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**Occupational Distribution within Swedish Industries**

**- an identification and market relation analysis**

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# **Occupational Distribution within Swedish Industries:**

## **An Identification and Market Relation Analysis**

**Charlotta Mellander**

### *Abstract*

*This paper sheds new light on the Swedish industry structure, by defining it through its occupational and educational structure. It is a merge of all Swedish private firms and all individuals employed within those firms, aggregated over industry, for the year 2001. Education is separated from creative occupations, and we also identify industries with the largest concentration of service and manufacturing occupations. The growth pattern within the industry segments between 1993 and 2001 is provided, and an examination of the spatial distribution. While there is a close relation between larger markets and knowledge, creative and service industries, we can detect a weaker link to the manufacturing industries. The effect from being located in the main urban area within the urban region, as well as within one of the three metropolitan regions, is highly significant for all industries, but relatively weaker for the manufacturing industry. The results also imply that diversity and creativity, in terms of the number of establishments, closely relate to the metropolitan regions. The concentration of activities, in terms of the number of employees, is more driven by large markets in general.*

*Key words:* Occupation, Industry, Creative, Knowledge, Market Size  
*JEL:* J24 R30

# 1. Introduction

There has been a debate about how to best identify and define creative industries. In this work there has often been a mix-up between creative industries and creative products, assuming that those producing creative products by default also must involve creative production processes (KEA, 2006). But, very little so far have been real attempts to statistically define industries based on their occupational structure. At the same time there has been a long-lasting debate on how to distinguish creativity from traditional education-based skills. One side has argued that an educational measure, traditionally the share of the labor force with a BA degree or more alternatively the average number of years in education, would be better (e.g. Glaeser, 2004). The other side contends that education will not tell the whole story: what people do is more relevant than their degree (e.g. Florida, 2002).

An attempt to connect occupations, educational levels and industries was made by Andersson (1985). He identified the occupational structure in Stockholm during the years 1960, 1970, and 1980. He distinguished between knowledge handling (which requires education), data/information handling (lower educational requirements), service, and manufacturing occupations. While the manufacturing occupations constantly decreased during these years, the other occupational sectors grew. Andersson separates knowledge from education, but he admits a strong correlation between the two. After Andersson (1985), very little follow-up research has been produced. Instead, much of the research has focused on the use of industry data, in other words the number of establishments and employees, paying little attention to the occupational distributions within the industries. Researchers have assumed a strong correlation between classifications of employment by occupation and industry, since they emerged as related concepts (Barbour and Markusen 2007). But, the occupational distribution within industries can be highly diverse. A large high-tech firm can include occupations such as accountants, software engineers, traditional manufacturing jobs, health-care assistants, service jobs at their food court. All of these would be accounted as one employee in the high-tech industry, but who in practice have very different tasks to perform on an everyday basis. This has also been shown in work by Currid and Stolarick (2008).

This paper sheds new light on the occupational distribution within industries, with a special focus on so-called *creative industries (based on its share of creative workers)*, also separating it from *knowledge industries (based on its share of highly educated workers)*. The identification of industries is based on a merged micro-data set for about 2 million individuals employed in about 165,000 private firms distributed within 216 industries (3 digit level). The top quartile industries, with the highest concentration of creative occupations or highest share of highly educated, will constitute the creative and knowledge industries. In the same way service and manufacturing industries will be identified as well.

Location theory suggests that creative and knowledge sectors have advantages from locating close to larger markets. Classic location theory assumes location decisions to be made mainly due to a minimization of transportation costs (von Thünen, 1826; Weber, 1909). But with a transition in the industry structure, going from an industrial into a knowledge-based society (Andersson, 1985; Noyelle and Stanback, 1985; Castells, 1989; Hall, 1990), and with a extensive decrease in transportation costs of manufacturing goods (Glaeser and Kohlhase, 2003), the region becomes more than a supplier of natural resources. The role of the region as a market place was highlighted already in Christaller (1933) and Lösch (1939). However, while they focused on a minimization of the transportation costs, more recent research takes on a demand-perspective, based on the distance to the market place. The local market place is more important for the service industry than for the manufacturing industry, because of the higher costs of transportation for services.

Agglomeration effects based on specialization and its externalities was introduced by Marshall (1890). In his context, specialization externalities are based on specialized supply, labor pooling and knowledge spillovers. Hoover (1937) explained how internal returns to scale are firm-specific, while localization economies are industry-specific and urbanization economies are urban region specific. The agglomeration economies and economies of scale are considered as the most important drivers in the urbanization process and development of cities. Artle (1959) emphasized the economies from firm location in proximity to suppliers and output purchasers. Later, Jacobs (1969) emphasized the role of diversity, rather than specialization, as the engines of urbanization economies. Lucas (1988) recognized the role of metropolitan regions and their importance as engines for economic growth. Lucas' argument is based on the consideration of localized information and knowledge spillovers, which are likely to develop in urban regions.

The relationship between spatial distribution of firms and the characteristics of their products and production processes is discussed in Johansson (1998). He distinguishes between (1) routine based products, and (2) knowledge based products. While the first can be dispersed from dense knowledge-based regions, the latter demands this knowledge-intense environment to renew and customize the supply. The role of the region as supplier of skilled labor and increased knowledge exchange is relatively more important for knowledge and creative industry firms.

The characteristics of the products and processes also relate to the market size from a demand perspective. While transportation of manufacturing goods is relatively low, transportation of services is still expensive. One needs to distinguish between (1) the frequency with which the service is consumed, and (2) the distance-sensitivity of it, though. The more frequently a service is being consumed, the lower the demand for market size. For example, it does not take a large market place to run a hairdresser firm or a bar. For services less frequently consumed, e.g. a concert, the relative importance of a large market place increases since it takes more customers to cover the fixed firm activity costs. Also, individuals tend to be more distance-sensitive in their frequent consumption of services, but can still be willing to travel far to experience a concert. In other words, we should expect to find a larger diversity of services in larger regions.

The second purpose of this paper is to analyze the relation between industrial sectors and the accessibility to urban area market places (municipalities), in terms of population as well as wage sums. From theory we know that creative, knowledge-based service sectors further demand nearby market places, large enough to work as an outlet for products and a place for interactions between people. Traditional manufacturing sectors depend less on the local market place, since transportation costs for manufacturing goods are relatively low.

Further to this purpose, we want to examine the spatial distribution of those industries in main urban areas within the urban regions (local labor markets). We will also test if there is a metropolitan regional effect on the spatial distribution of the industries.

Finally, we will separate between effects on the number of industry establishments and the effects on the number of industry employees from the regional market characteristics. We assume the number of establishments to be a measure more related to diversity. Based on monopolistic competition, we can assume slightly differentiated products, if they are supplied in the same market place. In other words, we assume a more diverse supply if the number of producers increases and that creativity is a prerequisite for this diversity. The number of employees is more of a concentration measure.

To sum up, we will test for the effect from; (1) larger markets, (2) main urban areas (Swe: kärnkommun), and (3) metropolitan urban regions (Stockholm, Gothenburg and Malmo

local labor markets) on industry establishments and employees for creative, knowledge, service, and manufacturing industry.

This analysis will be examined for all Swedish urban areas (Swe: Kommun) for year 1993 and 2001. The hypothesis is that the number of creative, knowledge and service industry establishments and employees will depend more strongly on large urban areas than the manufacturing sector establishments and employees.

## 2. Theory and Concepts

The term “Creative Industries” comprises industries with a pre-supposed higher concentration of creativity among the labor force. Quite often it is used for industries with high design products or limited to include industries such as art, technology, and programming. Also, “cultural industries” is often used interchangeably with creative industries, implying that there is not much difference between the two (see e.g. the KEA-report, 2006). The implication of this is that we fail to understand the possible creativity within all types of industries, not only the pre-supposed creative ones but within the traditional service and manufacturing sectors. However, several trends address that the demand for creativity and knowledge spans across several sectors, i.e. in many industries key functions and tasks increasingly require both of those (Florida, 2002). While this paper makes no attempt to thoroughly define differences between creativity and education, we still need to consider the relationship and differences between the two.

Sternberg (1999) contends that “(c)reativity is the ability to produce work that is both novel (i.e. original, unexpected) and appropriate (i.e. useful, adaptive concerning task constraints)”. And further “(c)reativity is a topic of wide scope that is important at both the individual and societal levels for a wide range of task domains. At an individual level, creativity is relevant, for example, when one is solving problems on the job and in daily life. At a societal level, creativity can lead to new scientific findings, new movements in art, new inventions, and new social programs. The economic importance of creativity is clear because new products or services create new jobs. Furthermore, individuals, organizations, and societies must adapt existing resources to changing task demands to remain competitive”.

