstorf and Klepper 2009), to the modern eclectic diffusion theories stressing long-term shifts in location due to the different requirements of firms in different phases of industrial development (Lundquist and Olander 1999, Duranton and Puga 2001, Neffke et al. 2011b).

Obviously, the distinction between regional factors explaining location and performance of manufacturing and business services are not that clear cut. Many of the factors explaining location of business services have been developed upon previous insights from theories and empirical studies concerned with manufacturing location. At the same time as education levels in manufacturing and business services have increased in the last decades (Henning et al. 2017), recent research have emphasized the importance of localized skills as one of the

most fundamental regional resources accessible to manufacturing and business service firms alike, having a decisive impact on location decisions (Neffke et al. 2018).

While access to a pool of skilled labour was emphasized in the seminal works of Marshall (1890) as an important agglomeration advantage, current contributions have in detail studied how industries to varying extent share dependence on the same type of skills in the labour force (making them related; Neffke and Henning 2013, Otto et al. 2014, Diodato and Weterings 2014, Fitjar and Timmermans 2017), as well as how regional flows of labour between plants and industries impact economic performance (Boschma et al. 2008, Eriksson 2011, Timmermans and Boschma 2013, Boschma et al. 2014). Analyzing specifically the interaction between manufacturing and service, Brenner et al. (2018) find no causal effects on regional growth patterns between manufacturing and KIBS, which could be interpreted as limited knowledge diffusion taking place. More importantly, however, as far as can be discerned with their method, they find shorter run regional labour sharing effects between manufacturing to KIBS.

Though many accounts agree that labour is a vital factor in today's economy, is less well investigated how labour flows take place between *sectors and regions* in the economy and how this impacts the regional economic development (Eriksson et al. 2018). This is especially true for manufacturing and business service interaction, where evidence on labour flows from a regional perspective and how this ties to structural change is scarce. Indeed, analysis of regional flow patterns between manufacturing and business services may not only provide evidence on the resource integration between manufacturing and business services and how established skills can find new applications, but also on how shared resource dependences is linked to processes of regional convergence or divergence in today's economy (Martynovich and Lundquist 2016, Eriksson et al. 2018).

Empirical approach and data issues

To answer our research questions, we analyze geo-coded individual data derived from the registers of Statistics Sweden. These data contain information on all individuals working in Sweden. We restrict the analysis to the period between 2010-2014, for which we have consistent industry classifications (SNI2007/ NACE Rev.2). By an anonymized ID, we are able to follow the individuals across years. For each individual and year, the economic status is recorded (for example income, industry affiliation of their main employer, etc.) as well as auxiliary individual variables (for example sex, education and age).

We rely on the standard industrial classification system to distinguish between manufacturing and business services. Inspired by Henning et al. (2017) and Johansson (2017), we distinguish between two sets of manufacturing industries, which we call low-skill manufacturing (LO-M) and high-skill manufacturing (HI-M). This reflects the fact that average growth, formal education levels and average incomes are higher in high-skill manufacturing than low-skill manufacturing (Table 1). Following the literature in the field, we also distinguish between two sectors of business services: knowledge intensive business services (KIBS) and other business

services (OSER). This distinction is reminiscent of that of Castellacci (2008), although OSER does not have a clear equivalent in Castellacci's taxonomy. However, we suggest that OSER are services that supply "supporting infrastructure" in Castellacci's (2008) terminology, auxiliary to and maybe even integrated with other innovative firms and sectors in the regional economies. In contrast to this rather broad category of business services, the literature has developed a wide agreement on precisely which industries should empirically be defined as KIBS. In the previous revisions of NACE this corresponded to NACE 72 (computer and related activities), 73 research and development, 74 other business activities such as legal services, accounting, technical testing, technical consultancies (Muller and Doloreux 2009). We here make adaptions to the new NACE revision 2.0 (Table 1).

Name	LO-M	HI-M	OSER	KIBS
Number of employees, 2010	255,767	305,845	243,332	229,477
Employment growth 2010-2014	-7.5%	-3.2%	-3.0%	8.2%
Average education level	3.5	4	3.7	4.8
Average wage	306,300	357,400	201,900	341,000
Examples	Food Textiles Wood Steel Furniture	Chemicals and pharmaceuticals Metal manufacturing Electronics Machinery Cars Vehicles	Vehicle leasing Recruitment Staffing agencies Security Cleaning Office services Call centers	Legal services Technical consultants Auditing Research PR
Codes SNI2007 (NACE Rev. 2)	10000-18200 22110-24540 31011-33200	19100-21200 25110-30990	77110-82990	69101-75000

Table 1: Description of the different industry aggregates. Own elaboration on data from Statistics Sweden. Note1: Education level is min 1 and max 7; where 1 is elementary education shorter than 9 years; 2 is 9 years elementary school; 3 is upper secondary school max 2 years; 4 upper secondary school 3 years; 5 is post- upper secondary school education shorter than 3 years; 6 is post- upper secondary school education 3 years or longer (normally a university degree); and 7 is PhD education.
Note 2: Income is net yearly salary in SEK.

