

What You Do, Not Who You Work For:

A Comparison of the Occupational and
Industry Structures of the United
States, Canada and Sweden

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What You Do, Not Who You Work For

Abstract

While there has been increased interest in the role of occupations, little has been done from a methodological and empirical approach to find out exactly how occupational analysis plays out on the ground in real places and how the study of the relationships among occupations across industries can further illuminate national and regional economic performance. This descriptive research enhances the understanding of the relationships among industries and occupations. These relationships are analyzed and compared at both national (United States, Canada, Sweden) and sample regional (Boston, Toronto, Stockholm) levels. We uncovered significant differences in occupation mix between North American and Swedish industries. While the United States and Canada rely more heavily on service class occupations, which typically pay much lower wages, Sweden has transformed its reliance on low-wage service workers by increasing its creative employment across the entire economy (knowledge, service, and goods producing industry sectors). However, this transition has resulted in a much smaller knowledge industry than is found in both the United States and Canada, which could mean that Sweden has optimized for the short-term but with long-term consequences.

Keywords: Occupations, Industries, Education, Industrial Structure

JEL: R1, J1, L00, O1, O5

Introduction

This is a time of social and economic transformation. Research has shown the ongoing transition of industrialized countries from a manufacturing based economy, towards a service and finally knowledge based economy (Landes 1969; Rosenberg 1986; Mokyr 1990; Diamond 1997 Piore and Sabel 1984; Rosenberg and Birdzell, 1986; Lucas Jr 1988; Diamond, 1997, Storper 1997). The US, Canada, and Sweden have, together with other industrialized countries passed through post-industrialization into a new era based on knowledge and creativity. At the same time these countries have experienced a gradual reallocation of labour-intensive and low-skilled functions towards developing countries. The new industrial structure demands a new type of skilled labour that is highly educated and creative, whose basic production input is cognitive (Saxenian 1994; Drucker 1993; Scott 2000; Florida 2002, Glaeser and Saiz 2004).

However, most analyses are based on the industry or firm level (e.g Porter 1998), without considerations of the new occupational structure. Industry categorization is product focused and determined by what is being made. But in order to really capture and understand the emerging industrial transformation, with regional differences, we need to ask *how are things being made?* The current economy is increasingly being driven by services with manufacturing continuing to play an important role (Florida 2002) but the focus within industries is changing to include a greater emphasis on *product* and *process-improvement*. Understanding today's economic structure requires investigating occupations (*what people do*) as well as industry (*where people work*).

Several trends address that the demand for creativity spans across a multitude of sectors, i.e. many industries' key functions and tasks are increasingly requiring creativity. For instance, Information and Communication Technologies (ICT) industries have lowered market transaction costs and increased opportunities for firms to capitalize on factor price differentials

across countries. Many developed countries in the OECD have witnessed a gradual reallocation of labour-intensive and low-skilled functions towards developing countries (e.g. South East Asia and Eastern Europe). This has and is forcing firms to specialize in knowledge-intensive activities where comparative advantages are driven by R&D, innovation and creativity. Moreover, fuelled by new technologies and knowledge diffusion, the innovation pace has accelerated in several industries. As a consequence, firms need to adapt to new market conditions at a faster rate to remain competitive.

There has been an increased interest in the role of occupations (Florida 2002; Markusen 2004), but little has been done from a methodological and empirical approach to determine how occupational analysis plays out in real places and firms. By studying how the relationship between occupations and industries determines relationships among occupations and across industries it is possible to further illuminate national and regional economic performance. Prior work in cluster analysis has generally taken an "either/or" approach towards occupational and industrial analysis. However, occupations *and* industries are both important. Evaluating them simultaneously will lead to a better understanding of national and regional competitiveness and possibilities for growth (Currid and Stolarick 2008, 2009).

There is both strong theoretical and empirical evidence that occupational analysis has become an effective method of understanding regional advantage and productivity. Economic development policy can be aided significantly by capitalizing on local strengths, best measured through the occupational or skill-mix a region possesses. A solely industrial-based analysis neglects the role of human capital in understanding clustering. External economies, after all, are a function of people and their respective skills and occupations – not industries. Rather, industries benefit from the external economies and spillovers that concentration of human capital and skills produces. The stock of human capital within industrial clustering is the real story (Markusen 2004).

Growth in regional employment results from increasing both the supply and the demand for that labour. Industrial productivity however is a function of human capital. Industries need skilled human capital to generate productivity and growth.

While some would claim that education is a pre-requisite for future creativity, studies like that conducted by Smith, Carlsson and Danielsson (1984) show that creativity, education and skill are all determinants of individuals' productivity. Creativity in this sense is both a complement and substitute to education and skill. In 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 do in practice. This does not replace *human capital* as a meaningful measure for economic development – instead it suggests that education level within a framework based on creativity may be a more appropriate approach.

More recent productivity measures take into account a region's human capital stock. Florida's (2002) "creative class" and Glaeser's (Glaeser and Saiz 2004) "skilled city" focus on the talent or supply contributions to regional growth. While Porter's earlier industry-based model focuses on the demand for labour, these more recent contributions focus on the supply that makes such industrial growth possible. In other words, human beings are the fuel for all industrial clusters.

This research explores the occupational distribution within industries in the United States, Canada and Sweden. In particular, it examines the occupational composition in terms of working task (*what people do*) and educational background (*what people studied*) of the labour force within each industry. The research will identify the industry sectors with the largest concentrations of service and manufacturing occupations. In addition, we will examine whether certain industries have managed to harness creativity among the labour force to a larger extent in any of the three countries.

We selected these countries to maximize the potential of uncovering differences within the developed world. Scandinavia and the United States are considered as opposites from one another, based on their political history – free market (US) versus Sweden’s more social democratic history with greater social protections and stronger unions. Canada, on the other hand, is somewhere between the poles, which should make the comparisons more informative. Also, there are major differences in the costs for higher education with Sweden basically free (if we disregard the opportunity costs), Canada has highly subsidized rates, while a university degree requires a significant investment in the United States.