While some would claim that education is a pre-requisite for future creativity, studies including Smith, Carlsson and Danielsson (1984) show that creativity, education, and skills are all determinants of individuals’ productivity. Creativity in this sense is both a complement and substitute to education and skill. In an earlier work by Andersson (1985) knowledge workers are separated from information, data, and administration workers, where the latter is a form of creative job which requires less education than the knowledge workers. Florida (2002) separates education from creativity, defining education as what you have studied for and creativity as what you in practice do, and he also distinguishes between two creative occupational groups: the super-creative core and the creative professionals who together form the so-called creative class. The super-creative core consists of scientists and engineers, architects, writers, analysts, among others. This group is close to what Andersson (1985) would categorize as knowledge workers, but Florida also includes arts, design, entertainment, sports, and media occupations. The creative professionals work within a wide range of knowledge-intensive industries, including financial services, legal occupations, and health care professions. These jobs usually demand a higher educational level. In response to Florida’s definition, Glaeser (2004) claims that the creative class Florida referred to was nothing else than highly educated individuals. Traditionally, the education level is used as a measure for human capital and can be defined as the share of the labor force with a university degree of three years or more. To a certain extent the education level indicates the ability of the individual to think, a quality guarantee related to the supply of labor. The occupational

measures take into account the tasks individuals perform at work and more relate to the industries' demand for qualified labor; the higher absorption capacity of the individual's creativity, the higher share of creative occupations we will expect to find.

Even though researchers do not agree on how to best measure human capital, most economists today would still agree on the role of human capital, be it in the form of traditional education or creativity, for economic growth. Going back, Schumpeter (1942) introduced the term "creative destruction", describing the process in which the reconfiguration of firms' and individuals' resources and ideas would lead to a reinvention of products and ideas. Vernon (1963), Thompson (1965) and Jacobs (1969) all showed the relation between concentration of human capital and longstanding economic growth. Romer (1986, 1990, 1994) and Lucas (1988) showed how new knowledge is a function of knowledge creation. Andersson (1985), Noyelle and Stanback (1985), Castells (1989) and Hall (1990) have all identified the societal transformation from a "goods-handling" industrial society into a knowledge based society more based on development activities. The role of human capital and its relation to new ideas, innovation and division of labor, not the least on a regional level has also been highlighted (Piore and Sable, 1984; Lucas, 1988; Saxanian, 1994; Storper, 1997; Scott, 2000; Florida, 2002; Glaeser, 2003).

There is also a consensus on the importance of the industrial structure. Much research has shown the transition in developed countries from a manufacturing based industry, towards a service and finally knowledge-based industry (Mokyr, 1990; Landes, 1969; Rosenberg and Birdzell, 1986; Diamond, 1997). Industry has clustered since the beginning of the industrial era, and the concentration process continues. Already in 1890 Marshall highlighted the role of industrial districts and industry clustering to increase innovation and productivity. Another scheme for analyzing agglomeration economies was outlined by Ohlin (1933). In contrast to Marshall, Ohlin focused more on how the individual firm is affected by co-location. Yet another famous classification of agglomeration economies was provided by Hoover (1937). In Hoover's setting, internal returns to scale are firm-specific, localization economies are industry specific and urbanization economies are specific for each urban region. Agglomeration economies and economies of scale also serve as one of the most important explanations to the process of urbanization and the development of cities. Edwin Mills (1967) analyzed the question how the economy would be if we imagine that there would be no economies of scale. It turns out that it is hard to see an economy without economies of scale, and also without cities. Another well-known contribution from this time-era is Jane Jacobs (1969), who stressed the importance of urbanization for economic growth, since cities host diverse economies that stimulate innovative activities. If Marshall focused on the benefits from many producers making the same thing (super-additive), Jacobs stressed the importance of diversity among those activities. Lucas (1988) recognized the role of metropolitan regions and their significance as engines for economic growth. Lucas' argument weighs in localized information and knowledge spillovers, which are likely to develop in urban regions. In this context regional and local accumulation of human capital and knowledge are assumed to explain economic growth. The field of new economic geography (Fujita, 1988; Krugman, 1991; Venables, 1996) employs models of endogenous growth, showing that geography and regional size matter. There is also a relationship between spatial distribution of firms and the characteristics of their products and production processes. Johansson (1998) distinguishes between (1) routine based products, and (2) knowledge based products. While the first can be dispersed from dense knowledge based regions, the latter demands this knowledge-intense environment to renew and customize the supply.

Already in 1969 Jacobs described how the dense city regions stimulate innovations, a factor also recognized by Lucas (1988). Florida (2002) showed how diverse cities have locational advantages for creative workers and industries. In Glaeser et al. (2001; 2004) the decreased transportation costs for manufacturing goods are shown to be a factor behind a

relocation of industry, increasing the share of knowledge based and service sectors to the cities, while traditional manufacturing industries locate further away. The rationale for this pattern is quite simple: Knowledge industries need to secure the input of qualified labor in the production process. Since the decreased transportation costs mainly concern the transportation of manufacturing goods, and not individuals, the service sector still highly depend on a local market place to secure the demand.

Altogether, much of the research in the past has either focused on the role of the industry *or* the role of the human capital (either in the form of highly educated or creative occupations), neglecting the interaction between firms and individuals; in other words, a demand for, as well as a supply of, skills. There are though some exceptions. Thompson and Thompson (1985) attempted to introduce the idea of an occupation over industry analysis. They argued that occupations would be a way of measuring the skill strength in the region, and that other industries would see the overall occupational structure, both as a firm location factor and a comparative advantage. Andersson (1985) mapped the Swedish capital's labor market, illustrating the distribution of occupations across industries and the changes between 1960 and 1980. Markusen (2004) showed how an occupational analysis helps explain the economic dynamics of the firms. Barbour and Markusen (2007) argued that innovative industries need to be a function of their occupations structure in order to explain their innovation capability. Nelson (2003) also pointed out how the same firm locates R&D in one place and production somewhere else. Feser (2003) argued that one has to distinct between the "work" and the products of firms in a region, and that this should be seen as a function of the local education and skill level. The need to analyze the economy both based on industry and occupation is also highlighted by Koo (2005). Currid and Stolarick (2008) also show the diversity of occupations within the Californian ICT sector and the implications of this in relation to the regional development.

The purpose of this paper is therefore twofold:

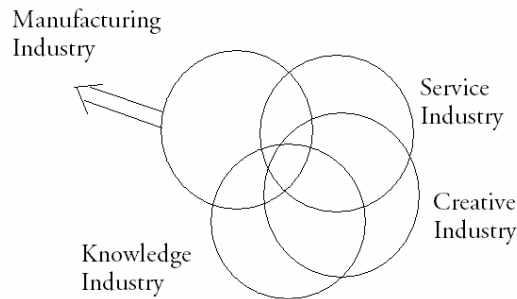
(1) *Identify industries based on their occupational distribution, with a special focus on creative and knowledge industries.*

This paper sheds new light on the occupational distribution within Swedish industries, with a special focus on so called *creative industries*, also separating it from *knowledge industries*. It examines the occupational composition in terms of working task and educational background of the labor force within each of the Swedish industries. The analysis is based on micro-data for approximately 2 million individuals employed in about 165,000 private firms distributed within 216 industries (3 digit level). The paper will also identify the industry sectors with the largest concentrations of service and manufacturing occupations, before moving on to the next step of the analysis, which is to

(2) *Identify the spatial location patterns of Swedish industries, with a special focus on the creative and knowledge industries, in relation to market size, main urban area effects and metropolitan effects.*

The second purpose aims to use the industries identified under step 1 of the analysis. They will be separated according to creative, knowledge, service, and manufacturing industries, but are expected to be partly overlapping. Theory suggests an under-representation of manufacturing industry in larger market places, due to decreased transportation costs. At the same time, we can expect a higher share of creative, knowledge and service industries in larger market places. The reason for this is that (1) larger market places are traditionally more dense in terms of a high qualified labor force, (2) larger markets consist of more potential customers for service firms. Figure 1 illustrates the expected overlapping of industries in the

center of the region with an expectation of the manufacturing sector being gradually removed to areas outside of the larger market places.



**Figure 1: The Spatial Distribution of Industries in a Region**

In relation to this purpose the spatial distribution of those industries will be examined in main urban areas within the urban regions. It will also be tested if there is a metropolitan regional effect on the spatial distribution of industries.

Finally, the effects on the number of industry establishments and the effects on the number of industry employees from the regional market characteristics will be separated. While the number of establishments can be considered to more related to diversity and creativity (based on the monopolistic competition assumption of a differentiation among the products in the same market place), the number of employees is more of a concentration measure.

To sum up, the empirical analysis will test for the effect from (1) larger markets (in terms of accessible population or wage sums), (2) main urban areas (Swe: kärnkommun), and (3) metropolitan regions (Stockholm, Gothenburg and Malmo local labor markets) on industry establishments and employees for creative, knowledge, service and manufacturing industry.

