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# Jobs and Exposure to International Trade within the Service Sector in Sweden\*

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## Abstract

The service sector is very heterogeneous with respect to internationalization; in some industries there is international trade (or it may potentially exist), whereas other industries are non-tradable. Data on international trade in services is, however, typically very limited, making it difficult to identify in which industries there are international trade. In this paper, we partially surmount the problems with insufficient service trade statistics by calculating locational Gini's for different industries in the private business sector as well as in the public sector. The basic idea is that from the regional concentration of different activities within a country one can identify industries where there appears to be regional trade, and hence also a potential for international trade. Based on our method we find that the number of employed in tradable service appears to be at least as large as in the manufacturing sector. Remarkably, a larger share of the skilled labor exposed to international trade is working in the service sector than in manufacturing, while a majority of the less skilled labor working in tradable industries is employed in manufacturing. When it comes to employment growth, we observe that the employment has increased in tradable service, while it has fallen in the manufacturing sector (the whole sector is regarded as tradable).

Keywords: jobs, service trade, regional concentration, structural change.

JEL: F16, J44, R12.

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# 1. Introduction

Historically, the service sector has often been regarded as non-tradable. On the other hand, due to the extensive trade in goods, manufacturing has been looked upon as being highly exposed to international competition. However, maintaining such a view today seems more and more outdated, especially in light of the growing trade in services which has been observed for some time now. If anything, the service sector is characterized by a remarkable heterogeneity, where in some industries there is considerable international trade in services, while in others the production of services is evenly distributed in proportion to population and incomes and therefore is carried out at the same place as it is consumed.

The difficulties in identifying, at a detailed level, in which industries within the service sector there is, or potentially could be, international trade are due to limitations in the trade statistics of services which, for instance, are not sufficiently disaggregated.<sup>1</sup> To get around these problems and to make it possible to have an idea as to how many jobs are affected by the increasing internationalization of the service sector, we utilize an approach developed by Jensen and Kletzer (2005), which they have applied on data for the US.<sup>2</sup> The basic idea in their approach is that from the regional concentration of different activities in the service sector within a country one can identify industries where there appears to be regional trade within a country. On the basis of this they infer that there is also a potential for international trade in these activities.<sup>3</sup> This means that there is, on the one hand, a risk that these operations can be moved abroad or, on the other hand, that the country will benefit from new jobs created by export.

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<sup>1</sup> In the official Swedish statistics, and in many other countries, trade in services is divided into 11 categories: (i) transportation, (ii) travel, (iii) communication, (iv) construction, (v) insurance, (vi) financial service, (vii) computer and information service, (viii) royalties and license fees, (ix) other business service, (x) personal, cultural and recreational service, and (xi) government service. An overview of the international classification system of service trade is given by Maurer et al. (2008).

<sup>2</sup> Blinder (2007a) uses another approach. He tries to classify different occupations on the basis of how easy/difficult it is to transfer their tasks to other countries (how offshoreable the work is). After that he can assess how many jobs are at risk of being transferred to other countries.

<sup>3</sup> In the General Agreement on Trade in Services (GATS) typology of modes of provision in service trade it can be supposed that this approach capture mode 1 (cross-border trade), mode 2 (consumption abroad), and mode 4 (temporary movement of labor), but not mode 3 (commercial presence in another country).

In this paper we apply their strategy to a small, high-skilled economy (Sweden) by calculating locational Ginis – a commonly used measure of regional concentration – for different industries in the private business sector as well as for the public sector. In contrast to Jensen and Kletzer (2005), we are able to compare how the Ginis have developed over a longer time period (between 1990 and 2005). Even though the transport costs of goods do not appear to have decreased in any larger proportions, technical change, particularly in telecommunication and in information technology, has involved important improvements in conveying information between regions within a country and internationally between countries.<sup>4</sup> What are the consequences of lower information costs on the regional geographic concentration, especially for the industries in the service sector?