Three regions, one within each of the countries were also selected to be able to compare nation to region, but also to identify differences across the regions. For Sweden, Stockholm is the obvious choice given its position in the Swedish urban hierarchy and its role as the economic engine of the country. Toronto fills a similar role in the Canadian economy. Since the regions atop the United States urban hierarchy would be much larger than Stockholm and Toronto, we selected Boston, which is also a knowledge economy of similar size.

Theory and Concepts

While the occupational approach has received a flurry of attention over the last several years, Thompson and Thompson (1985) introduced 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. In this vein, scholars have argued that it is occupations not industrial classifications that are most accurate in their measure of human capital clustering (Barbour and Markusen 2007; Koo 2005; Feser 2003; Markusen 2004; Florida 2002). This methodological approach argues that occupations are a better gauge for what people do and where value is being added as this measure counts individuals who may not be

captured by traditional educational measures but are contributing significantly to the economy. Further, occupational analysis allows for a more targeted approach in using human capital to enhance local economic development efforts (Markusen 2004).

Industrial cluster theory posits that externalities occur due to co-location of firms and skills. While there have been rebukes towards the effectiveness of the cluster model (see for example, Lundequist and Power 2002; Martin and Sunley 2001; Hervas-Oliver and Albers-Garrigos 2007), there is a pervasive belief across the social sciences that the geographical clustering of industries and their related human capital and resources is significant to economic growth. Originally conceived in Marshall's (Marshall, 1890; Guillebaud et al. 1961) seminal discussion of "industrial districts", geographical clustering has been thought to allow for not only efficiency and ease of resource and skill exchange (e.g. localization economies) but also more intangible "tacit" knowledge (Gertler 2003) and "untraded interdependencies" (Storper 1997) that outweigh the tangible or formal exchanges among firms and human capital.

Piore and Sabel's (1984) ground breaking look at the new industrial map points towards regions which had flexible exchanges of resources, labour pools and ideas across firms and industries. Despite the advanced technology that allows people and firms to locate in geographically dispersed regions, people and firms increasingly tend to agglomerate in the same locations due to the intangible benefits of face-to-face contact, exchange of ideas and competition that drives firms to achieve greater innovation (Storper 1997; Porter 1998; Glaeser and Saiz 2004; Stolarick and Florida 2006) Regional productivity therefore is a function not only of the right resources in the right place but the positive spillovers associated with that agglomeration.

Understanding regional growth formalizes the ways in which industrial agglomerations work and the linkages most important in the exchange of resources and information. As Piore and Sable (1984) noted, these linkages were marked by vertical disintegration, where firms increasingly outsourced

for materials, skills and resources for their production. Porter (1998) synthesized these dynamics in industrial clustering defined as “geographical concentrations of interconnected companies and institutions in a particular field” (p. 78). Thus, successful regions possessed dense agglomerations of firms able to help each other produce differentiated products by constant shifts from being collaborators to competitors with these dynamics resulting in a “lock-in” competitive advantage over other locations (Scott 2000; Castells, Hall et al. 1994). As many geographers and planners have argued subsequently, regional growth as understood in the cluster model cannot be attributed to one industry but the synergies across different industries that work to create diversified products and innovations within the same geographically-based industrial concentration.

While perceived as ground breaking in regional growth models, Porter’s (1998) model focused primarily on the demand side of regional productivity without taking into account the people employed in these clusters. More contemporary research revolves around a more nuanced version of clustering; that it is the concentration of people and skills which drives regional growth. From these perspectives, human capital has become the critical factor dictating regional success (Drucker 1993; Glaeser and Saiz 2004; Lucas Jr 1988; Florida 2002).

Many recent explorations tied largely into Schumpeter’s (1942) discussion of “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 (1960), 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 innovation and productivity growth are a function of knowledge creation. The role of human capital and its relation to new ideas, innovation and division of labour on a regional level have also been highlighted (Piore and Sabel 1984; Lucas 1988; Saxenian 1994; Storper 1997; Scott 2000; Florida 2002). Glaeser and Saiz (2004) found that cities possessing greater stocks of human capital (as measured by those with a bachelor’s degree or above) exhibited greater

productivity and growth than those with less “skills” with original stocks of human capital predicting growth and productivity over time. Stolarick and Florida (2006) find that regions with greater “spill-acrosses” created by the interactions among the creative, technical, business and design communities are more productive in the long run.

While the education measure tells us where general skills are, it does not inform what people are doing with their skills and how these skills are exchanged within a regional economy. Traditionally, the education level is used as a measure for human capital and can be defined as the share of the labour force with a university degree. However, education only measures base line skills. It does not measure the application of education or skills important to a region’s productivity. As a result, there has been increasing debate as to *which* skills are important for regional productivity. In other words, scholars have begun to sift through human capital stocks to parcel out which types of skills are most important. The clearest proxy for measuring these dynamics are occupations as they take into account the tasks individuals perform and industries’ demand for qualified labour.

Several different approaches have been undertaken to get at the occupational dynamics of a region. Markusen (2004) showed how an occupational analysis helps explain the economic dynamics of firms. Barbour and Markusen (2007) point out innovative industries cannot be predicted by their industry alone as occupations are more geographically divided with research and development and production located in different parts of the country, a point that Massey (1984) and Nelson (2003) have also argued. Therefore, occupations within an industry may differ by geographic location. Similarly, Feser (2003) argues that one has to distinguish between the “work” and the products of firms and this is a function of the education and skills of a region. Workers may move between occupations and industries within the same geographic region, often without having to attain significant new skills, because “many skills and knowledge-bases are common to multiple occupations” (Feser 2003, p. 1940). While the earlier work of Thompson and Thompson (1985) used a generic categorization for occupational clusters, Feser (2003) and Koo (2005) base

their definitions of occupational clusters on the knowledge requirements of occupational categories using Occupational Information Network (O*NET) classifications.