### 3. The Occupational Structure:

The industry is a set of firms composed by one or several individuals in the labor force. The labor force is a function of its education and the occupational tasks they perform.

Each individual  $i$  can either have a university degree or not;

$$i : u_i \in \{\text{yes, no}\}$$

There is also an occupational task  $t$  which they perform at work;

$$t : t_i \in \{c, s, m, f\}$$

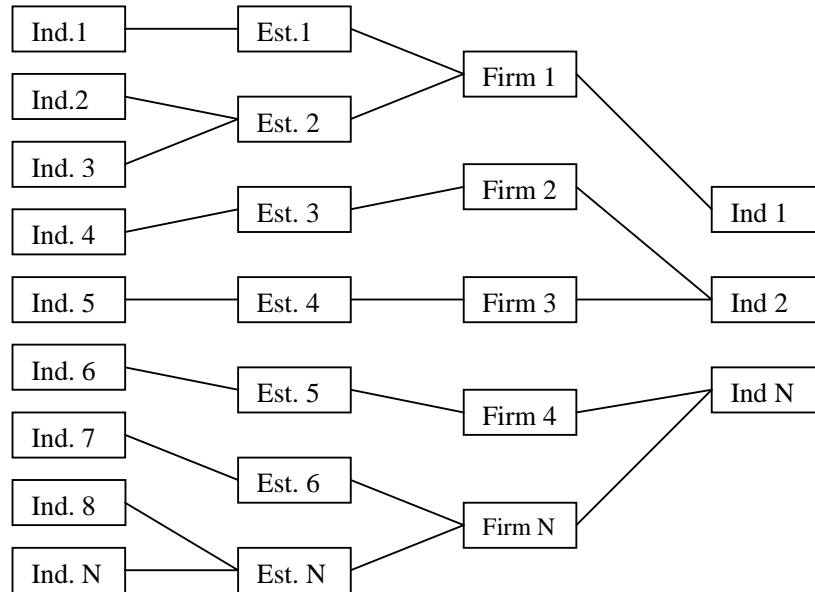
The task can either be creative (c), service-related (s), manufacturing (m) or fishing and farming (f).



To identify the industry labor composition, we aggregate the labor composition establishments, firms and then over industry, checking the total composition of labor within each industry, also separating education from occupation. From this we will be able to identify the industries with the highest levels of creative occupations and also the highest share of highly educated. We will also highlight industries with the highest concentration of service and manufacturing based occupations, still separated from education. In this context the regional effects will be held constant, though one may expect a variation of the labor composition between regions within the same types of industries.

### 3.1 Data, Variables, and Methods

We use the *Statistics Sweden FAD* (The Dynamics of Firms and Establishments) micro data base including all firms, establishments, and individuals in Sweden. We use year 2001 (which is the first year with available occupational data for Sweden) and select all private firms, excluding the public sector. We also select a labor force between the ages of 20-64 years. For each individual we check the occupational status as well as his or her education. We separate occupations according to creative, service, manufacturing blue-collar and fishing/farming occupations. If the individual has a university degree of three years or more, he or she is categorized as highly educated. We then match all the individuals with the establishments where they were working in 2001. The next step is to match those establishments with the firms and finally industry they belong to. The final step is to aggregate the labor force and its characteristics over industry (using a three digit level), and calculating the distribution of occupations and education among the labor force within each of those, also distinguishing creative occupations from highly educated individuals.



**Figure: 2: The matching process from individuals to industry**

**Establishments/Industry:** The establishments included in the dataset are related to firms defined as:

- Joint-stock company (not publicly owned)
- Other company (not publicly owned)
- Company (governmentally owned)
- Company (municipally owned)
- Other private organization

Excluded from the dataset are firms defined as:

- Government services
- Government business activity
- Municipal services
- County Council (Swe: Landsting)
- Other public institutions

This is also in line with how *Statistics Sweden* separates public from private firms. This generates 164,970 firms, which then are aggregated over 216 number of industries. Industry is defined according to the SIC divisions and a 3-digit level will be used in the analysis. All data is from the FAD data base at *Statistics Sweden*.

**Creative occupation:** The occupations are identified according to Statistics Sweden occupational system SSYK at a four-digit level. The creative occupations definition is based on Florida (2002) definition (see appendix 1 for the full definition). Normally the educational and healthcare occupations would be a dominant part of the creative occupations, but that effect is somewhat neutralized by including only private establishments. Only individuals between 20 and 64 years of age are included in the data set, generating 1,927,128 number of observations connected with the selected firms, out of which 709,030 had a creative occupation and 1,248,098 without a creative occupation. The latter group was distributed with 454,504 individuals with a service occupation, 774,248 with a manufacturing occupation and finally 19,346 with a fishing or farming occupation.

**Highly educated:** A highly educated individual is someone with a university degree of three years or more. The data is taken from *Statistics Sweden* and is for year 2001. Only individuals between 20 and 64 years of age are included in the data set, generating 214,364 individuals with a highly educated and 1,712,764 without a higher education.

**Table 1: Descriptive Statistics of the Labor Force among Private Firms Based on Education and Occupation**

<b>Variable</b>	<b>N</b>	<b>Share (%)</b>
Selected labor force in private firms	1,927,128	100
<i>Decomposed based on education:</i>		
With a university degree	214,364	11.12
Without a university degree	1,712,764	88.88
		Σ100
<i>Decomposed based on occupation:</i>		
Creative	709,030	36.79
Service	454,504	23.58
Manufacturing	744,248	40.18
Fishing or Farming	19,346	1.00
		Σ100
<i>Decomposed based on education and occupation</i>		
With University degree and creative	187,807	9.75
Without university degree and creative	521,223	27.05
With University degree and service	17,340	0.90
Without university degree and service	437,164	22.68
With University degree and manufacturing	8,815	0.46
Without university degree and manufacturing	735,433	38.16
With University degree and fishing or farming	402	0.02
Without university degree and fishing or farming	18,944	0.98
		Σ100

Table 1 illustrates one of the raised objections whether highly educated and creative occupations are in fact the same individuals. Out of the approximately 710,000 individuals with a creative occupation, about 25 percent had a university degree of three years or more, leaving 75 percent without. Out of the approximately 215,000 individuals with a university degree, approximately 88 percent had a creative occupation, leaving 12 percent without. Two thirds of these individuals had a service-based occupation, one third a manufacturing occupation and a minor group an occupation related to fishing or farming. In other words, getting a higher education may imply getting a more creative occupation later on. However, it is by no means a condition for a creative occupation in this context.

### 3.2 Findings

Using the occupational and educational compositions in private establishments, and thereafter aggregating over industry, gives us an option to categorize and rank industries according to their creativity (table 2) and knowledge intensity (table 3).

**Table 2: Top ten creative Industries based on Occupational Distribution**

Rank	SIC	Creative Share (%)	Industry
1	651	100.00	Monetary intermediation
2	111	100.00	Extraction of crude petroleum and natural gas
3	751	100.00	Administration of the State and the economic and social policy of the community
4	912	100.00	Activities of trade unions
5	722	94.43	Software consultancy and supply
6	721	94.08	Hardware consultancy
7	660	93.62	Insurance and pension funding, except compulsory social security
8	726	93.03	Other computer related activities
9	723	90.40	Data processing
10	402	90.08	Manufacture of gas; distribution of gaseous fuels through mains

While some of those industries are among what traditionally would be included in the definition creative industries (e.g. software, hardware and data processing) other industries, traditionally categorized as manufacturing, would probably be left out from any *ad hoc* definitions. Extraction of crude petroleum and natural gas firms have only creative occupations among their labor force, and among firms registered as Manufacture of gas; distribution of gaseous fuels through mains nine out of ten hold a creative job. Still, it is plausible that those industries employ very few people in Sweden, and that those are related to a head office with little actual production, but rather it is a question of administrative tasks. Also, those industries would be found in very few regions.

Since some researchers suggest no difference between creative occupations and highly educated individuals (e.g. Glaeser, 2004), we also identify industries with the highest share of labor with a university degree.

**Table 3: Top Ten Knowledge Industries based on Occupational Distribution**

Rank	SIC	Knowledge Share (%)	Industry
1	751	100.00	Administration of the State and the economic and social policy of the community
2	912	100.00	Activities of trade unions
3	803	65.24	Higher education
4	731	53.80	Research and experimental development on natural sciences and engineering
5	802	52.20	Secondary education
6	111	50.00	Extraction of crude petroleum and natural gas
7	801	48.51	Primary education
8	732	46.35	Research and experimental development on social sciences and humanities
9	603	42.86	Transport via pipelines
10	741	40.75	Legal, accounting, book-keeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy; holdings

While some of these industries would be characterized as public and not private, we should once more recall that the selected firms in the data set are only private ones according to the Statistics Sweden definition. Still, we can conclude that many of the industries on the top 10 list are highly related to governmental activities. Interesting enough, none of the traditional ICT industries make it into the top ten-list. Instead, we find many education and research related firms. We also find petroleum and gas extraction as well as transport via pipelines. Once more, we could expect that most of these firms are related to head office activities, and very little production.