As regional indicator, we use the regional labour market location of the plant that individuals are mainly affiliated with, and from where we also draw their industry affiliation. The regional labour markets (*LA-region*) are defined by Statistics Sweden based on commuter patterns, and we use the 2014 version. These are grouped into three sets of regions according to the typology used by the Swedish Agency for Economic and Regional Growth (2011 p. 19) depending on their economic and geographical characteristics: countryside regions, dense

regions and metropolitan regions (Table 2)[2]. The metropolitan regions have generally much bigger and more varied labour markets than other types of regions. The countryside regions are normally also located in comparatively peripheral areas. Overall, the typology gives an informed description of the structure of the Swedish hierarchy of regions.

	Metropolitan regions	**Dense regions**	**Countryside regions**
Number of regions	3	29	41
Average size of labour market (employees, 2010, our definition)	708,680	52,668	14,321
Examples	Stockholm Gothenburg Malmö	Linköping Borås Sundsvall Umeå	Ljungby Filipstad Ludvika Åsele

Table 2: descriptives of the regional aggregates. Own elaboration on data from Statistics Sweden.

In the empirical analysis, we concentrate on two types of worker mobility. First, we track if workers *change their main industry affiliation* between any of the manufacturing and service aggregates between our measuring points at 2010 and 2014. This mobility occurs when an individual switches job to a plant in a different sector, or when an entire plant changes sector. We call this a sector labour flow. Secondly, we track whether this move is associated with a *change of regional region of work* (measured by location of the plant to which the individual is mainly associated). We call this regional mobility. We limit our analysis to those individuals who earn an income from employment, and that are within the age span of 18-65 years in 2010. We also remove the relatively few individuals for which either industry affiliation or region is unknown.

Findings: manufacturing-business service links, integration, and regional change

The total flow manufacturing → business services in Sweden over the period we investigate is 27,434 workers. Flows the other direction, business services → manufacturing account for 24,436 workers. Thus, although there is some evidence for "de-industrialization" by means of a higher manufacturing → business services flow (about 3,000 workers), flows are largely bi-directional and the difference is relatively small. This suggests that there is rather an integration of manufacturing and business services in labour market terms, than a one-directional exodus from manufacturing to business services.

To investigate this notion further, Figure 3 shows the number of sector labour flows between the measuring points in 2010 and 2014 for the different sector categories: LO-M, HI-M, OSER and KIBS. While the vertical axis registers the category of move (1 being, for example flows LO-M ↔ KIBS), the shape of the marker registers if the flow is from manufacturing to

[2] The Swedish Agency for Economic and Regional Growth employ a slightly different definition of regions (*FA-regions*), and we adapt this to the LA-regions used by Statistics Sweden. See also Eriksson and Hane-Weijman (2017).

business services (in this case LO-M → KIBS) or vice versa (KIBS ← LO-M). As expected, the high skill driven combination HI-M → KIBS displays by far the highest worker flow (Figure 3) among the possible combinations. But again, flows in the direction business services → manufacturing are not far behind their manufacturing → business services counterparts in absolute terms, in any of the sector combinations. In one instance, the flows between OSER → HI-M, numbers actually supersede the counter direction flows.[3]

Given these sizeable sector labor flows in both directions, the question is of course if they are larger than what can be expected from any arbitrary normal labour interaction between sectors in the economy, in a way that represents the integration of the sectors by use of similar skill resources (experienced workers). Inspired by the skill-relatedness method and theoretical arguments of Neffe and Henning (2013) and Otto et al. (2014), but making the representation directional, we calculate this relatedness R_{ij} between the sectors *i* and *j* as (Otto et al. 2014):

$$SR_{ij} = \frac{F_{ij}}{\hat{F}_{ij}} \quad (1)$$

where $F_{i,j}$ is observed flow between sectors *i* and *j* between 2010 and 2014, and $\hat{F}_{i,j}$ is expected flow under a random flow scenario calculated as:

$$\hat{F}_{ij} = \frac{F_{i.}F_{.j}}{F} \quad (2)$$

where F is the total labour flow between sectors in the economy, $F_{i.}$ are total outflows from sector *i* and $F_{.j}$ are total inflows into sector j. In all, this will give us a quote representing the size of the observed flow between a sector pair 2010-2014 (for instance, HI-M → KIBS), compared to an expected flow under random circumstances. If the quote is above 1, we take this as an indication that they are dependent on partially the same worker resources for their operation they are *skill related* (Neffke and Henning 2013).