Industrial-based analysis neglects the role of human capital in understanding clustering. Benefits accrue in clusters from the external economies and spillovers that the concentration of human capital and skills produce. In this respect, the Porter (1998) model only partly tells us what is going on through the examination of the demand-side: industry and production locations. However, occupational analysis explains why the industries are geographically located where they are – for the specific skills that particular regions possess. Occupational analysis informs the supply-side of regional productivity and growth, and gives an understanding of the types of human capital and skills that are important to regional productivity. There is both strong theoretical and empirical evidence that occupational analysis has become an effective method of understanding regional advantage and productivity. Prior work in cluster analysis has generally taken an “either/or” approach towards occupational and industrial analysis. However, Currid and Stolarick (2008, 2009) have shown that both industrial and occupational analysis is essential in providing a deeper understanding of the role of human capital and skills in industrial clustering.

Data, Variables, and Methods

The analysis for the United States uses the 2005 American Communities Survey (ACS) Public Use Micro data Sample (PUMS) from the United States Bureau of the Census. Occupational class and industry sector are determined from the Census occupation and industry codes. Number of years of schooling is calculated from the educational attainment variable reported for each individual in the PUMS. Only information on those who are currently employed is retained. The United States data is from a 5 percent sample.

The analysis for Canada uses data drawn from Statistics Canada’s 2006 Census of Canada Master File (20 percent sample). The analysis includes all

individuals whose labour force status was reported to be employed in 2006. Individuals who are institutionalized were excluded. The Census includes industry data as classified by the North American Industry Classification System (NAICS) 2002 and occupation data classified by the National Occupational Classification Statistics (NOCS) 2006. The number of years of schooling is calculated from the Highest Certificate, Diploma or Degree (HCDD) variable using a customized derivation. These custom cross-tabulations have been rounded per Statistics Canada's disclosure requirements and regulations.

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 2005 (which is the latest year available for occupational data for Sweden) and select all firms and all employees. For each individual we check the occupational status as well as his or her education and match all individuals with establishment with the firms and finally industry.

This descriptive research is focused on understanding the relationships among a high-level set of industries and a high-level categorization of occupations. For each of the pairings between an industry and an occupation, educational levels (high school diploma is 12 years and bachelor's degree is 16 years) will also be examined. These relationships will be analyzed and compared at both national (United States, Canada, Sweden) and sample regional (Boston, Toronto, Stockholm) levels.

The industry is a set of firms composed by one or several individuals in the labour force. The labour force is a function of its education and the occupational tasks they perform. To identify each industry labour composition we aggregate the labour composition over establishments, firms and thereafter over industry, checking the total composition of labour within each industry, also separating education from occupation. From this we will be able to identify the occupational and educational composition of each industry class.

We group occupations into four classes similar to Florida (2002): creative, service, working and fishing, farming and forestry. Creative occupations are generally high autonomy occupations where workers add economic value through the generation of new ideas and forms. Service occupations are low-autonomy occupations in the service sector which are routine-oriented. Working occupations are occupations that depend highly on physical skills and repetitive tasks. Farming, fishing and forestry occupations are those occupations which are highly physical occupations typically found in the natural resource sector. Similarly, we group industries to the four classifications of knowledge, services, goods producing or fishing, farming and forestry.

Each individual i has a certain number of years of education;

$$i : E_i \geq 0$$

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

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

The task can either be creative (c_i), service-related (s_i), working (w_i) or fishing, farming and forestry (f_i).

Each industry j has different activities they focus on:

$$a : a_j \in \{k, s, g, f\}$$

The activity can either be knowledge (k_j), services (s_j), goods producing (g_j) or fishing, farming and forestry (f_j).

Findings

The first part of our analysis will focus on differences in industry versus occupational distribution across our three countries; United States, Canada and Sweden. The second step will compare three knowledge intense regions in each country; Boston, Toronto and Stockholm. The regions are of similar size in terms of population and are all considered to be creative economies in their nations. Finally, we will make a comparison on a national versus regional level – to determine what extent the composition and the occupational distribution differs within the regions compared to their national averages.

Table 1: National comparison

Industry	Occupation	US				Canada				Sweden			
		Obs:	Av years in education	Share of industry	Share of national employment	Obs:	Av years in education	Share of industry	Share of national employment	Obs:	Av years in education	Share of industry	Share of national employment
Knowledge	Creative	395,539	16.1	59.19	22.99	2,212,740	16	62.30	13.81	134,671	13.9	65.38	6.35
Knowledge	Service	241,830	14.3	36.19	14.06	1,228,035	14	34.57	7.67	44,966	11.8	21.83	2.12
Knowledge	Working	30,524	14.0	4.57	1.77	102,365	13	2.88	0.64	25,823	10.9	12.54	1.22
Knowledge	Fish/Farm	402	14.5	0.06	0.02	8,860	13	0.25	0.06	511	11.2	0.25	0.02
Service	Creative	110,383	15.2	17.11	6.42	1,769,895	15	24.32	11.05	383,734	13.2	35.48	18.08
Service	Service	435,148	14.2	67.45	25.29	4,831,610	13	66.39	30.16	467,518	11.5	43.22	22.03
Service	Working	98,465	13.8	15.26	5.72	617,140	13	8.48	3.85	226,358	11.1	20.93	10.67
Service	Fish/Farm	1,116	14.0	0.17	0.06	59,265	13	0.81	0.37	3,990	11.2	0.37	0.19
Goods Producing	Creative	82,637	15.5	22.03	4.80	867,280	14	19.32	5.41	254,154	13.2	31.91	11.98
Goods Producing	Service	43,122	14.0	11.50	2.51	1,047,390	13	23.34	6.54	50,665	11.6	6.36	2.39
Goods Producing	Working	248,869	13.8	66.34	14.47	2,486,110	13	55.39	15.52	488,827	10.9	61.38	23.03
Goods Producing	Fish/Farm	495	13.8	0.13	0.03	87,440	13	1.95	0.55	2,719	11.0	0.34	0.13
Fish/Farm	Creative	14,555	14.7	45.81	0.85	103,360	15	14.70	0.65	6,733	13.2	17.51	0.32
Fish/Farm	Service	2,379	14.2	7.49	0.14	61,060	13	8.69	0.38	2,664	11.5	6.93	0.13
Fish/Farm	Working	1,963	13.8	6.18	0.11	102,895	13	14.64	0.64	14,345	10.7	37.31	0.68
Fish/Farm	Fish/Farm	12,877	14.1	40.53	0.75	435,720	12	61.98	2.72	14,702	11.0	38.24	0.69