Interesting also is to see the difference in relation to the ICT sector, which could be found on several positions on the creative industries list, but nowhere in the knowledge industries list. The discussion around how to best measure human capital – in the form of education or occupation – is closely related to the development of this industry.

In table 4 and 5 the top ten most service and manufacturing occupation intense industries are ranked. On the service list we find traditional service industries such as bars, restaurants and hotels, but also security and retail activities. On the list of the most manufacturing occupational based industries we find traditional manufacturing, mining and building.

**Table 4: Top Ten Service Industries based on Occupational Distribution**

Rank	SIC	Service Share (%)	Industry
1	746	88.85	Investigation and security activities
2	554	84.97	Bars
3	521	84.05	Retail sale in non-specialized stores
4	553	83.29	Restaurants
5	641	82.09	Post and courier activities
6	505	80.11	Retail sale of automotive fuel
7	015	80.00	Hunting, trapping and game propagation including related service activities
8	551	79.99	Hotels
9	555	79.47	Canteens and catering
10	747	79.37	Industrial cleaning

**Table 5: Top Ten Manufacturing Industries based on Occupational Distribution**

Rank	SIC	Manufacturing Share (%)	Industry
1	202	86.53	Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board, fibre board and other panels and boards
2	231	85.71	Manufacture of coke oven products
3	454	84.12	Building completion
4	193	84.02	Manufacture of footwear
5	101	83.33	Mining and agglomeration of hard coal
6	143	83.33	Mining of chemical and fertilizer minerals
7	275	83.14	Casting of metals
8	602	82.88	Other land transport (than Transport via railways)
9	204	82.52	Manufacture of wooden containers
10	141	82.34	Quarrying of stone

To further examine the development of those industry segments, we now let the top quartile within each group represent the creative, knowledge, service and manufacturing industries. Since Swedish occupational data is only available from year 2001, we cannot check for earlier occupational distribution. However, using the identified industries from 2001, we check for the growth rates within the very same industries from 1992 (or 1993 for wage sums) and year 2001, to see if the industries with the highest concentrations of creative, knowledge, service or manufacturing based occupations are the industries that have been growing the most during the last decade. The exact industry definitions with overlaps are available in appendix 2.

**Table 6: Growth rates of top 25% industries based on creative, service, manufacturing and knowledge concentrations among the employees**

	Establishments Growth 92-01	Employment Growth 92-01	Wagesum Growth 93-01	N*
<b>Creative (top 25%)</b>	32.87	9.41	59.82	55
<b>Knowledge (top 25%)</b>	37.11	9.31	58.89	55
<b>Service (top 25%)</b>	18.48	2.81	42.85	55
<b>Manufacturing (top 25%)</b>	2.26	12.51	48.48	55
<b>All industries</b>	12.76	1.68	52.56	219

\*note that industries can be overlapping. For industry definition, see appendix 2.

If we check for growth rates (table 6) among the 25 percent of the most creativity, service, manufacturing and education based industries and relate those to the national overall growth rate, we see how the industries with a larger share of creative occupations have an establishment growth of 32.87 percent between the years 1992 and 2001. The employment growth within these industries was 9.41 percent compared to the 1.68 national growth rate. In terms of total wages sums paid by industries (which also reflect their productivity) the growth rate was 59.82. The pattern is very similar for industries with a large share of highly educated. The establishment growth is even above the one for top creative industries, accounting for a growth rate of 37.11 percent. The employment growth rate is 9.31 percent and there has been an increase in the wage sums by 58.89 percent. As for the top 25 percent of industries based on service occupations there was an establishment growth of 18.48 percent, but just a 2.81 percent employment growth and 42.85 percent growth in wage sums, the latter far below the national growth. As for manufacturing the establishment growth was only 2.26 but with an employment growth of 12.51 percent, above all other industry segments here. Still, the wage sums growth was only 48.48, below the national growth.

## 4. Spatial Distribution of Industries

Using the identified occupational structure within Swedish industries, we progress to the next step of this analysis. Based on theory (e.g. Jacobs, 1969; Johansson, 1998), we expect to find a larger representation of creative and knowledge firms in larger regions. Their production is less standardized and often depends on the supply of skilled labor. As market size increases, we also expect a higher representation of service firms, more dependent on a local market place than traditional manufacturing industries, due to higher transportation costs.

In this context, we let the creative industry be represented by the quartile with the highest concentration of creative workers. In the same manner, the knowledge, service and manufacturing industries are identified. The next step is to investigate to what extent the number of establishments and employees within these industries are related to the accessible market place.

We define market accessibility as follows; each region (i) offers access to a Y, where

$$Y \in \{\text{Population, Wagesums}\}$$

but there is also an access to Y in the closely located regions (j). This is the case for all regions in the set N {1,...,n}.

The total Y in region i is defined as follows:

$$A_i^Y = Y_i f(c_{ii}) + Y_j f(c_{ij}) + \dots + Y_n f(c_{in})$$

where  $f(c)$  is a distance decay function to determining how the accessibility value is influenced by the related cost of reaching this particular wage sum. Based on Johansson, Klaesson and Olsson (2003) we can approximate this specific relationship by an exponential function:

$$f(c_{ij}) = \exp \{-\lambda t_{ij}\}$$

where  $t_{ij}$  is the time distance between urban areas  $i$  and  $j$ .  $\lambda$  is a time-sensitivity parameter that determines how the accessibility changes in  $t$ <sup>1</sup>.

By combining these two equations we get the  $Y$  accessibility in region  $i$  defined as follows:

$$A_i^Y = \sum_{j=1}^{290} Y_j \exp \{-\lambda t_{ij}\}$$

In this analysis the accessibility is arranged in two categories: urban areas and urban regions, thereby excluding any locations outside of the urban regions. This regional division is partly based upon the main stream of economic interaction in space. In other words, the analysis will have two relevant parts; accessibility within the urban area ( $A_{inUrbanA}^Y$ ) and accessible population within the urban region ( $A_{inUrbanR}^Y$ ).

The formal expression for each of these definitions would be as follows:

$$A_{inUrbanA}^Y = Y_i e^{-\lambda t_{ii}}$$

$$A_{inUrbanR}^Y = Y_i e^{-\lambda t_{ii}} + \sum_{j=1}^n Y_j e^{-\lambda t_{ij}}$$

where  $n$  is the number of urban areas within the urban region besides  $i$ .

We now let the number of establishments and employees within each of the identified industries (creative, knowledge, service, and manufacturing based) be explained by the accessibility to population within the urban area (table 7 and 8) and the urban region (for urban region regression results, see appendix 3). The number of establishments is closer related to the diversity of the market place, or the regional creativity level. The number of employees is more of a concentration measure.

We also include two dummies, one controlling for is the region is main urban area within the urban region that functions as the economic engine, another one if the urban area is a part of one of the three metropolitan urban regions Stockholm, Gothenburg or Malmö. We run the same regressions for year 1993 and 2001 to see if there are any significant differences between those years. From this we get the following equations<sup>2</sup>:

$$\ln Est = \alpha + \ln \beta_1 Urban Area Population + \beta_2 Urban Area Dummy + \beta_3 Metro Dummy$$

$$\ln Est = \alpha + \ln \beta_1 Urban Area Population + \beta_2 Urban Area Dummy + \beta_3 Metro Dummy$$

Before estimating the equations, we have to examine the most appropriate estimation procedure. An ordinary least square (OLS) can be run under the assumptions of e.g. linearity in the parameters, zero mean value of the disturbance term, and equal variance of the disturbance term. To exclude that the urban area population accessibility parameter includes

<sup>1</sup> The estimation of  $\lambda$  has been made by Johansson, Klaesson and Olsson (2003) and reflects the implicit value of daily time use.

<sup>2</sup> OLS regressions have also been run including a variable for accessible Urban Region Population. Those results were weaker, but are still reported for in appendix 3.



the same information as the main urban area dummy or metro dummy a collinearity test is performed. This generates a VIF value. While there is no established critical VIF value, generally 2 alternatively 5 is suggested by statistics literature (e.g. Greene, 1993). Our values are all under 2, indicating that there are no collinearity problems. Given the size distribution of Swedish urban areas, we can expect heteroscedasticity problems, generating biased non-efficient estimations. However, the coefficients will still be unbiased and consistent. To further investigate the distribution of the parameters, histograms have been plotted. While the manufacturing sector is normally distributed, the service, creative and knowledge sector are more skewed, and Stockholm, Gothenburg and Malmo are three extreme outliers among the observations. One way of dealing with this can be by using quantile regressions, which will give less weight to outliers of the dependent variable. While OLS estimates the conditional mean of the dependent variable as a function of the explanatory variables, quantile regression makes the estimation of any conditional quantile of the dependent as a function of the explanatory variables. This is a way of decreasing the heteroscedasticity problems, and the result is a more complete description of the relationship between the dependent and explanatory variables. Based on this I run both OLS and quantile regressions. But, since the main urban area and metro dummy variables are more represented in larger regions with more establishments and firms, we can partly assume this dummy to capture the same effects in the OLS, as the quantile regressions will do by giving lower weight to the extreme outliers. Both OLS and quantile regressions results revealed a similar pattern. OLS is reported in table 7-10, and the quantile regression results are reported in appendix 4.