Based on our calculated locational Ginis, we classify industries according to where trade seems to occur regionally and where no regional trade appears to exist. It is well known that the industries in the manufacturing sector are more or less exposed to international competition and that international trade in goods occurs on a large scale. Therefore, we use the size of the locational Ginis in manufacturing industries as a benchmark to identify industries in the service sector where international trade might exist. How large a share of all the persons employed in the Swedish economy are working in tradable industries and what are the characteristics of those who are employed in tradable industries?

A similar approach to that which we utilized for industries has also been employed to identify occupations which are tradable and non-tradable. This is an interesting question given the discussions and evidence (in most cases anecdotic) which have been put forward regarding occupations that despite the fact that they are exercised in industries which are non-tradable, they are considered to be threatened by the growing internationalization. Examples of such jobs are switchboard operators in taxi services and analyzers of x-ray pictures in hospitals.

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<sup>4</sup> Krugman (1991) argues that “technology is moving in a direction that will promote more localization of services” (p. 66).

Admittedly, there is some arbitrariness in the determination of where the cut-off between tradable and non-tradable industries and occupations should be drawn. Yet the classifications appear to a large extent to be in accordance with the conventional wisdom governing which industries and occupations are tradable (or at least potentially tradable).

Judging from the results, the number of employed in the service sector working in tradable industries seems to be at least as many as those working in the tradable manufacturing sector. This is due to the fact that the service sector is considerably larger than the manufacturing sector. It is also noteworthy that the share of skilled labor (employees with some post-secondary education) is larger in tradable services than in manufacturing. Moreover, persons working in tradable industries and in tradable occupations have higher wages than those working in non-tradable industries and non-tradable occupations.

Following Jensen and Kletzer (2005), we also compare the employment growth in the tradable and non-tradable sectors. In our study we are able to focus on a much longer time period, which may result in long-term patterns becoming clearer and that the results are affected by occasional crises to a lesser degree.<sup>5</sup> We find no significant changes in industry employment, neither in the tradable sector nor in the non-tradable sector. On the contrary, within the tradable sector there has been extensive restructuring. The more skill-intensive industries in the tradable sector have experienced positive employment growth which, however, has been counteracted by heavily reduced employment in the less skill-intensive manufacturing industries.<sup>6</sup> Generally, widespread structural changes have taken place where less skilled workers were replaced by more skilled workers. This tendency seems to have been particularly marked in the tradable sector of the Swedish economy.

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<sup>5</sup> Because of limitations in their data, Jensen and Kletzer (2005) could only study employment growth during the relatively short period between 1998 and 2002 (in our study 1990 to 2005). This means that their results most likely are affected by the bursting IT-bubble.

<sup>6</sup> According to our classification the whole manufacturing sector is regarded as tradable.

The paper is structured as follows: In section 2.1, we discuss the measure of regional concentration – locational Gini – that we use to determine which industries and occupations are tradable and non-tradable. In section 2.2, we present our data and calculations of locational Ginis on industry level for 2005 and 1990. In section 3, we classify industries into tradable and non-tradable. Based on these classifications we can estimate the share of the employment in the service sector which is tradable (or potentially tradable) and examine the characteristics of the employees in these industries. In section 4.1, we investigate whether wages are higher in tradable industries and occupations than in non-tradable. We also examine if there have been differences in the general employment growth and the employment growth of skilled and less skilled labor in tradable and in non-tradable industries over the last 15 years. In section 4.2, we try to explain the changed employment pattern by evaluating the importance of factors on the supply side, such as the greatly increased relative supply of skilled labor, owing to the rapid expansion of higher education in Sweden over the studied period, and factors on the demand side, such as skill-biased technical change and growing imports from and increased foreign direct investments in low-wage countries. Section 5 provides a summary and conclusion.