Industry and Occupation Structures on National Scales

United States

In the United States, the knowledge (38.9%) and service (37.5%) industries are significantly larger than the goods producing industry (21.8%) and fishing, farming, and forestry (1.9%). The knowledge industry has much higher education levels than the other three industry sectors with an average of 15.5 years of schooling while the other three industry sectors average 14.5 years.

While the knowledge and service industries are roughly the same size, the occupational structure of the United States tells a different story. The largest share of employment is in service class occupations at 42.0% while creative occupations account for 35.1% of total employment. Working class trails behind with only 22.1%, and fishing, farming, and forestry is under 1% of total employment. The education levels reveal a similar pattern as the industry sectors. Those in creative occupations average 15.8 years of education while service class occupations average 14.2 years with fishing, farming, and forestry at 14.1 years and working at 13.8 years. While the average years of schooling across the service and goods producing industry sectors are similar with manufacturing occupations averaging lower levels of education than service-based ones.

When occupations within industries are considered, not surprisingly, the largest share of occupational employment within each industry sector is from the occupations most closely associated to that sector. For the service industry, service class occupations are 67.5% of the industry and 25.3% of all United States employment; working classes are 66.3% of the goods producing industry (14.5% of the United States); creative occupations comprise 59.2% of the knowledge industry (23% of the United States employment).

Interestingly, at 14.1% of total United States employment, service class occupations just in the knowledge industry sector (36.2% of industry employment) account for almost as much of total United States employment as working class in the goods producing industry.

Across industry and occupation combinations, educational levels repeat themselves in a strikingly consistent fashion: for occupations, creative > service > working; for industry knowledge > service (roughly) = goods producing. At the high end are creative workers in the knowledge industry averaging 16.1 years of education (average above a bachelor's degree). At the low end are working class occupations in the service and goods producing industry sectors with an average of 13.8 years of education. They do have a higher average of 14.0 years in the knowledge industry (significantly higher on a one-tailed t-test; $p=0.05$). Those with service class occupations average slightly more education than the working class occupations across all industry sectors, again with workers in the knowledge sector averaging higher education (14.0 years) than the service and goods producing industry sectors (both 13.8 years).

Canada

In Canada, the service industry has the largest share of national employment (45.4%) followed by goods producing (28.0%), knowledge (22.2%) and fishing, farming and forestry (4.4%). While it may have been expected that knowledge industry may be a larger proportion of national employment, Canada has a strong economic base in natural resources and manufacturing. Examination of employment by occupation finds service class occupations (44.7%) with the largest share of employment followed by creative (30.9%), working class (20.7%) and fishing, farm and forestry (3.7%). It is not unexpected that service class occupations is the largest share of employment as service class occupations are large components of each industry with the exception of fishing, farming, and forestry. Not unexpectedly, individuals in creative occupations have the highest average years of schooling (15.0 years) in comparison to the other three occupation categories of service (14.0 years), working (13.0 years) and fishing, farming and forestry (12.0 years). The average years of schooling by industry sector reveals similar results to that of occupation sectors.

Predictably, the largest share of national employment occurs with occupation categories employed in their industry categories such that the largest shares of

employment are service class occupations in the service industry (30.2%) followed by working class occupations in the goods producing industry (15.5%) and then creative occupations in knowledge industry (13.8%). The examination of both occupation and industry of individuals highlights that creative and service class occupations are a large share of each of the industries. While the service and goods producing industries are 'less creative' than the knowledge industry, creative occupations are still a relatively large share of the employment in these two industries. Individuals employed in creative occupations within the knowledge industry have the highest levels of education (16 years) while those in fishing, farming and forestry occupations in the fishing, farming and forestry industry have the lowest (12 years).

Sweden

In Sweden, the service industry makes up the largest share of the overall economy with 51.0% of the national employment followed by the goods producing sector (37.3%). Overall, the service and goods producing industry make up close to 90% of the Swedish employment with knowledge industry employment accounting for 9.7% and the fishing, farming and forestry industry sector representing 1.8%. If we instead examine the occupational structure, we see that creative occupations make up the largest share of the economy with 36.7%, approximately at the same level as working class occupations (35.6%) while there is a smaller share of service class occupations.

The combined data for industry and occupations for Sweden reveal that the largest share of employment is found for working class occupations within the goods producing industry (23.0%), service class occupations within service industry (22.0%) and creative occupations within the service industry (18.1%). The share of creative occupations within the service industry is more than three times larger than the share of creative occupations within the knowledge industry (6.3%). Also in Sweden, educational levels tend to be the highest among the creative occupations; 13.9 years within knowledge industries, 13.2 years within service and 13.2 years within goods production and fishing and farming. However, for service and working class occupations, the level of education tends to be fairly similar for all industry groups.