For all establishments and all employees within our identified industry groups based on the creative, knowledge, service, and manufacturing occupation concentration among their labor force.

**Table 7: Absolute number of establishments and employees explained by accessibility to population and regional characteristics in 1993**

	Creative		Knowledge		Service		Manufacturing	
	Est	Emp	Est	Emp	Est	Emp	Est	Emp
<b>Constant</b>	-0.179	1.356	0.129	1.397	1.310	2.675	1.447	2.423
<b>Urban Area Pop.</b>	0.579**	0.688**	0.530**	0.678**	0.486**	0.592**	0.416**	0.560**
<b>Accessibility</b>	(24.117)	(24.340)	(22.306)	(24.450)	(22.505)	(23.835)	(19.946)	(21.149)
<b>Main Urban Area Dummy</b>	0.842**	1.021**	0.837**	0.985**	0.767**	0.864**	0.599**	0.502**
	(12.740)	(13.126)	(12.808)	(12.914)	(12.915)	(12.659)	(10.436)	(6.894)
<b>Metro Dummy</b>	0.378**	0.165	0.273**	0.104	0.080	0.093	0.249**	-0.544**
	(4.774)	(1.774)	(3.491)	(1.133)	(1.124)	(1.134)	(3.622)	(-6.224)
<b>R2</b>	0.784	0.777	0.758	0.774	0.751	0.766	0.710	0.668
<b>Obs</b>	285	285	285	285	285	285	285	285

**Table 8: Absolute number of establishments and employees explained by accessibility to population and regional characteristics in 2001**

	Creative		Knowledge		Service		Manufacturing	
	Est	Emp	Est	Emp	Est	Emp	Est	Emp
<b>Constant</b>	-0.595	0.820	-0.468	0.965	0.731	2.135	1.121	2.164
<b>Urban Area Pop.</b>	0.614**	0.710**	0.583**	0.686**	0.532**	0.619**	0.440**	0.570**
<b>Accessibility</b>	(25.190)	(25.109)	(23.953)	(24.687)	(23.894)	(24.727)	(21.334)	(21.297)
<b>Main Urban Area Dummy</b>	0.840**	1.024**	0.843**	1.020**	0.794**	0.908**	0.551**	0.422**
	(12.529)	(13.174)	(12.585)	(13.355)	(12.962)	(13.194)	(9.713)	(5.728)
<b>Metro Dummy</b>	0.534**	0.275**	0.484**	0.241**	0.222**	0.191*	0.356**	-0.495**
	(6.700)	(2.980)	(6.086)	(2.654)	(3.047)	(2.336)	(5.279)	(-5.659)
<b>R2</b>	0.800	0.786	0.785	0.782	0.772	0.780	0.734	0.657
<b>Obs</b>	289	289	289	289	289	289	289	289

According to theory, we could expect higher concentrations of creative and knowledge industries in regions with larger market places. This is also confirmed by the results; the higher the accessibility to population, the higher the coefficients for explaining the existence of establishments and employees in the creative and knowledge sectors. The service industries have coefficients of approximately 0.1 below the creative and 0.5-0.6 below the knowledge sectors. Also, in 1993 the controlling metro dummy is not significant in the case of the service sector, but significant at the 0.01 level for the location of creative and knowledge establishments. In year 2001 the metropolitan dummy is significant both in terms of establishments and employees for the creative and knowledge sectors. For the service sector the metropolitan dummy is now significant at the 0.01 level for establishments and at the 0.05 level for employees, but with a coefficient lower than the one for creative and knowledge industries. The pattern for the manufacturing industry location looks somewhat different. Besides the fact that it has significantly lower coefficient values in relation to the population accessibility, it also experiences a decrease in those values for all factors besides the metropolitan dummy for establishments. This indicates an increased divergence in the spatial location pattern between manufacturing based firms and firms within the creative, knowledge or service sector, with manufacturing being less dependent on the market size today relatively the other industries, compared to the situation in 1993. The manufacturing industry is also the only sector with a negative relation between employment and the metropolitan dummy, indicating a lower share of manufacturing employees in the metropolitan regions.

Another important factor is that the number of employees (which is more of a concentration measure) within creative and knowledge industries is relatively stronger related to accessibility to population than the number of establishments (which is more of a diversity or regional creativity measure). The relationship is reversed in relation to the metropolitan dummy, though, where the number of establishments is stronger related to the metropolitan regions relatively the number of employees. It implies that diversity and creativity is more closely related to the metropolitan regions, and than concentration of activities is more driven by large markets in general. Also, in general, the coefficients had a stronger significance level in year 2001 than in year 1993.

The quantile regressions (appendix 4) reveal a similar pattern. In general, the urban area population accessibility coefficient becomes stronger. At the same time the metro dummy no longer significantly explains creative and knowledge establishments in 1993, nor creative and knowledge employees in 2001. The metro dummy has also lost its significance in relation to service establishments and employees in 2001.

Access to a population is just one way of illustrating the size of the market place. Another way of illustrating this is by using access to wage sums. We could assume a strong correlation between those two, but wage sum is also including information about the economic strength of the population. To analyze this we re-run the following regressions<sup>3</sup>:

$$\ln Est = \alpha + \ln \beta_1 Urban Area Wage Sums + \beta_2 Urban Area Dummy + \beta_3 Metro Dummy$$

$$\ln Est = \alpha + \ln \beta_1 Urban Area Wage Sums + \beta_2 Urban Area Dummy + \beta_3 Metro Dummy$$

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<sup>3</sup> OLS regressions have also been run including a variable for accessible Urban Region Wage Sums. Those results were weaker, but are still reported for in appendix 3.

**Table 9: Absolute number of establishments and employees explained by accessibility to wage sums and regional characteristics in 1993**

	Creative		Knowledge		Service		Manufacturing	
	Est	Emp	Est	Emp	Est	Emp	Est	Emp
<b>Constant</b>	-6.009	-5.775	-5.219	-5.654	-3.602	-3.446	-2.573	-3.416
<b>Urban Area Wage Accessibility</b>	0.539**	0.651**	0.494**	0.643**	0.454**	0.560**	0.379**	0.532**
	(26.194)	(27.993)	(24.092)	(28.356)	(24.374)	(27.151)	(20.129)	(24.094)
<b>Main Urban Area Dummy</b>	0.737**	0.890**	0.741**	0.854**	0.679**	0.752**	0.530**	0.394**
	(11.667)	(12.455)	(11.768)	(12.277)	(11.890)	(11.889)	(9.174)	(5.807)
<b>Metro Dummy</b>	0.460**	0.245**	0.343**	0.178**	0.144*	0.160**	0.320**	-0.471**
	(6.311)	(2.973)	(4.728)	(2.223)	(2.195)	(2.192)	(4.806)	(-6.030)
<b>R2</b>	0.806	0.816	0.780	0.816	0.775	0.747	0.712	0.718
<b>Obs</b>	285	285	285	285	285	285	285	285

**Table 10: Absolute number of establishments and employees explained by accessibility to wage sums and regional characteristics in 2001**

	Creative		Knowledge		Service		Manufacturing	
	Est	Emp	Est	Emp	Est	Emp	Est	Emp
<b>Constant</b>	-6.236	-5.966	-5.811	-5.594	-4.184	-3.566	-2.774	-3.498
<b>Urban Area Wage Accessibility</b>	0.553**	0.652**	0.524**	0.630**	0.480**	0.566**	0.388**	0.535**
	(26.610)	(28.671)	(25.102)	(28.076)	(25.376)	(27.768)	(21.202)	(25.159)
<b>Main Urban Area Dummy</b>	0.740**	0.898**	0.748**	0.899**	0.706**	0.799**	0.484**	0.313**
	(11.337)	(12.567)	(11.401)	(12.745)	(11.874)	(12.475)	(8.410)	(4.688)
<b>Metro Dummy</b>	0.622**	0.359**	0.569**	0.322**	0.296**	0.267**	0.429**	-0.442**
	(8.274)	(4.358)	(7.527)	(3.962)	(4.326)	(3.611)	(6.463)	(-5.744)
<b>R2</b>	0.815	0.823	0.798	0.818	0.790	0.813	0.732	0.724
<b>Obs</b>	289	289	289	289	289	289	289	289

Overall, the accessibility to wage sums coefficients tends to be lower than the ones in relation to accessibility to population (table 9 and 10). The importance of being located in the main urban area within the urban region is rather constant over time for the creative and knowledge based firms, but increased for the service firms. At the same time we have experienced a decrease for this among the manufacturing firms, and the main urban area coefficient is approx 0.5 lower in 2001 compared to in 1993. The metropolitan dummy is significantly higher in year 2001 for all sectors. Also, there is still a negative relation between the metropolitan dummy and the manufacturing industry employees.