## 2. Geographic concentration

### 2.1 Measurement of geographic concentration

In order to describe the geographic concentration of various activities we employ locational Ginis.<sup>7</sup> The point of departure for calculating these Ginis is the location quotient, which can be expressed as:

$$L_{ir} = (E_{ir} / E_{iSwe}) / (E_r / E_{Swe}) \quad (1)$$

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<sup>7</sup> See, e.g. Krugman (1991) pp. 54-59 and pp. 65-66.

where  $E_{ir}$  is employment in industry  $i$  in region  $r$  and  $E_{iSwe}$  is employment in Sweden in industry  $i$ .  $E_r$  is total employment in region  $r$  and  $E_{Swe}$  is total employment in Sweden. The location quotient  $L_{ir}$  shows the extent to which employment in industry  $i$  is concentrated to region  $r$  by comparing the share of employment in that particular industry with the share of total employment. A quotient greater than one indicates that the share of employment in industry  $i$  in region  $r$  is higher than the region's share of total employment in Sweden.

The Gini coefficient  $G_i$  provides a measure of the distribution of the location quotients  $L_{ir}$  for industry  $i$  across all regions  $r$  in a country. When calculating  $G_i$ , the regions are first sorted in ascending order with regard to  $L_{ir}$  for industry  $i$ . Then the cumulative share of employment in industry  $i$  across the regions  $k = 1, \dots, n$ ,  $y_{i,k}$ , is calculated, where  $y_{i,0} = 0$  and  $y_{i,n} = 1$ , and the cumulative share of total employment across the corresponding regions  $k = 1, \dots, n$ ,  $x_{i,k}$ , is calculated, where  $x_{i,0} = 0$  and  $x_{i,n} = 1$ .<sup>8</sup>

If the points for the different regions  $(x_{i,k}, y_{i,k})$  are plotted in a diagram and connected, we have a Lorenz curve (see Figure 1).<sup>9</sup> If  $A$  is the area between the Lorenz curve and the 45 degree line (the line of perfect equality) and  $B$  is the area under the Lorenz curve, then the Gini coefficient for industry  $i$ ,  $G_i$ , is defined as  $A/(A+B)$ . Since  $A+B=0.5$  it follows that  $G_i = A/0.5 = 2A = 1 - 2B$  and  $G_i$  can be calculated as:

$$G_i = 1 - \sum_{k=1}^n (x_{i,k} - x_{i,k-1})(y_{i,k} + y_{i,k-1}) \quad (2)$$

The more geographically concentrated employment in industry  $i$  is, the more the Lorenz curve will depart from the 45 degree line.  $G_i$  is equal to zero if employment in industry

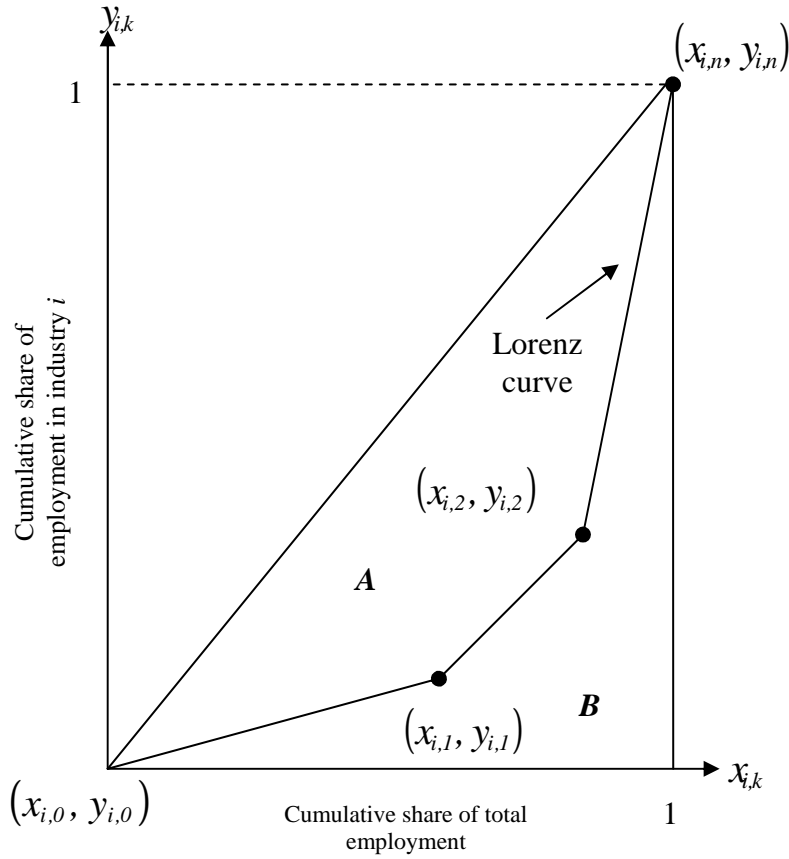
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<sup>8</sup> Note that  $k$  is the regions  $r$  sorted in ascending order with regard to  $L_{ir}$  for industry  $i$ .