Industry and Occupation Structures on Regional Scales

Boston

The occupational and industrial structure of Boston differs significantly from the United States. The knowledge industry has over 51% of total regional employment followed by the service industry, at 33.3%, which is lower than the United States' share, and the goods producing industry, which at 15.5% is well below the United States' share of 21.8%. The average knowledge industry worker in Boston has 16.3 years of education, compared to a national average of 15.5 and regional averages of 15.0 (service) and 15.3 (working class) years. Both the service and goods producing industry sectors have education levels above their corresponding national averages.

The pattern repeats itself at the occupational level. Creative workers are almost 48% of Boston's workforce and have an average of 16.5 years of education. Service workers comprise 38.3% of the workforce and have 14.8 years of education, and working class workers are 13.7% of the workforce and have 14.3 years of education. While it's not unexpected that the creative workers of Boston are more educated than their United States counterparts (16.5 versus 15.8 years), it is interesting to note that individuals employed in service class and working class occupations also have more education. Working class workers increase from 13.8 to 14.3 years, and service workers increase from 14.2 to 14.8 years. This is likely the result of Boston's higher levels of employment in the knowledge industries, but even that is interesting as it demonstrates a difference between similar occupations across different industries.

As with the United States national numbers, the highest industry shares are with their related occupations. However, there are interesting differences between the individual industry and occupation shares for Boston and the overall United States. While service workers in the service industry comprised the largest share of United States employment (25.3%), in Boston it is creative

workers in the knowledge industry sector (35.2%) while service workers in the service industry are only 22% of the Boston workforce. While, working class workers comprise the largest share of the goods producing industry sector at 53.3% of industry employment, they are only 8.2% of total employment across Boston although 14.5% of total United States' employment. Boston has significantly more service employees in the knowledge industries (14.6%) and does exceeding well in the other industries. Creative employees account for 35.6% of goods producing industry sector employment (22.0% for United States) and 21.4% of service industry employment (17.1% for United States). The *creative intensity* of employment in the Boston area is not just reflected in the knowledge industry – it is endemic across the entire Boston economy.

In Boston, the education levels are higher across the board when compared to the national levels. For example, while creative workers in the knowledge industry for the United States average 16.1 years of education, the same workers in Boston average 16.7 years of education. In addition, those working in the service industry across Boston also average about ½ year more of education than the United States across all occupational groups.

Toronto

The industry and occupation of employment in the Toronto Census Metropolitan Area (CMA) differs from the national employment distribution. The service industry (40.4%) has the largest regional employment share followed by the goods producing (29.8%), knowledge (29.4%) and fishing, farming and forestry (0.5%) industry sectors. The knowledge industry in Toronto has a larger share of employment than the national average while smaller shares in the service and fishing, farming and forestry industries. Those employed in the goods producing or fishing, farming and forestry industry sectors in Toronto have more years of schooling (14.0 years) than the national average (13.0 years). In terms of occupational distribution, Toronto has the largest regional employment share in service (43.7%) followed by creative (36.6%), working class (18.8%) and fishing, farming and forestry (0.9%) occupations. There is a larger share in creative occupations in Toronto than the national average with a smaller share in service class occupations.

The years of schooling by occupational group is the same between Toronto and Canada with the exception of those employed in fishing, farming and forestry occupations (13.0 years for Toronto and 12.0 years for Canada).

When examining the intersection between industries and occupations the distribution of employment differs between Toronto and Canada with service class occupations in the service industry (26.2%) the largest share of employment followed by creative occupations in the knowledge industry (18.9%) and working class occupations in goods producing industry (15.0%). Creative occupations in the knowledge industry are a significantly larger share of employment in Toronto than the national level. The occupational distribution among the three industries of knowledge, service and goods production are similar between Toronto and Canada. However, while there is only a smaller number employed in the fishing, farming, and forestry industry in Toronto, there is a much larger share employed in creative occupations (25.8%) than on the national scale (14.7%). Creative occupations comprise a larger share of each of the four industries in Toronto than the national average. Generally, for those employed in creative or service class occupations across the four industries in Toronto the average years in education is higher than the Canadian national average.

Stockholm

In Stockholm, we find that 65.4% of the regional employment is within the service industry followed by the knowledge and goods producing industry, both with a share of approximately 17% of the regional employment. The service sector clearly dominates the regional economy, and is overrepresented also from a national perspective with a share of 50.8%. Meanwhile, the goods producing sector makes up a much smaller share of the Stockholm economy (17.2%) than the Swedish economy as a whole (37.5%). Instead, we find a larger representation of the knowledge industry in Stockholm, with 17.3% compared to the national average of 9.7%. In terms of occupations, the share of creative occupations by far make up the largest group (56.2%) followed by service class occupations (29.8%) and working class occupations in Stockholm (13.8%).

If we turn to the occupations within industries in Stockholm, we find the largest shares for creative occupations within the service industry (32.8%) and service class occupations within the service industry (26.1%). This is followed by creative occupations within the knowledge industry with a share of 13.7% of the regional employment. While service class occupations within service industry is approximately at the same level as the national share, the concentration of creative occupations, both within knowledge and service industries, is twice as strong. In terms of education levels, Stockholm performs better for all occupational groups compared to the Swedish national average