Figure 4 displays this directional skill relatedness between the combinations of sectors 2010-2014. Although we have concluded that job flows between manufacturing and business services occur quite frequently, the labour flows are in most cases slightly lower than expected from a random assumption. In fact, many of the manufacturing → business services do not qualify as being skill-related, as measured by their exchange of labour. Rather, they tend to exchange labour by virtue of their sector size. There are however some striking exceptions from this. The mutual resource dependencies in terms of shared skills, are strong between HI-M and KIBS, in *both* directions (1.11 and 1.17 respectively). Also the OSER → HI-M relatedness link is above 1 (1.05).

[3] This has been checked for robusness in case the high number of moved pertained to one dominating establishment, but this is not the case. Moves are widely distributed across a large number of establishments.

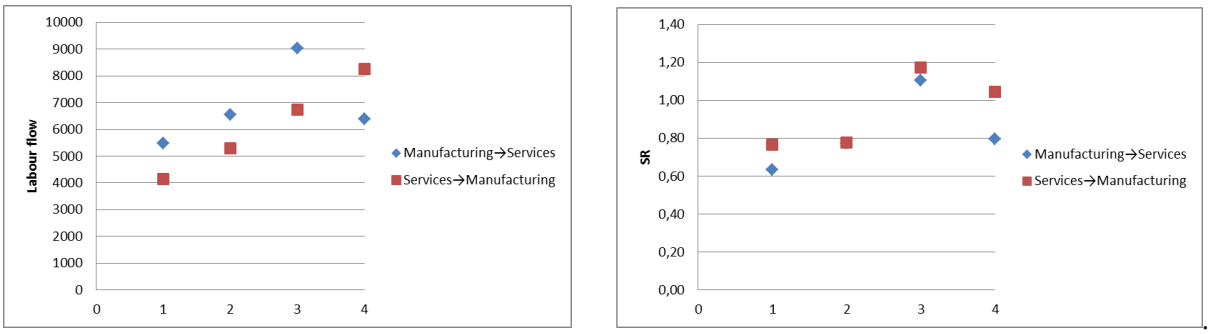


Figure 3: Labour flows between the different sectors (directional, number of individuals). To facilitate interpretation, markers indicate whether flows are from manufacturing to service, or vice versa. The detailed categories are: 1 is LO-M ↔ KIBS, 2 is LO-M ↔ OSER, 3 is HI-M ↔ KIBS, 4 is HI-M ↔ OSER. Own elaboration on data from Statistics Sweden.

Figure 4: Relatedness (directional) from manufacturing to service, or vice versa. The detailed categories are: 1 is LO-M ↔ KIBS, 2 is LO-M ↔ OSER, 3 is HI-M ↔ KIBS, 4 is HI-M ↔ OSER. Own elaboration on data from Statistics Sweden.

In all, the strength of resource integration between manufacturing and producer services, measured as dependence on the same type of worker skills through inter-industry labour flows, show two different facets. The low-skill manufacturing ↔ business services labour flows are generally high in both directions in absolute terms, but not higher than could be expected by their importance in the economy. From a resource perspective, the distinction traditionally drawn between low-skill manufacturing and business services, seems unproblematic (though they could of course be dependent in multiple other ways). For the high-skill industries the situation is very different, with a high skill relatedness with KIBS, and partly with OSER. To some degree, it may even be problematic to distinguish between them as separate analytical units (industries) in the economy.

Our second research question regarded the consequences if this integration and employment shift toward services, for regional development. In Figure 5, we describe the distribution of the sectors in the regional groups (as shares of total employee numbers in Sweden). LO-M has a relative location emphasis in the dense regions, while HI-M is less represented in the countryside regions and has a slight bias towards the metropolitan regions. The most striking regional concentration patterns pertain to services, with a clear hierarchical representation metropolitan – dense – countryside regions. This is especially marked for KIBS, with an about 70% location to the three metropolitan regions. This concentration is far above any of the manufacturing sectors. During our period of study, however, not only have metropolitan regions higher shares of the growing services, they also loose less in declining sectors than the other regional groups (Figure 6). Overall, KIBS is the only of our four studied sectors that experience growth during the period, in all regional groups but in particular in the metropolitan regions.

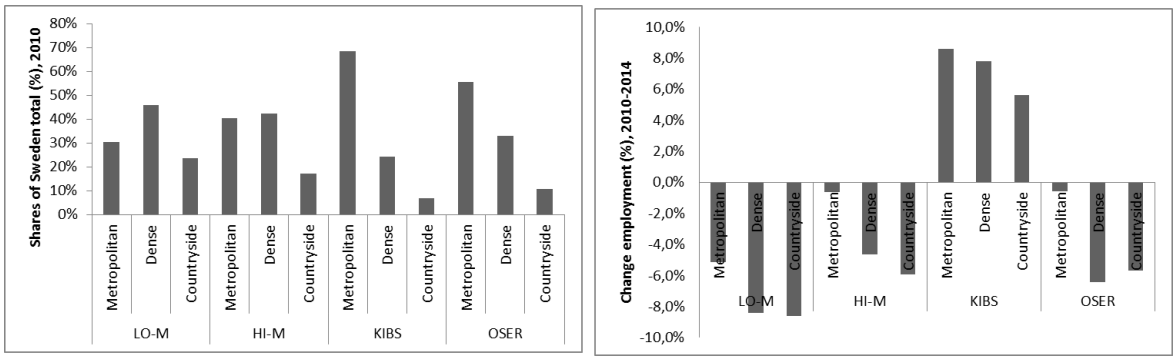


Figure 5: sector shares of employees for LO-M, HI-M, KIBS and OSER (of Swedish total) in metropolitan, dense and countryside regions, 2010. Own elaboration on data from Statistics Sweden.