<sup>9</sup> Figure 1 illustrates an example where region 1 has 50 percent of total employment but only 15 percent of employment in industry  $i$ . Region 2 has 30 percent of total employment and also 30 percent of employment in industry  $i$ , while region 3 only has 20 percent of total employment but 55 percent of employment in industry  $i$ .

$i$  is distributed completely equally across all regions and approaches one the more geographically concentrated employment in the industry in question is.<sup>10</sup>

**Figure 1.** Lorenz curve and Gini coefficient.



<sup>10</sup> For our purposes it does not matter what causes the concentration of an activity, except if an activity is non-tradable and the demand for this activity is concentrated. As a consequence, the non-tradable activity will be concentrated too, and we will wrongly draw the conclusion that the activity is traded. To adjust for this Jensen and Kletzer (2005) cleverly propose a measure that tries to account for how much geographic concentration there is in demand for an activity in a particular region, which they in turn use to correct their measure of economic concentration. Their adjusted measure requires input-output data. Unfortunately, Swedish input-output tables are much more aggregated than input-output tables for the US; the input-output table for Sweden in 2005 has 53 industries. In other words, there is a trade-off between adjusting the locational Ginis for demand-induced agglomeration and having fairly disaggregated industries. In order to apply the Jensen-Kletzer adjustment we would have to reduce the number of industries by almost 70 percent (from 172 to 53). Therefore, we have chosen not to adjust our locational Ginis.



## 2.2 Geographic concentration on industry level in Sweden

The analysis of locational Ginis in Sweden is based on Statistics Sweden's Regional Labor Market Statistics (RAMS). Industries are primarily defined on 3-digit NACE level<sup>11,12</sup> (172 industries), and as our geographical entity we use a definition of functional labor market (FA) regions (72 regions). The FA regions are preferred to traditional administrative units such as municipalities or counties. The FA regions constitute integrated housing and labor market areas where most people can find both a place to live and a place to work. By construction they are defined to maximize internal commuting possibilities and minimize commuting flows across the regional borders.<sup>13</sup> Table 1 presents summary statistics of the calculation of Gini coefficients.<sup>14</sup>

**Table 1.** Geographic concentration of industries in manufacturing and services, 2005 and 1990.

Gini coefficients	Manufacturing NACE 15-37		Services NACE 40-93	
	2005	1990	2005	1990
Mean	0.611	0.625	0.280	0.301
Standard deviation	0.161	0.157	0.163	0.184
Weighted mean*	0.555	0.554	0.160	0.149
Employment	706,131	893,406	3,334,418	3,284,315
Share of total employment	17.1	20.6	80.8	75.8
Number of industries	80	80	92	92

*Notes:* \* For the weighted mean Gini, the industries' share of total employment are used as weights. The share of total employment in manufacturing and services is expressed in percent.

<sup>11</sup> Seven industries are defined on 2-digit level: Mining of coal and extraction of peat (100), Other mining and quarrying (140), Manufacture of textiles (170), Manufacture of wearing apparel (180), Tanning and dressing of leather (190), Manufacture of coke, refined petroleum and nuclear fuel (230), and Recycling (370). In addition, industries where total employment is less than 500 have been excluded.

<sup>12</sup> A familiar problem with the current industrial classification is that while manufacturing is described on a very detailed level, the presentation of the service sector is still fairly coarse. Although the industrial classification is somewhat obsolete in this sense, it allows for comparisons over a rather long time period.