Table 2: Regional Comparison

Industry	Occupation	Boston (PMSA)				Toronto (CMA)				Stockholm (Local Labour Market)			
		Obs:	Av years in education	Share of industry	Share of regional employment	Obs:	Av years in education	Share of industry	Share of regional employment	Obs:	Av years in education	Share of industry	Share of regional employment
Knowledge	Creative	7,095	16.7	68.99	35.19	497,010	16	64.45	18.92	39,483	14.1	79.48	13.74
Knowledge	Service	2,936	15.0	28.55	14.56	257,220	15	33.35	9.79	7,123	12.2	14.34	2.48
Knowledge	Working	252	14.6	2.45	1.25	16,335	14	2.12	0.62	3,026	11.2	6.09	1.05
Knowledge	Fish/Farm	1	16.0	0.01	0.00	615	14	0.08	0.02	42	11.1	0.09	0.02
Service	Creative	1,435	15.8	21.36	7.12	284,565	15	26.83	10.83	94,076	13.7	50.09	32.75
Service	Service	4,434	14.7	66.00	21.99	688,450	14	64.92	26.2	74,914	11.9	39.88	26.08
Service	Working	848	14.1	12.62	4.21	81,400	13	7.68	3.1	18,579	11.3	9.89	6.47
Service	Fish/Farm	1	18.0	0.01	0.00	6,095	13	0.57	0.23	264	11.8	0.14	0.09
Goods Producing	Creative	1,110	16.1	35.62	5.51	175,340	15	22.42	6.67	27,713	13.8	56.18	9.65
Goods Producing	Service	345	14.3	11.07	1.71	201,100	14	25.72	7.65	3,436	11.9	6.96	1.20
Goods Producing	Working	1,660	14.3	53.27	8.23	394,175	13	50.41	15	17,959	11.0	36.40	6.25
Goods Producing	Fish/Farm	1	13.0	0.03	0.00	11,380	13	1.46	0.43	223	11.6	0.45	0.08
Fish/Farm	Creative	12	15.9	28.57	0.06	3,520	16	25.78	0.13	178	13.6	0.97	0.06
Fish/Farm	Service	5	16.0	11.90	0.02	2,340	14	17.14	0.09	83	11.8	0.45	0.03
Fish/Farm	Working	0	n/a	0.00	0.00	1,340	13	9.81	0.05	55	10.5	0.30	0.02
Fish/Farm	Fish/Farm	25	13.5	59.52	0.12	6,455	13	47.27	0.25	132	11.0	0.72	0.05

Comparison of Industry and Occupation Structures of Three Countries

National Industry Structures:

Aggregation of industries into the four sectors of knowledge, service, goods producing and fishing, farming and forestry illuminate the differences in industry structure across the three countries. The service industry sector employs the largest share of national employment for Sweden (51.0%) and Canada (45.4%); however, unlike these two countries the United States has its largest share of national employment in the knowledge industry sector (38.8%). The share of national employment within the knowledge industry sector highlights large differences among the three countries as the United States had the largest share (38.8%) while Canada and Sweden have much smaller shares (22.2% and 9.7% respectively). In contrast, the service industry sector employs larger shares in Sweden (51.0%) and Canada (45.4%) and a smaller share in the United States (37.5%).

Canada has the largest share in the fishing, farming, and forestry industry sector (4.4% of national employment) in comparison to almost 2 percent in both Sweden and the United States. This is expected as Canada has historically and continues to have a strong economic base in its natural resources resulting in a relatively larger share in the fishing, farming and forestry industry sector than the other two countries.

Surprisingly, the share of national employment in the goods producing industry sector is highest in Sweden (37.5%) followed by Canada (28.0%) and the United States (21.8%). As we will show below, Sweden also has a larger share of creative workers in the goods producing industry sector than both the United States and Canada and has a smaller share of working class in the goods producing industry sector than the United States. Sweden's larger share of goods producing industry sector employment may well reflect its position in the forefront of the transition to a manufacturing basis that is focused on the creative aspects of manufacturing (design, management, etc.) rather than the more mundane and lower paying assembly-line occupations.

While this is an aggregate analysis of the industry structure of these three countries, major industry sector differences are apparent. The analysis highlights the strength of the knowledge industry sector in the United States in comparison to Canada and Sweden. For instance, the examination of the knowledge to goods producing national employment share ratio highlights key industry differences as the United States has a ratio of 1.78 followed by Canada (0.79) and Sweden (0.26). That is, for every employee in the goods producing industry sector in the United States there are 1.78 employees in the knowledge industry sector. In comparison, in Sweden there are four goods producing industry sector employees for each knowledge industry sector employee. By industrial sector, the goods producing industry sector is a larger employer for Sweden than either United States or Canada.

National Occupation Structures:

Examination of the occupation structure of the three countries across the four categories of creative, working, service and fishing, farming and forestry highlights the similarity of the occupation structure between the United States and Canada and their differences in comparison to Sweden. For creative occupations, the three countries have similar occupation structures with Sweden having the largest national share of employment (36.7%) followed closely by the United States (35.1%) and Canada (30.9%). Canada and the United States have similar occupational employment shares in service and working class occupations in comparison to Sweden. Service occupations are the majority of occupations in the United States (42.0%) and Canada (44.8%) while a significantly lower share in Sweden (26.7%). In contrast, the United States and Canada have a smaller share in working class occupations (22.1% and 20.7% respectively) than Sweden (35.6%).

National Industry-Occupation Structures:

By examining the relationship between industry and occupation structures in each of the three countries, the types of occupations which are employed

within each of the four industry sectors can be highlighted. Across the three countries, the largest share of national employment occurs in service class occupations within the service industry with the largest proportion in Canada (30.2%) followed by the United States (25.3%) and Sweden (22.1%). The majority of occupations in the service industry sector are service class occupations particularly for Canada (66.4%) and the United States (67.5%) while less dominant in Sweden (43.2%).

Examination of the ratio of occupations within an industry sector highlights the importance of the simultaneous examination of industry and occupation structures. The national employment ratio of creative occupations to service class occupations within the service industry sector emphasizes the difference between the United States (0.25) and Canada (0.37) and Sweden (0.82). This ratio implies that for every individual employed in a creative occupation in the service sector there are four individuals with service class occupations in the United States, three in Canada and 1.22 in Sweden. The results from Sweden indicate that there has been an occupation shift within the service industry sector moving away from the more traditional service class occupations to more creative occupations. Relatively high service costs in Sweden may have expedited the shift from the traditional service class occupations in the service industry towards creative occupations unlike in Canada and the United States.