Figure 6: employment changes (percent) for LO-M, HI-M, KIBS and OSER in metropolitan, dense and countryside regions, 2010-2014. Own elaboration on data from Statistics Sweden.

Our focus is now directed to what the labour flows between manufacturing ↔ business services, and especially for the highly integrated high-skill manufacturing industries and KIBS, imply for the increasingly uneven geographical distribution of economic activities. Table 3 records what share of the sector labour flows manufacturing ↔ business services involve a regional move. Numbers are higher than expected from traditional migration numbers, because here regional move does not necessarily record a change in region of residence, but in location of workplace. Around 30 percent of the moves manufacturing → business services involve a regional move, and this is generally above the economy average (last row). Numbers for the direction business services → manufacturing are lower and in general are slightly below the economy average.

Sector	% involving regional move
LO-M→KIBS	33%
LO-M→OSER	27%
HI-M→KIBS	28%
HI-M→OSER	27%
KIBS→LO-M	22%
OSER→LO-M	23%
KIBS→HI-M	24%
OSER→HI-M	21%
Average all flows	25%

Table 3: frequencies of labour sector flows 2010-2014 and percentages involving a regional move. Note1: regional move does not necessarily record a change in region of residence, but in location of workplace. Own elaboration on data from Statistics Sweden.

Thus, the labour flow manufacturing ↔ business services have a distinct geographical component. While they relatively often involve a spatial move, manufacturing → business services flows are more often, and more often than the average, associated with a spatial move. However, Table 3 does not record the geographical destination of the regional moves. To investigate this, we split up the geographical mobility indicators by regional type. Figure 7 describes how we do this. The aim is to figure out and compare the relative intensity of a specific sector worker flow type, in different spatial move combinations.

As an example, we would like to identify the spatial patterns for those who leave low-skill manufacturing (LO-M). First, we consider all possible sector labour flow alternatives for this specific combination: LO-M → KIBS, LO-M → OSER and LO-M→ Other sector (in the economy), in the same metro (blue fields in Figure 7). We calculate the share of a specific move among these as:

$$S_{ij,sp} = \frac{F_{ij,sp}}{\sum F_{i,sp}} \quad (3)$$

which shows the shares of workers making a specific move combination (*ij*, for instance LO-M→KIBS) in a specific spatial combination (*sp*) as a share of all labour flow alternatives who *could* have achieved from that sector combination in that specific spatial setting. This calculation is repeated for the other spatial combinations (arrows), and transferred to a comparison (red field), displayed in Figure 9. Then the sequence is reiterated for all spatial combinations (working in another metro 2014 compared to 2010; and working in another regional group 2014 compared to 2010, and all sector combinations). This results in the of Figures 8-15. *In essence, we measure the intensity of a particular sector flow pattern, compared to available alternatives in specific spatial move (or not) combinations, i.e. if specific industry combinations are more common among a certain spatial move pattern, than others.*