When comparing the creative industry and knowledge industry location pattern, the results reveal a very similar structure. The coefficients are approximately at the same level in relation to the accessibility to population and wage sums. However, the main difference is the metropolitan dummy, where the creative establishments are stronger related to this factor than the knowledge establishments. The difference between the two is decreased in year 2001 compared to the year 1993.

We can once more notice the relationship between the number of employees (concentration of an industry) and the accessibility to larger market places in terms of wage sums, versus the stronger relationship between the number of establishments (the diversity or

creativity factor) and the metropolitan regions. Also in this case, the coefficients had a stronger significance level in year 2001 compared to year 1993.

Once more the quantile regressions showed a similar pattern as the OLS regressions (appendix 4). The Urban Area Wage Accessibility variable has a stronger weight relatively the dummy variables, which is in line with what we could expect given the representation of main urban areas and metros among the larger urban areas. In 1993, the metro dummy is significant only in relation to creative and knowledge establishments, as well as manufacturing firms. For year 2001, the metro dummy is significantly related with creative and knowledge employees as well.

Also, the OLS regressions were run, substituting the accessibility to population and wage sums within the urban area with total accessibility within the urban region. Those results are available in appendix 3, and overall those are weaker, indicating a more important relation between the very close market place and the industries, rather than to the larger market place also including nearby urban areas.

## 5. Summary and Conclusions

The purpose of this paper was twofold:

(1) *Identify industries based on their occupational distribution, with a special focus on creative and knowledge industries;*

Micro data were used for approximately 2 million individuals employed in approximately 165, 000 number of private firms distributed within 216 industries (3-digit level). This data was merged the firms with the individuals, keeping information about their occupational status and educational background. Thereafter, the occupations and educational backgrounds were aggregated over the industries (3 digits) that the firms belonged to. The top quartile were used for industries with the highest concentrations of highly educated, creative, service and manufacturing occupations. In the analysis of the growth pattern within each of those industries between the years 1993 and 2001, we could detect the strongest increase in terms of establishments within the knowledge (37.11%) and creative industry (32.87%), followed by the service industry (18.48%) and the manufacturing industry (2.26%). The employment growth was somewhat different with the strongest increase within the manufacturing industry (12.51%), followed by the creative (9.41%), knowledge (9.31%) and finally the service industry (2.81%). But even if there has been a major increase in the number of manufacturing industry employees, the increase in wage sums during the same time period shows that it is still lead by the creative (59.82%) and knowledge (58.89%) industries. They have a wage sum growth with is approximately 10 % above the one within the manufacturing (48.48%) and service (42.85%) industries.

The second purpose of this paper was to

(2) *Identify the spatial location patterns of Swedish industries, with a special focus on the creative and knowledge industries, in relation to market size, main urban area effects and metropolitan effects;*

The second purpose was to examine the spatial location pattern of each of the industries identified during the first step of the analysis. Theory suggests an under-representation of manufacturing industry in larger market places, due to decreased transportation costs, but with a higher share of creative, knowledge and service industries. The reason for this is that (1)

larger market places are traditionally denser in terms of a high qualified labor force, (2) larger markets consists of more potential customers.

The industry size in the analysis was expressed both in terms of the number of establishments and number of employees. While the first is assumed to be closer related to the diversity of the market place, or the regional creativity level, the latter is more of a concentration measure.

The results were in line with theory, with more creative and knowledge firms (both in terms of establishments and employees) located in larger market places. The service firms turned out to have a somewhat weaker relation with the larger market places in terms of accessible population, but still in front of the manufacturing industry. The coefficient is marginally increased for the creative industries between the years 1993 and 2001, and slightly decreased for the knowledge, service and manufacturing industries. There is also a significant change in importance of being located within a main urban area within the urban region or within a metropolitan urban region

When examining the spatial distribution of those industries and their relation to larger markets in terms of accessible wage sums the result is similar. The changes between 1993 and 2001 are also minor. The relative importance of the metropolitan regions is also decreased during this time period, while the importance of being located within a main region is approximately on the same level in 1993 and 2001.

Important to notice in the analysis is that the number of employees (which is more of a concentration measure) within creative and knowledge industries, is relatively stronger related to accessibility to population and wage sums than the number of establishments (which is more of a diversity or regional creativity measure). The relationship is though reversed in relation to the metropolitan dummy, where the number of establishments is stronger related to the metropolitan regions relatively the number of employees. It implies that diversity and creativity is more closely related to the metropolitan regions, and than concentration of activities is more driven by large markets in general.

This analysis was made holding regions constant. For future research it would be of major interest to further examine the occupational distribution variation between regions, holding industry constant, and also check for firm variation within the industries.

## **APPENDIX 1: CREATIVE CLASS DEFINITION**

Computer and mathematical occupations  
Architecture and engineering  
Life physical and social science  
Education and training  
Arts, design, entertainment, sports and media  
Management occupations  
Business and financial operations  
Legal occupations  
Healthcare  
High-end sales and sales management.

(Florida, 2002)

## APPENDIX 2: INDUSTRY DEFINITIONS AND OVERLAPS

### 1. Industry structure based on occupational distribution (Manufacturing not overlapping any other industry)

SIC	Creative	SIC	Creative overlap Service	SIC	Service	SIC	Manufacturing
111	Extraction of crude petroleum and natural gas	517	Other wholesale	15	Hunting, trapping and game propagation including related service activities	103	Extraction and agglomeration of peat
221	Publishing	523	Retail sale of pharmaceutical and medical goods, cosmetic and toilet articles	183	Dressing and dyeing of fur; manufacture of articles of fur	132	Mining of non-ferrous metal ores, except uranium and thorium ores
223	Reproduction of recorded media	633	Activities of travel agencies and tour operators; tourist assistance activities n.e.c.	371	Recycling of metal waste and scrap	141	Quarrying of stone
233	Processing of nuclear fuel	634	Activities of other transport agencies	372	Recycling of non-metal waste and scrap	142	Quarrying of sand and clay
244	Manufacture of pharmaceuticals, medicinal chemicals and botanical products	652	Other financial intermediation	501	Sale of motor vehicles	143	Mining of chemical and fertilizer minerals
296	Manufacture of weapons and ammunition	672	Activities auxiliary to insurance and pension funding	503	Sale of motor vehicle parts and accessories	151	Production, processing and preserving of meat and meat products
322	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy	724	Data base activities	504	Sale, maintenance and repair of motorcycles and related parts and accessories	152	Processing and preserving of fish and fish products
332	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment	743	Technical testing and analysis	505	Retail sale of automotive fuel	155	Manufacture of dairy products

333	Manufacture of industrial process control equipment	745	Labor recruitment and provision of personnel	521	Retail sale in non-specialized stores	171	Preparation and spinning of textile fibres
401	Production and distribution of electricity	801	Primary education	522	Retail sale of food, beverages and tobacco in specialized stores	172	Textile weaving
402	Manufacture of gas; distribution of gaseous fuels through mains	851	Human health activities	524	Other retail sale of new goods in specialized stores	173	Finishing of textiles
403	Steam and hot water supply	911	Activities of business, employers and professional organizations	525	Retail sale of second-hand goods in stores	175	Manufacture of other textiles
410	Collection, purification and distribution of water	921	Motion picture and video activities	526	Retail sale not in stores	177	Manufacture of knitted and crocheted articles
511	Wholesale on a fee or contract basis	923	Other entertainment activities	551	Hotels	191	Tanning and dressing of leather
514	Wholesale of household goods			552	Camping sites and other provision of short-stay accommodation	192	Manufacture of luggage, handbags and the like, saddlery and harness
515	Wholesale of non-agricultural intermediate products, waste and scrap			553	Restaurants	193	Manufacture of footwear
516	Wholesale of machinery, equipment and supplies			554	Bars	201	Sawmilling and planing of wood, impregnation of wood
642	Telecommunications			555	Canteens and catering	202	Manufacture of veneer sheets
651	Monetary intermediation			601	Transport via railways	203	Manufacture of builders' carpentry and joinery
660	Insurance and pension funding, except compulsory social security			611	Sea and coastal water transport	204	Manufacture of wooden containers
671	Activities auxiliary to financial intermediation, except insurance and pension			612	Inland water transport	205	Manufacture of other products of wood