In the knowledge industry sector, approximately 60 percent are creative occupations for each of the three countries; however, the United States has a larger proportion employed in creative occupations in the knowledge industry sector (23.0% of national employment) in comparison to Canada and Sweden (13.8% and 6.4% respectively). In addition, there is a large proportion of national employment in service class occupations within the knowledge industry sector in the United States (14.1%) with Canada close to half (7.7%) and Sweden (2.1%). Overall, within the knowledge industry sector, the shares of each occupation type are similar across the three countries; however, their shares of national employment differ with shares in the United States generally larger for each occupation type than Canada and Sweden. While the United States has a larger share of national employment in the knowledge

industry in creative occupations, both Canada and Sweden have a larger national employment share of creative occupations in both service and goods producing industry sectors.

The goods producing industry sector primarily employed individuals in working class occupations (66.3% in the United States, 61.4% in Sweden and 55.4% in Canada). However, working class occupations within the goods producing industry sector as a share of national employment are a smaller proportion in Canada (15.5%) and the United States (14.5%) than Sweden (23.0%). Indeed, Sweden has a larger share of national employment in working class occupations across the service, goods producing and fishing, farming and forestry industry sectors than the United States and Canada.

When we compare the national educational levels, the United States performs better than Canada on average, especially within the goods producing industry. Both the US and Canada have an average level of education significantly above that found in Sweden- this holds for all industries and occupations. This is an important factor that may be related to the differences in industrial structures that we have witnessed between the three countries, with the United States and Canada having a significantly larger share of knowledge industry. We return to this discussion in the conclusion.

Comparison of Industry and Occupation Structures of Three Regions

Regional Industry Structures:

Regional industry structures are similar to national patterns discussed in the earlier section. Boston has a substantially larger proportion of the regional share of employment in the knowledge industry sector (51.0%) compared to Toronto (29.4%) and Stockholm (17.3%). Each of these three regions has a larger proportion employed in the knowledge industry sector than the national average with the largest differential in Boston. Re-enforcing national patterns, Stockholm has its largest regional share of employment in the

service industry sector (65.4%) while Toronto and Boston have much smaller shares (40.4% and 33.3% respectively). Stockholm has an approximately 15 percentage points larger share of employment in the service industry sector than its national average; however, Toronto and Boston have approximately 5 percentage points less.

In Toronto, the regional share employed in the goods producing industry sector (29.8%) is similar to that of the Canadian national average (28.0%); however, this employment share is significantly lower in both Boston and Stockholm (15.5% and 17.2% respectively). The share of employment in the goods producing industry sector in Stockholm is less than half of the Swedish national average. Compared to national averages, Boston and Stockholm have an overrepresentation of employment in knowledge and service industry employment sectors while Toronto has a similar industry structure to the Canadian national average. In terms of the fishing, farming and forestry and farming sector, few are employed in this sector in each of the three regions. In general, Toronto is more similar in industry structure to the Canadian average while Boston and Stockholm differ in many aspects to their national averages. Toronto's similarity to the Canadian average may be in part due to the examination of the census metropolitan area of Toronto which encompasses a large range of industries within its geographic boundary.

Regional Occupation Structures:

Although the Stockholm region has the smallest share employed in the knowledge industry sector out of the three regions, Stockholm has a larger share of regional employment in creative occupations (56.2%) than Boston and Toronto (47.9% and 36.6% respectively). In addition, the creative occupational shares of each of these three regions are larger than the national averages. Although there is a larger share of employment in Boston than Stockholm in the knowledge industry sector, in terms of occupational structure a greater proportion of creative employment occurs in Stockholm. Similarly, Stockholm has the lowest share of regional employment in service class occupations (29.8%) compared to Boston (38.3%) or in Toronto (43.7%);

despite a large share of employment in the service industry sector in Stockholm (65.4%). There is a higher regional share of working class occupations in Toronto (18.8%) compared to Boston and Sweden (13.7% and 13.8% respectively); however, these regional shares are lower than the national averages.

Regional Industry-Occupation Structures:

In general, there is a larger share of creative occupations within each of the four industry sectors for the three regions in comparison to national averages. Of particular interest is the share of employment of creative occupations within the knowledge industry sector. Boston has a much larger proportion employed (35.4%) than either Toronto (18.9%) or Stockholm (13.7%). Boston is the headquarters for many universities and large science and technology firms such as Bose and EMC which have encouraged the growth of both the knowledge sector and creative occupations in Boston. While Toronto is the location choice of Canadian subsidiaries these headquarters are likely smaller than their United States or international counterparts.

The creative to service occupation within the service industry sector ratio of the three regions is similar to that of national measures with 0.32 for Boston and 0.41 for Toronto implying that for every creative occupation within the service sector there are more than two service class occupations. This ratio for Stockholm is 1.26 implying there are more creative occupations in the service sector than traditional service class occupations. Indeed as a share of the regional economy, the creative occupations within the service sector constitutes the largest share of regional employment in Stockholm (32.8%) while Boston's large share is in creative occupations within the knowledge industry sector (35.2%) and Toronto's largest share is in service class occupations within the service industry sector (26.2%). Echoing national results, Stockholm has undergone an underlying shift within the service industry sector moving from traditional service class occupations to creative occupations. However, this shift to creative occupations within the knowledge industry sector is less apparent in Stockholm compared to Boston and

Toronto. Potentially, this shift within the service industry sector may be due to a more narrow income distribution in Sweden than in Canada and the United States. An individual may choose a creative job within the service industry, just as easily as choosing a creative job within the knowledge industry, since the wage levels are usually rather equal. This can also be one of the reasons behind the relatively low share that the knowledge industry makes up in Sweden as well as in the Stockholm region. From a wage and content perspective, getting a creative occupation within the service industry from the individual's perspective is equal to getting one within the knowledge industry.