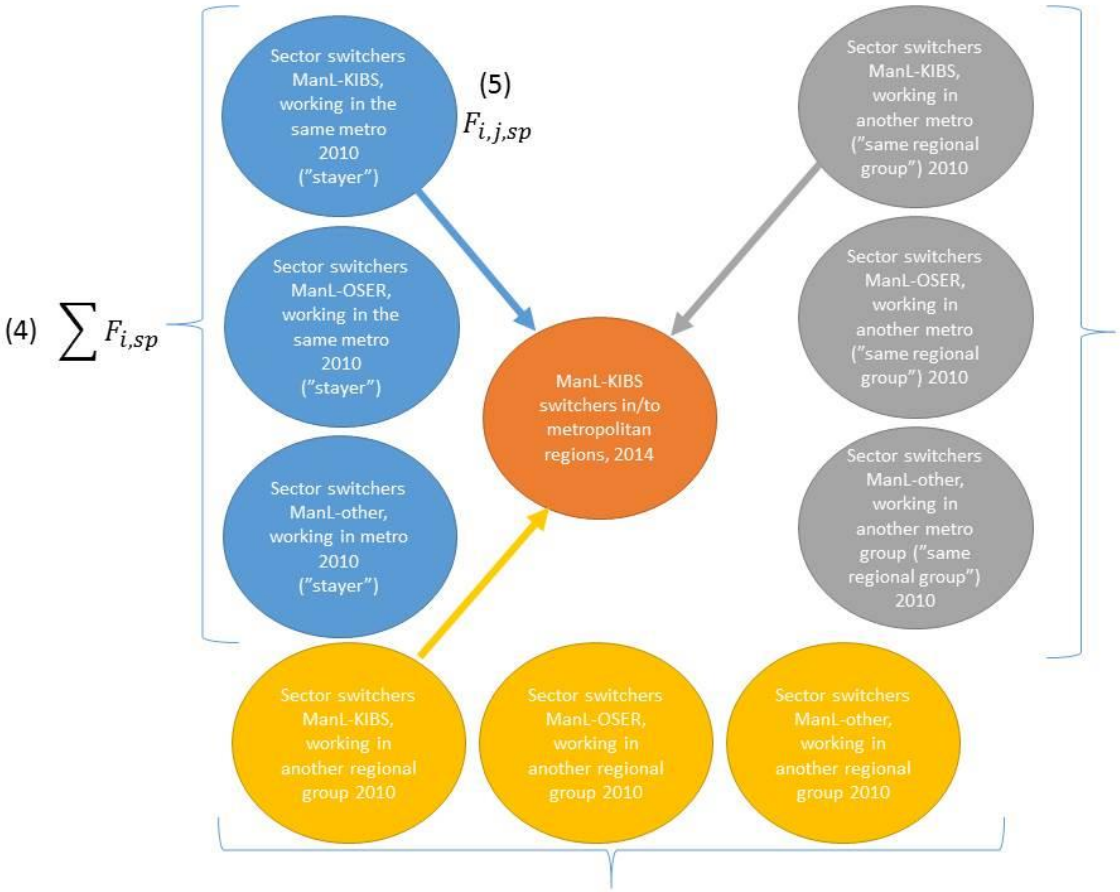
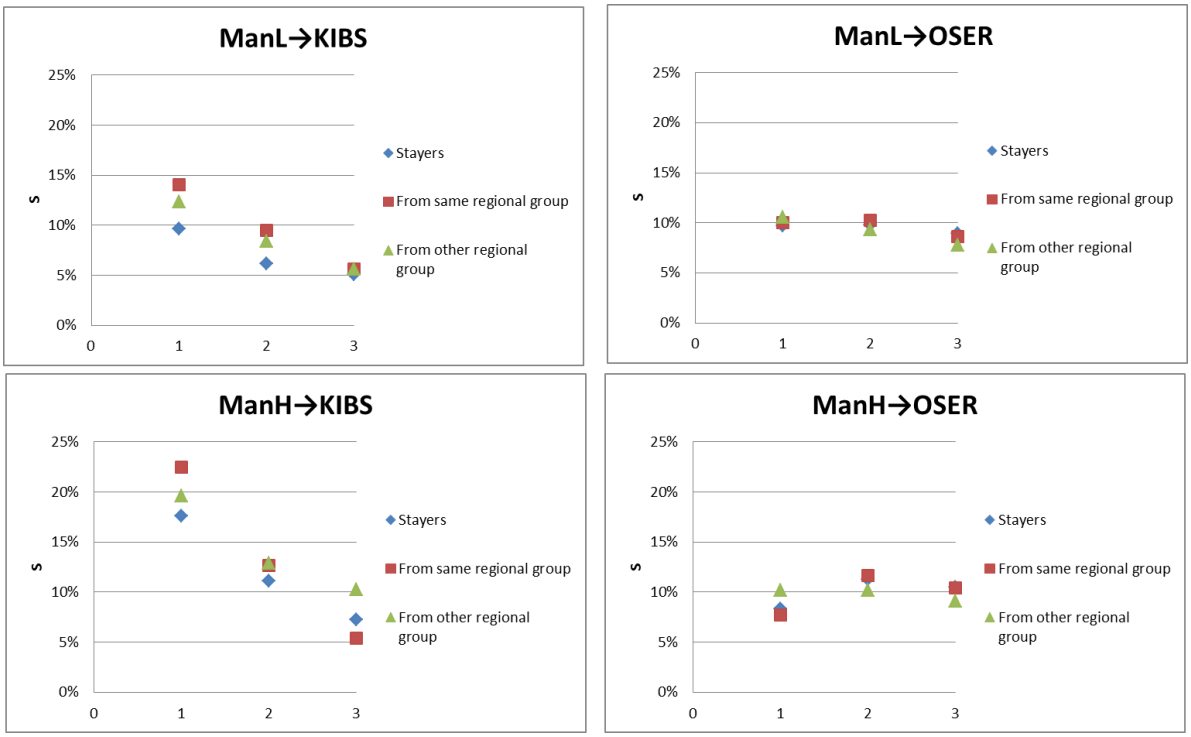


Figure 7: illustration of calculations of $S_{i,j,sp}$ used in figure 8-15, here for the example of flows among regional stayers in metropolitan regions leaving HI-M, concentrating on those who enter KIBS.