<sup>13</sup> For a detailed description of how the FA regions are constructed, see ITPS (2008) pp. 195-203. The average number of employees in the Swedish FA regions in 2005 is 57,986 and the median is 16,922, which indicates that the distribution is skewed, with a few quite large regions and many small regions. The largest region is Stockholm (1,109,462 employees) and the smallest region is Sorsele (1,210 employees). The FA regions are generally much smaller than the Metropolitan Statistical Areas that Jensen and Kletzer (2005) use in their calculations for the US.

<sup>14</sup> A complete list of calculated Gini coefficients and employment on industrial level for 2005 and 1990 can be found in Table A1 in the Appendix.

Not surprisingly, Table 1 reveals that the geographical concentration is considerably higher in the manufacturing sector than in the service sector.<sup>15</sup> The mean Gini for the manufacturing sector is significantly higher and this pattern also holds when the mean is weighted by industry size. The weighted means are much lower, indicating that there are a lot of small industries, both in the manufacturing and service sectors, having high Ginis.

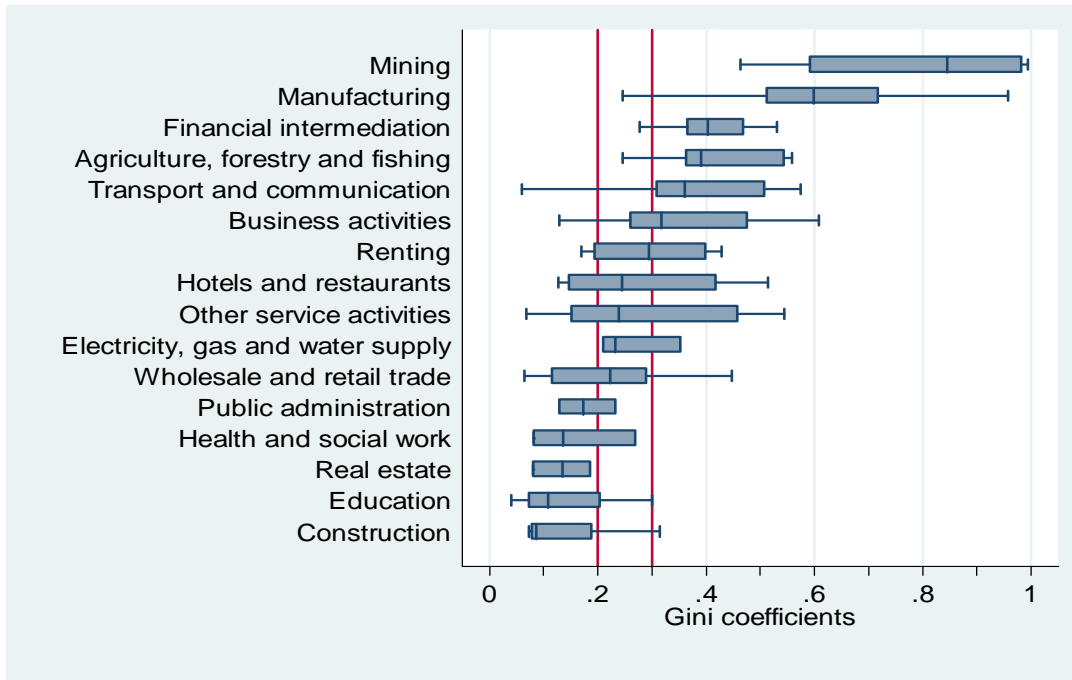
Somewhat surprisingly, the size of the Gini coefficients has not changed between 2005 and 1990, neither for the manufacturing industry nor for the service sector. The weighted mean for the manufacturing industry is about 0.55 in both years and around 0.15 for the service sector. Based on these results, the geographical concentration seems to have remained unchanged during the last 15 years. The correlation between the Ginis in 2005 and 1990 is very high (0.93), suggesting that the geographical pattern has been very stable over time. Table 1 further shows that during the period in question the share of employment in the manufacturing sector has dropped from slightly above 20 percent to 17 percent, while the share in the service industry has increased from 76 percent to over 80 percent.