	funding						
701	Real estate activities with own property			621	Scheduled air transport	211	Manufacture of pulp, paper and paperboard
721	Hardware consultancy			622	Non-scheduled air transport	231	Manufacture of coke oven products
722	Software consultancy and supply			631	Cargo handling and storage	247	Manufacture of man-made fibres
723	Data processing			632	Other supporting transport activities	251	Manufacture of rubber products
725	Maintenance and repair of office, accounting and computing machinery			641	Post and courier activities	252	Manufacture of plastic products
726	Other computer related activities			711	Renting of automobiles	261	Manufacture of glass and glass products
731	Research and experimental development on natural sciences and engineering			714	Renting of personal and household goods n.e.c.	262	Manufacture of non-refractory ceramic goods other than for construction purposes
732	Research and experimental development on social sciences and humanities			746	Investigation and security activities	266	Manufacture of articles of concrete, plaster and cement
741	Legal, accounting, book-keeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy; holdings			747	Industrial cleaning	267	Cutting, shaping and finishing of ornamental and building stone
742	Architectural and engineering activities and related technical consultancy			748	Miscellaneous business activities n.e.c.	271	Manufacture of basic iron and steel and of ferro-alloys
744	Advertising			752	Provision of services to the community as a whole	272	Manufacture of tubes
751	Human health activities			853	Compulsory social security activities	273	Other first processing of iron and steel
802	Secondary education			900	Sewage and refuse disposal,	274	Manufacture of basic precious



					sanitation and similar activities		and non-ferrous metals
803	Higher education			913	Activities of other membership organizations	275	Casting of metals
804	Adult and other education			925	Library, archives, museums and other cultural activities	281	Manufacture of structural metal products
852	Veterinary activities			926	Sporting activities	282	Manufacture of tanks, reservoirs and containers of metal
912	Activities of trade unions			927	Other recreational activities	284	Forging, pressing, stamping and roll forming of metal
922	Radio and television activities			930	Other service activities	285	Treatment and coating of metals
924	News agency activities					286	Manufacture of cutlery, tools and general hardware
						287	Manufacture of other fabricated metal products
						297	Manufacture of domestic appliances n.e.c.
						313	Manufacture of insulated wire and cable
						314	Manufacture of accumulators, primary cells and primary batteries
						342	Manufacture of bodies (coachwork) for motor vehicles
						343	Manufacture of parts and accessories for motor vehicles and their engines
						351	Building and

							repairing of ships and boats
						361	Manufacture of furniture
						451	Construction; Site preparation
						452	Building of complete constructions or parts thereof
						453	Building installation
						454	Building completion
						455	Renting of construction or demolition equipment with operator
						602	Other land transport

## 2. Knowledge vs Creative Industries

SIC	Knowledge	SIC	Knowledge overlap Creative	SIC	Creative
15	Hunting, trapping and game propagation including related service activities	111	Extraction of crude petroleum and natural gas	223	Reproduction of recorded media
112	Service activities incidental to oil and gas extraction	221	Publishing	401	Production and distribution of electricity

	excluding surveying				
241	Manufacture of basic chemicals	233	Processing of nuclear fuel	403	Steam and hot water supply
263	Manufacture of ceramic tiles and flags	244	Manufacture of pharmaceuticals, medicinal chemicals and botanical products	511	Wholesale on a fee or contract basis
300	Manufacture of office machinery and computers	296	Manufacture of weapons and ammunition	514	Wholesale of household goods
331	Manufacture of medical and surgical equipment and orthopaedic appliances	322	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy	515	Wholesale of non-agricultural intermediate products, waste and scrap
334	Manufacture of optical instruments and photographic equipment	332	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment	516	Wholesale of machinery, equipment and supplies
353	Manufacture of aircraft and spacecraft	333	Manufacture of industrial process control equipment	517	Other wholesale
363	Manufacture of musical instruments	402	Manufacture of gas; distribution of gaseous fuels through mains	523	Retail sale of pharmaceutical and medical goods, cosmetic and toilet articles
603	Transport via pipelines	410	Collection, purification and distribution of water	633	Activities of travel agencies and tour operators; tourist assistance activities n.e.c.
611	Sea and coastal water transport	651	Monetary intermediation	634	Activities of other transport agencies
612	Inland water transport	652	Other financial intermediation	642	Telecommunications
913	Activities of other membership organizations	660	Insurance and pension funding, except compulsory social security	725	Maintenance and repair of office, accounting and computing machinery
925	Library, archives, museums and other cultural activities	671	Activities auxiliary to financial intermediation, except insurance and pension funding	744	Advertising
		672	Activities auxiliary to insurance and pension funding		
		701	Real estate activities with own property		
		721	Hardware consultancy		

		722	Software consultancy and supply		
		723	Data processing		
		724	Data base activities		
		726	Other computer related activities		
		731	Research and experimental development on natural sciences and engineering		
		732	Research and experimental development on social sciences and humanities		
		741	Legal, accounting, book-keeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy; holdings		
		742	Architectural and engineering activities and related technical consultancy		
		743	Technical testing and analysis		
		745	Labor recruitment and provision of personnel		
		751	Administration of the State and the economic and social policy of the community		
		801	Primary education		
		802	Secondary education		
		803	Higher education		
		804	Adult and other education		
		851	Human health activities		
		852	Veterinary activities		
		911	Activities of business, employers and professional organizations		
		912	Activities of trade unions		
		921	Motion picture and video activities		
		922	Radio and television activities		
		923	Other entertainment activities		
		924	News agency activities		

### 3. Industries with a less specialized labor force or fishing/farming based

11	Growing of crops; market gardening; horticulture	283	Manufacture of steam generators, except central heating hot water boilers
12	Farming of animals	291	Manufacture of machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines
13	Growing of crops combined with farming of animals (mixed farming)	292	Manufacture of other general purpose machinery
14	Agricultural and animal husbandry service activities, except veterinary activities; landscape gardening	293	Manufacture of agricultural and forestry machinery
19	Small-scale farming	294	Manufacture of machine-tools
20	Forestry, logging and related service activities	295	Manufacture of other special purpose machinery
50	Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing	311	Manufacture of electric motors, generators and transformers
131	Mining of iron ores	312	Manufacture of electricity distribution and control apparatus
145	Other mining and quarrying n.e.c.	315	Manufacture of lighting equipment and electric lamps
153	Processing and preserving of fruit and vegetables	316	Manufacture of electrical equipment n.e.c.
154	Manufacture of vegetable and animal oils and fats	321	Manufacture of electronic valves and tubes and other electronic components
156	Manufacture of grain mill products, starches and starch products	323	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods
157	Manufacture of prepared animal feeds	335	Manufacture of watches and

			clocks
158	Manufacture of other food products	341	Manufacture of motor vehicles
159	Manufacture of beverages	352	Manufacture of railway and tramway locomotives and rolling stock
160	Manufacture of tobacco products	354	Manufacture of motorcycles and bicycles
174	Manufacture of made-up textile articles, except apparel	355	Manufacture of other transport equipment n.e.c.
176	Manufacture of knitted and crocheted fabrics	362	Manufacture of jewellery and related articles
181	Manufacture of leather clothes	364	Manufacture of sports goods
182	Manufacture of other wearing apparel and accessories	365	Manufacture of games and toys
212	Manufacture of articles of paper and paperboard	366	Miscellaneous manufacturing n.e.c.
222	Printing and service activities related to printing	502	Maintenance and repair of motor vehicles
232	Manufacture of refined petroleum products	512	Wholesale of agricultural raw materials and live animals
242	Manufacture of pesticides and other agro-chemical products	513	Wholesale of food, beverages and tobacco
243	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	527	Repair of personal and household goods
245	Manufacture of soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations	702	Letting of own property
246	Manufacture of other chemical products	703	Real estate activities on a fee or contract basis
264	Manufacture of bricks, tiles and construction products, in baked clay	712	Renting of other transport equipment
265	Manufacture of cement, lime and plaster	713	Renting of other machinery and equipment
268	Manufacture of various other non-metallic mineral products		

### APPENDIX 3 – URBAN REGION ACCESSIBILITY REGRESSIONS

**Table 1: Absolute number of establishments and employees explained by urban region accessibility to population and regional characteristics in 1993**

	Creative		Knowledge		Service		Manufacturing	
	Est	Emp	Est	Emp	Est	Emp	Est	Emp
<b>Acc In Urban</b>	0.477**	0.557**	0.423**	0.546**	0.381**	0.474**	0.328**	0.433**
<b>Region Pop</b>	(16.987)	(16.500)	(15.227)	(16.418)	(14.791)	(15.965)	(13.780)	(13.885)
<b>Main Urban</b>	1.247**	1.500**	1.204**	1.456**	1.103**	1.275**	0.886**	0.887**
<b>Area Dummy</b>	(15.523)	(15.534)	(15.140)	(15.295)	(14.961)	(15.012)	(13.018)	(9.939)
<b>Metro Dummy</b>	0.120	-0.119	0.066	-0.172	-0.094	-0.142	0.096	-0.732**
	(1.116)	(-0.921)	(0.616)	(-1.348)	(-0.954)	(-1.242)	(1.050)	(-6.108)
<b>R2</b>	0.673	0.647	0.632	0.640	0.608	0.629	0.582	0.489
<b>Obs</b>	285	285	285	285	285	285	285	285