In figures 8-15 we organize *S* in such a way that we can compare across the different categories. In Figure 8, for example, low-skill manufacturing flows to KIBS are described. In the first category (horizontal), which is metropolitan regions, we compare three values: shares of the regional *stayers* in the metropolitan regions who leave low-skill manufacturing and make the move LO-M → KIBS (9 percent), shares of the regional movers *between metropolitan regions* who leave LO-M and make the move LO-M→KIBS ("from the same regional group", 14 percent), and shares among the regional movers into a metropolitan region *from another regional group* who leave LO-M and make the move LO-M → KIBS (12 percent).

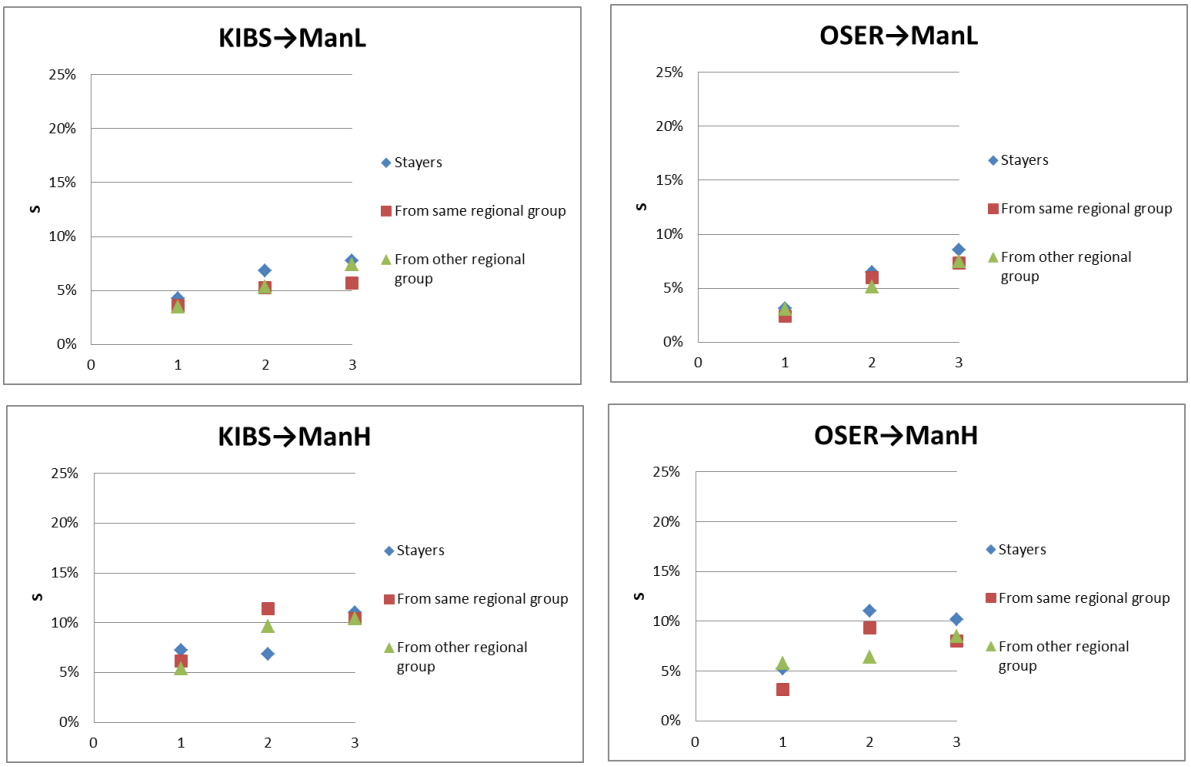
For manufacturing ↔ OSER, the intensities of OSER-involved flows among the different regional categories do not vary much, but hoover around 10% of flows from low-skill as well as high-skill manufacturing (figures 9 and 11). Again, labour flows into KIBS have the clearest spatial implications (Figures 8 and 10). They are especially important among the metropolitan region flows, both in terms of moves from other metropolitan regions, and other regions in the regional system. Numbers here are high: among all those leaving high-skill manufacturing in metropolitan regions and going to other metropolitan regions, high-skill manufactruring account for as much as 22 percent of the flows. The KIBS shares for regional

movers into metropolitan regions from other regional levels in the regional system are almost 20 percent. Numbers for other regional types are much lower. The LO-M → KIBS transitions have a similar hierarchy, but the differences between the regional groups are less drastic (figure 9). One remarkable side aspect could be noted though (figure 10): in countryside regions, there is a certain overrepresentation of high skill manufacturing → KIBS flows, pointing to an low but present "import" of labour in this category.