If the service sector is sub-divided into more detailed sectors it becomes apparent that the degree of geographic concentration varies a great deal. Figure 2 presents box plots over Gini coefficients in different industries. The industries in the sectors “Financial intermediation”, “Transport and communication” and “Business services” have locational Ginis almost at the level of the industries in “Manufacturing” and in the primary activities “Agriculture, forestry and fishing” and “Mining and quarrying”. However, the Gini coefficients of industries in the sectors “Construction”, “Education”, “Real estate activities” and “Health and social work” are considerably lower.

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<sup>15</sup> In the paper we use a residual approach to define the service sector which means that all activities not included in the primary sector, NACE 01-14, and in the secondary (manufacturing) sector, NACE 15-37, are classified as services.

**Figure 2.** Geographic concentration in different industries, 2005.



Source: Statistics Sweden, Labor Statistics Based on Administrative Sources (RAMS).

### 3. Tradable and non-tradable industries and occupations

#### 3.1 Tradable industries

A key issue in the empirical analysis is to determine the level of geographic concentration necessary for an industry to be classified as domestically tradable and hence potentially exposed to international trade. In other words, how high must the locational Gini be for an industry to be considered as potentially tradable? Since virtually all industries in the manufacturing and primary sector are tradable, this is a natural reference point when deciding on a reasonable threshold value. Almost all industries in these sectors have Gini coefficients above 0.30 and none have a coefficient less than 0.20. Furthermore, it is reasonable to assume that the majority of activities within the sectors “Construction”, “Education” and “Health and social work” are characterized as being non-tradables. Only a few industries in these sectors have Gini

coefficients above 0.20.<sup>16</sup> It thus appears as if a Gini coefficient in the range 0.20-0.30 might be a suitable threshold value when deciding whether an industry is potentially tradable or not.

The suggested approach also seems reasonable when looking at specific industries in other sectors. Most of the industries in “Wholesale and retail trade” have Gini coefficients less than 0.20. This is also the case for industries such as Hotels (551), Restaurants (553) and Industrial cleaning (747). A significant share of the industries in the sectors “Financial intermediation”, “Transport and communication” and “Business services” have Gini coefficients above 0.30. Table 2 reports the share of employment in different sectors working in industries with Gini coefficients less than 0.20 (*Gini 1*), between 0.20 and 0.30 (*Gini 2*) and greater than or equal to 0.30 (*Gini 3*).

Within the sectors “Real estate activities”, “Construction”, “Health and social work” and “Hotels and restaurants” more than 90 percent of the employed are working in industries with a Gini coefficient less than 0.1. Apart from the primary activities “Agriculture, forestry and fishing” and “Mining and quarrying” and “Manufacturing”, we can see that in services it is primarily within the sectors “Financial intermediation”, “Transport and communication” and “Business services” that we find a large share of employment in industries having a Gini coefficient above 0.30. Table 2 reveals that slightly less than 42 percent of the employees in the Swedish economy are working in industries with Gini coefficients above 0.20. This gives us an indication (possibly an overestimation) of the number of employees working in industries that are (or potentially are) tradable.

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<sup>16</sup> Note that Higher education (803) is the only industry within the education sector that would be considered as tradable using our suggested classification. In 2005, the Gini coefficient for Higher education was 0.30. In 1990, the coefficient was as high as 0.42. The decreasing geographical concentration of Higher education is most certainly a result of the rapid expansion of universities and university colleges that has taken place throughout the country since the early 1990s.