**Table 2: Absolute number of establishments and employees explained by urban region accessibility to population and regional characteristics in 2001**

	Creative		Knowledge		Service		Manufacturing	
	Est	Emp	Est	Emp	Est	Emp	Est	Emp
<b>Acc In Urban</b>	0.509**	0.575**	0.476**	0.550**	0.714**	0.489**	0.347**	0.433**
<b>Region Pop</b>	(17.959)	(17.105)	(16.819)	(16.618)	(15.686)	(16.141)	(14.608)	(13.741)
<b>Main Urban area Dummy</b>	1.282**	1.531**	1.260**	1.509**	1.171**	1.346**	0.862**	0.820**
	(15.692)	(15.796)	(15.454)	(15.793)	(15.198)	(15.410)	(12.597)	(9.015)
<b>Metro Dummy</b>	0.199	-0.082	0.183	-0.093	-0.018**	-0.093	0.156	-0.718**
	(1.807)	(-0.627)	(1.667)	(-0.720)	(-0.178)	(-0.786)	(1.692)	(-5.850)
<b>R2</b>	0.697	0.661	0.675	0.652	0.633	0.639	0.605	0.465
<b>Obs</b>	289	289	289	289	289	289	289	289

**Table 3: Absolute number of establishments and employees explained by urban region accessibility to wage sums and regional characteristics in 1993**

	Creative		Knowledge		Service		Manufacturing	
	Est	Emp	Est	Emp	Est	Emp	Est	Emp
<b>Acc In Urban</b>	0.451**	0.526**	0.399**	0.515**	0.358**	0.447**	0.307**	0.408**
<b>Region Wage</b>	(17.298)	(16.786)	(15.418)	(28.656)	(14.840)	(16.162)	(13.785)	(14.055)
<b>Main Urban area Dummy</b>	1.228**	1.478**	1.187**	1.435**	1.087**	1.257**	0.872**	0.869**
	(15.444)	(15.442)	(15.018)	(28.656)	(14.779)	(14.876)	(12.839)	(9.810)
<b>Metro Dummy</b>	0.069**	-0.185	0.017	-0.236	-0.133	-0.197	0.068	-0.769**
	(0.639)	(1.430)	(0.160)	(-1.844)	(1.341)	(-1.729)	(0.744)	(-6.424)
<b>R2</b>	0.677	0.651	0.635	0.643	0.608	0.632	0.581	0.493
<b>Obs</b>	285	285	285	285	285	285	285	285

**Table 4: Absolute number of establishments and employees explained by urban region accessibility to wage sums and regional characteristics in 2001**

	Creative		Knowledge		Service		Manufacturing	
	Est	Emp	Est	Emp	Est	Emp	Est	Emp
<b>Acc In Urban</b>	0.471**	0.533**	0.440**	0.509**	0.385**	0.452**	0.318**	0.402**
<b>Region Wage</b>	(18.185)	(17.367)	(17.020)	(16.806)	(15.683)	(16.284)	(14.546)	(13.921)
<b>Main Urban area Dummy</b>	1.267**	1.514**	1.246**	1.493**	1.158**	1.331**	0.851**	0.808**
	(15.629)	(15.761)	(15.387)	(15.725)	(15.041)	(15.322)	(12.425)	(8.931)
<b>Metro Dummy</b>	0.129	-0.163	0.118	-0.168	-0.070	-0.158	0.115	-0.780**
	(1.156)	(-1.236)	(1.057)	(-1.290)	(-0.663)	(-1.326)	(1.224)	(-6.268)
<b>R2</b>	0.701	0.667	0.679	0.656	0.633	0.642	0.604	0.470
<b>Obs</b>	289	289	289	289	289	289	289	289

#### APPENDIX 4 – QUANTILE REGRESSIONS

**Table 7: Absolute number of establishments and employees explained by accessibility to population and regional characteristics in 1993**

	Creative		Knowledge		Service		Manufacturing	
	Est	Emp	Est	Emp	Est	Emp	Est	Emp
<b>Constant</b>	-1.275	0.278	-0.917	0.437	0.413	1.679	0.911	2.528
<b>Urban Area Pop. Accessibility</b>	0.717** (26.15)	0.822** (24.26)	0.663** (28.69)	0.795** (20.99)	0.600** (26.69)	0.714** (20.83)	0.485** (21.08)	0.545** (13.44)
<b>Main Urban Area Dummy</b>	0.602** (8.00)	0.885** (13.126)	0.589** (9.22)	0.824** (7.97)	0.541** (8.66)	0.704** (7.48)	0.454** (7.17)	0.526** (4.63)
<b>Metro Dummy</b>	0.160 (1.77)	-0.141 (-0.26)	-0.012 (-0.16)	-0.102 (-0.82)	-0.101 (-1.35)	-0.089 (0.79)	0.159* (2.09)	-0.415** (-3.04)
<b>R2</b>	0.531	0.534	0.507	0.526	0.513	0.523	0.463	0.423
<b>Obs</b>	285	285	285	285	285	285	285	285

**Table 8: Absolute number of establishments and employees explained by accessibility to population and regional characteristics in 2001**

	Creative		Knowledge		Service		Manufacturing	
	Est	Emp	Est	Emp	Est	Emp	Est	Emp
<b>Constant</b>	-1.682	-0.436	-1.608	-0.210	-0.482	0.941	0.687	2.113
<b>Urban Area Pop. Accessibility</b>	0.742** (27.02)	0.853** (28.84)	0.717** (28.96)	0.820** (21.20)	0.676** (24.74)	0.753** (22.46)	0.490** (22.31)	0.575** (16.43)
<b>Main Urban Area Dummy</b>	0.560** (7.93)	0.834** (10.21)	0.593** (8.74)	0.826** (7.78)	0.535** (7.13)	0.772** (8.36)	0.458** (7.60)	0.407** (4.24)
<b>Metro Dummy</b>	0.331** (3.69)	-0.047 (-0.48)	0.259** (3.22)	-0.003 (-0.03)	0.047 (0.53)	0.004 (0.04)	0.271** (3.79)	-0.466** (-4.08)
<b>R2</b>	0.558	0.541	0.538	0.535	0.536	0.544	0.482	0.431
<b>Obs</b>	289	289	289	289	289	289	289	289



**Table 9: Absolute number of establishments and employees explained by accessibility to wage sums and regional characteristics in 1993**

	Creative		Knowledge		Service		Manufacturing	
	Est	Emp	Est	Emp	Est	Emp	Est	Emp
Constant	-8.113	-8.402	-7.175	-7.914	-5.460	-5.645	-3.570	-3.293
Urban Area Wage Accessibility	0.648** (32.11)	0.788** (39.79)	0.596** (26.46)	0.761** (41.78)	0.550** (27.33)	0.673** (34.62)	0.430** (21.11)	0.525** (16.80)
Main Urban Area Dummy	0.496** (7.98)	0.605** (9.96)	0.509** (7.33)	0.599** (10.70)	0.453** (7.31)	0.534** (8.99)	0.447** (7.12)	0.385** (3.98)
Metro Dummy	0.323** (4.48)	-0.003 (-0.04)	0.170* (2.14)	-0.016 (-0.24)	-0.017 (-0.24)	0.002 (0.03)	0.303** (4.21)	-0.421** (-3.77)
R2	0.555	0.588	0.529	0.584	0.533	0.574	0.464	0.479
Obs	285	285	285	285	285	285	285	285

**Table 10: Absolute number of establishments and employees explained by accessibility to wage sums and regional characteristics in 2001**

	Creative		Knowledge		Service		Manufacturing	
	Est	Emp	Est	Emp	Est	Emp	Est	Emp
Constant	-8.145	-8.642	-7.719	-8.172	-5.874	-5.890	-3.671	-3.293
Urban Area Wage Accessibility	0.648** (22.39)	0.786** (37.20)	0.620** (21.98)	0.759** (34.74)	0.567** (27.51)	0.673** (36.59)	0.434** (20.61)	0.530** (17.63)
Main Urban Area Dummy	0.624** (6.86)	0.701** (10.53)	0.603** (6.75)	0.681** (9.92)	0.510** (7.88)	0.648** (11.16)	0.400** (6.08)	0.277** (2.94)
Metro Dummy	0.481** (4.59)	0.237** (3.10)	0.386** (3.76)	0.219** (2.74)	0.129 (1.73)	0.120 (1.80)	0.345** (4.55)	-0.468** (-4.30)
R2	0.564	0.591	0.545	0.580	0.550	0.582	0.477	0.490
Obs	289	289	289	289	289	289	289	289

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