Panel 1: Figures 8-11: Flow directions comparisons: shares of destination from sector as shares of all possible destinations according to eq. 4. Vertical categories are 1=metropolitan regions, 2=dense regions, 3=countryside regions. Own elaboration on data from Statistics Sweden.

Business service → manufacturing flows (Figures 12-15) in general show lower shares of all flows, as expected, but also a different geographical pattern than the manufacturing → business service flows. In general, metropolitan regions show slightly lower shares in these flow combinations than the other regional groups, and regional stayers often end up with the highest shares. The most striking patterns are shown by the labour flows of dense regions, in combinations involving high-skill manufacturing (Figures 14 and 15). Labour circulation from other dense regions as well as flows from other regional categories seem to be especially important here, compared to the regional stayers. Stayers are considerably more important for flow combinations involving OSER (Figure 15).



Panel 2: Figures 12-15: Flow directions comparisons: shares of destination from sector as shares of all possible destinations. Vertical categories are 1=metropolitan regions, 2=dense regions, 3=countryside regions. Own elaboration on data from Statistics Sweden.

Our tests once again display the particularities of manufacturing ↔ KIBS moves. They are not only intense in terms of scale, but also in terms of geography. The destination of these moves are often towards or among the metropolitan regions, but only for combinations → KIBS. In the movement away from KIBS, although they take place to resource integrated sectors, spatial patterns are not nearly as distinct. But from previous literature, we know that geographical mobility and industry flow patterns are highly variable between categories of individuals (Boman 2011, Eriksson et al. 2018). It is of course likely that also our moves partly involve a self-selection of individuals which have to do much more with personal characteristics such as age, sex and education, and less with the development of spatial settings. To investigate this, we specify a logit model regression where the binary dependent variable takes the value of 1 if the specified move of the model is taken by an individual (for example LO-M → KIBS in Model 1), and 0 for those individuals that leave the sector, but enter another sector of destination (analogous to Figure 7, but for all spatial combinations). The main independent variables of interest are if the origin region of the individual (2010) is in a countryside region (reference), dense region or metropolitan region. As individual controls we add the following control variables: sex, age, wage and education level (results for these are not shown).

The results in general confirm the geographical patterns in manufacturing → business service transitions that we identified previously. Also after controlling for important individual features in Table 4, especially the indications of metropolitan induced KIBS-mobilities

remain. Those who leave manufacturing in metropolitan regions, have a higher probability to enter KIBS (about 1,5 times higher for high-skill manufacturing → KIBS after individual controls). For other combinations, the geographical traits are not at all as clear. As for business service→ manufacturing, few regional indicators remain significant. Essentially, the only reliable statistical indication that is obtained, is the lower probability of workers in metropolitan regions to enter manufacturing after leaving OSER (2,3 times lower for OSER → low-skill manufacturing).

	1	2	3	4	5	6	7	8
	ManL→KIBS	ManL→KIBS	ManL→OSER	ManL→OSER	ManH→KIBS	ManH→KIBS	ManH→OSER	ManH→OSER
Dense region	0.180	0.120	0.064	0.095	0.414*	0.288	0.053	0.144
	(0.10)	(0.10)	(0.08)	(0.09)	(0.19)	(0.18)	(0.08)	(0.09)
Metropolitan region	0.472***	0.322***	0.019	0.107	0.793***	0.372**	-0.252***	0.029
	(0.10)	(0.10)	(0.07)	(0.07)	(0.12)	(0.12)	(0.07)	(0.08)
Ind. Controls	No	Yes	No	Yes	No	Yes	No	Yes
Constant	-2.696***	-5.174***	-2.274***	-0.545***	-2.341***	-4.942***	-2.139***	-0.466***
	(0.09)	(0.14)	(0.07)	(0.11)	(0.10)	(0.21)	(0.07)	(0.11)
N	67914.000	67845.000	67914.000	67845.000	64449.000	64384.000	64449.000	64384.000
Ll	-18937.619	-17845.203	-21500.043	-20981.142	-25825.412	-23877.548	-20709.042	-19938.260

Table 4: logit regression coefficients with specific transition as respondent variable. Numbers within brackets are robust standard deviations (LA regions). Individual controls are sex, age, education and wage (at their 2010 values). Own elaboration on data from Statistics Sweden.