Conclusions

We have dissected industry sectors across three countries and three regions to demonstrate the different internal structures based on occupational distributions and educational levels. Traditionally, economic analysis has relied on industry, number of establishments and number of employees, as a significant control. But, industry definitions are based on the final product and are treated as homogeneous within and across nations and regions. As we have just shown, clearly industry (where you work) varies by at least occupation (what you do) and educational levels. We would expect to find a variety of occupational requirements within all industries. For example, Software Publishing (knowledge industry) includes manufacturing workers (packaging and logistical support), service workers (clerical and janitorial), and creative workers (managers and programmers) which would all be homogeneously categorized as employees (simple count) of the same industry. However, each has different educational requirements and would contribute differentially to firm productivity.

We uncovered significant differences between North American and Swedish industries. While the United States and Canada rely more heavily on service class occupations, which typically pay much lower wages, Sweden has transformed its reliance on low-wage service workers by increasing its creative employment across the entire economy (knowledge, service, and goods producing industry sectors). However, this transition has left a much smaller

knowledge industry than is found in both the United States and Canada, which could mean that Sweden has optimized for the short-term but with long-term consequences.

Sweden has a very different service industry than either the United States or Canada, and this difference is even more pronounced for Stockholm, Sweden's largest city. For the United States, Canada, Boston, and Toronto, service workers account for 65-68% of the service industry; creative workers are 17-27%, and manufacturing occupations are 7.5-15%. For Sweden, the service industry draws only 43% of its workforce from service class occupations; creative supplies over 35%, and working class nearly 21%. In Stockholm, over 50% of the service sector is *creative* workers, with 40% service and 10% manufacturing. This is a reallocation of resources that could have been used within the knowledge industry (which potentially is more productive) to the service industry, which is more local-based and does not bring in as much money from outside the region. However, with its significantly higher minimum wage, Sweden's allocation of jobs within the service industry reflects a service industry that is not "addicted" to the low-wage, low-skill service class occupations.

Although Sweden's high share of creative workers in the service industries and high share of creative workers in the goods producing industry sector results in a much lower national share of employment in the higher-value, high-growth knowledge industries, the additional creative content in the goods producing industry sector also bring benefits to Sweden. The industry structure of manufacturing firms in Sweden is based on high-design and high-technology firms like Ericsson, IKEA, ABB, Astra but also more traditional manufacturers like Husqvarna, Volvo and Electrolux. Much of Swedish industry sits at the intersection of design/R&D and traditional manufacturing. The high share of creative occupations reflects the greater concentration of creative activity in the goods producing work that is done in Sweden. This may well indicate that Sweden has developed an even more "post-industrial" goods producing sector than either the United States or Canada.

Andersson (2009) reports on the variation in returns to education across countries, including the three considered here. He finds that the returns to education are much higher in the United States (average 10.0) and Canada (8.7) compared to Sweden (3.9). The lower returns could reduce individuals' willingness to increase their education which would lower education levels generally. This could help to explain the smaller share of the knowledge industry in Sweden compared to the United States and Canada. Similarly, if we compare the United States and Canada – Canada consistently has a lower education level than the United States *and* a lower share of knowledge industry. Coupled with these lower returns, the higher wage structure in Sweden across all occupations and industries introduces even higher opportunity costs for taking time away from work to complete an education. This could reinforce the lower education levels.

In looking at the goods producing industry sector between the United States and Canada, the larger share of creative employment within the goods producing industry sector in the United States may be a result of a greater “home office” presence in the United States than in Canada. The much higher share of service class workers in the goods producing industry in Canada does not seem to be related to this same issue and is discussed further below.

By definition we would expect knowledge industries (and service industries) to be located in bigger cities in general, since their products are more distance sensitive and demand an interaction between producers and consumers to a higher extent. Knowledge industries also demand a larger supply of creative, highly educated labour (because of the processes within the firms are more knowledge intensive), and these tend to be attracted to larger cities with more diversity/amenities. In all of these three regions we have higher share of employees within the knowledge industry than their national averages – with Boston being the extreme with more than 50%! We also see that the intensity of creative work within the knowledge industry is higher (much higher for Boston and Stockholm) in the three urban areas when compared to their individual countries.

This is a clear pattern in the United States and Sweden, but the difference between Toronto and Canada's share of employees in knowledge industries is not all that different. Part of this difference seems to be related to Canada's traditional approach to manufacturing where the innovative work is developed outside of Canada, but Canada then excels at producing the products most efficiently. Toronto has over twice as much of its workforce in the goods producing industry sector than either Boston or Stockholm, but has a lower share in the knowledge industries. Also, we see an overrepresentation of service class occupations within the goods producing industry in Toronto (8% of total workforce versus 1-2% in Boston and Stockholm). Canada is also scoring higher for this group also on a national level, but not to such a large extent as we find at a regional level. This could be an effect of differences in non-monetary benefits for workers within the goods producing industry sector. This could even be a reflection of unionization activities, which are stronger in Canada than the United States (but lower in Toronto than Canada (Clemens 2005)). Workers, who to obtain benefits or higher salaries, must be categorized as unionized manufacturing workers in the United States, obtain the same benefits and are union members but in service class occupations in Canada. On average and across multiple industries, Canada also under-spends the United States in technology investments (Sharpe and Arsenault, 2008). It may simply be a case of more service class occupations are needed for manufacturing in Canada to provide additional "manual" labour that has been automated in the United States.

This paper introduces a new way of analyzing differences in structures within industries which can be used both for national and regional comparisons. This analysis enhances our understanding of productivity differentials among and between countries and regions to a much greater extent than the traditional approach of counting the number of employees or establishments within industries would. By understanding both industries and occupations *simultaneously* a much more complete understanding of the structure of the economy is developed.

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