	9	10	11	12	13	14	16	16
	KIBS→ManL	KIBS→ManL	KIBS→ManH	KIBS→ManH	OSER→ManH	OSER→ManH	OSER→ManL	OSER→ManL
Dense region	-0.070	-0.044	-0.071	-0.093	0.163	0.142	-0.220	-0.227
	(0.15)	(0.15)	(0.27)	(0.26)	(0.21)	(0.21)	(0.15)	(0.15)
Metropolitan region	-0.432	-0.424	-0.318	-0.483	-0.554*	-0.599*	-0.859**	-0.844**
	(0.40)	(0.38)	(0.36)	(0.36)	(0.26)	(0.25)	(0.28)	(0.27)
Ind. Controls	No	Yes	No	Yes	No	Yes	No	Yes
Constant	-2.653***	-2.410***	-2.210***	-2.972***	-2.349***	-1.264***	-2.527***	-0.645**
	(0.13)	(0.30)	(0.24)	(0.36)	(0.17)	(0.26)	(0.14)	(0.20)
N	83954.000	83820.000	83954.000	83820.000	115052.000	114902.000	115052.000	114902.000
Ll	-16469.337	-16265.712	-23366.691	-22295.695	-29229.392	-28518.906	-21148.837	-20711.176

Table 5: logit regression coefficients with specific transition as respondent variable. Numbers within brackets are robust standard deviations (LA regions). Individual controls are sex, age, education and wage (at their 2010 values). Own elaboration on data from Statistics Sweden.

Conclusions and theoretical implications

Regional divergence not only has to do with different growth rates and structural change taking place *within* regions. In this paper, we have investigated how labour flow patterns between manufacturing and business services between *between* regions induce geographical change, closely linked to structural change. There is a striking geography behind the transition from a manufacturing- to a service-dominated economy. On aggregate level, we are not the first to emphasize this. Our detailed analysis resonates well with other ideas about a new locational regime coming with the current era of economic growth since the 1980s (Schön 2010, Enflo and Henning 2017).

In order to investigate how sector integration interacts with regional change, we first relied on notions from the business service and labour flow literatures to define to what extent

contemporary manufacturing and business services are mutually dependent on partly the same resources for their production. In fact, we find that are important differences in the integration between different kinds of manufacturing and business services. Only the relationships between high-skill manufacturing and KIBS, and partly between high-skill manufacturing and OSER, suggest that they are becoming integrated to the extent that they actually are dependent on partly the same skill resources in their production. Our findings here underline the labour sharing aspects between the manufacturing and KIBS, and corroborates the results concerning this identified by Brenner et al. (2018). Indeed, we believe that the mutual and *bi-directional* resource dependence in labour market terms that we identified between manufacturing and business services deserves to be more thoroughly investigated in a longer time-span. When did this link arise? This could certainly add a resource-based flavor to the already investigated links between manufacturing and service, which especially have focused on integration of products and services in consumer offering (Howells 2004), and service exchange (Shearmur and Doloreux 2017).

Indeed, the integration in skill terms between manufacturing and business services has not proceeded as far as we anticipated from our literature review for all of our sector combinations. While it still makes sense to treat low-skill manufacturing, OSER and KIBS as independent and distinct sectors in resource terms, it is more questionable for the combinations of high-skill manufacturing and KIBS. They are highly bi-directionally dependent and sharing dependence on the same types of skills, to the extent that recruitment between them often transcend all those obstacles that prevent people from switching their region of work. We believe that we soon reach the point, where we need to figure out other ways to understand their division of labour, than those given by the standard industrial classifications (Bryson and Daniels 2010). The analysis of occupation compositions could be one way.

Notwithstanding these integrative findings, most importantly perhaps, there is a twofold geographical aspect in manufacturing ↔ business services labour links. First, sector labour flows manufacturing → business services come with a high share of geographical mobility, and especially towards and between the metropolitan regions. Movements upwards the regional hierarchy are common. This is an indication of dual labour markets, where recruitment efforts tend to stretch further in space for some highly qualified jobs (Gordon 1995). Also, workers leaving manufacturing in the metropolitan regions have a much higher likelihood to enter the growing KIBS sector, than workers in other regions, also accounting for a series of confounding individual traits. This could be explained by the fact that these regions offer rich "markets for skills" for the experienced workers, speaking in the words of Marshall (1890). Second, labour flows business services → manufacturing have a lower rate of spatial mobility, and the regional movement patterns have a much more distributed geography, than for opposite movements. This complements previous findings about divergence mechanisms found on the level of labour migration (Martynovich and Lundquist 2017), who specifically identified the regional labour pull mechanisms exerted by the service sectors, complementing the stability provided by the manufacturing sectors.

Our investigation speaks for the merits of a spatial approach to structural change. However, it does not serve good news for all regions. Looking at the more skill-intensive manufacturing ↔ business service transitions, regions outside the metropolitan areas seem to miss out on the opportunities of these transitions, both *within* and *across* regions. The problem for many regions outside the metropolitan areas, is not only that business services do not grow in general, but also that people that are obviously qualified to work in the growing KIBS sectors tend to leave. While there are some tendencies for countryside regions to import experienced workers into their KIBS sectors from other regions, the size of these flows are relatively minor. This indicates that the opportunities for service job transitions in the periphery must be improved, otherwise these regions will surely have less of an interesting future. The structural transition to high growth services, integrated and drawing on manufacturing skills, does not work there at present. Because we suspect this to be the case in many countries, as long as it is, it is hard also to see how the regional cohesion targets of the EU can be reached during the present divergent growth regime.

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