**Table 2.** Share of employment by Gini coefficient class in different sectors, 2005.

NACE code	Sector	Gini 1	Gini 2	Gini 3	Employment
01-05	Agriculture, forestry and fishing	0.0	9.2	90.8	79,071
10-14	Mining and quarrying	0.0	0.0	100.0	7,735
15-37	Manufacturing	0.0	13.0	87.0	706,131
40-41	Electricity, gas and water supply	0.0	91.6	8.4	28,216
45	Construction	98.8	0.0	1.2	249,934
50-52	Wholesale and retail trade	67.4	27.9	4.7	520,187
55	Hotels and restaurants	90.3	0.0	9.7	110,378
60-64	Transport and communication	57.4	0.0	42.6	262,686
65-67	Financial intermediation	0.0	49.5	50.5	84,808
70	Real estate activities	100.0	0.0	0.0	69,234
71	Renting of machinery and equipment	63.0	16.2	20.8	10,725
72-74	Business services	20.8	46.3	32.9	428,175
75	Public administration	68.5	31.5	0.0	238,788
80	Education	89.5	0.0	10.5	439,703
85	Health and social work	99.5	0.5	0.0	686,000
90-93	Other community, social and personal services	75.5	0.0	24.5	205,584
01-93	All sectors	58.4	14.3	27.4	4,127,355

*Note:* Gini 1 is less than 0.20, Gini 2 is between 0.20 and 0.30 and Gini 3 is greater than or equal to 0.30.

From now on, industries with a Gini coefficient above 0.20 will be classified as tradable.<sup>17</sup> As a form of sensitivity analysis, in some cases calculations based on a threshold value of 0.30 will be reported in parenthesis. Table 3 shows which sectors that have many employees working in industries which are (or potentially are) tradable. Besides from “Manufacturing”, we can see that in the service sector it is particularly the case for “Business services”, but also “Wholesale and retail trade”, “Transport and communication” and “Financial intermediation”.

<sup>17</sup> Jensen and Kletzer (2005) set their cut off Gini at 0.1. As we previously pointed out, the US regions (the Metropolitan Statistical Areas) are much larger than the Swedish regions (the FA regions), which generally leads to lower Ginis.

**Table 3.** Share of total employment working in industries that are (or potentially are) tradable, 2005.

NACE code	Sector	Tradable		Non-tradable	
01-05	Agriculture, forestry and fishing	1.9	(1.7)	0.0	(0.2)
10-14	Mining and quarrying	0.2	(0.2)	0.0	(0.0)
15-37	Manufacturing	17.1	(14.9)	0.0	(2.2)
40-41	Electricity, gas and water supply	0.7	(0.1)	0.0	(0.6)
45	Construction	0.1	(0.1)	6.0	(6.0)
50-52	Wholesale and retail trade	4.1	(0.6)	8.5	(12.0)
55	Hotels and restaurants	0.3	(0.3)	2.4	(2.4)
60-64	Transport and communication	2.7	(2.7)	3.7	(3.7)
65-67	Financial intermediation	2.0	(1.0)	0.0	(1.0)
70	Real estate activities	0.0	(0.0)	1.7	(1.7)
71	Renting of machinery and equipment	0.1	(0.1)	0.2	(0.2)
72-74	Business services	8.2	(3.4)	2.2	(7.0)
75	Public administration	1.8	(0.0)	4.0	(5.8)
80	Education	1.1	(1.1)	9.5	(9.5)
85	Health and social work	0.1	(0.0)	16.5	(16.6)
90-93	Other community, social and personal services	1.2	(1.2)	3.8	(3.8)
01-93	All sectors	41.6	(27.4)	58.4	(72.6)

Table 4 reports the number of employees working in industries that are (or potentially are) tradable. In addition, the employees have been divided into skilled and less skilled, depending on whether or not they have any post-secondary education. According to the table, 1.72 million employees are working in tradable industries and of these are 0.71 million working in manufacturing and 0.93 million working in services. From this we can conclude that despite the fact that large parts of the service sector can be classified as non-tradable, there are as many or probably even more workers in industries which are (or potentially are) tradable in the service sector than in the manufacturing sector. Even though this primarily is a reflection of the absolute size of the service sector, it is nonetheless a very interesting finding.

There are only minor differences in the share of skilled labor in the tradable and non-tradable parts of the Swedish economy. However, within the service sector there are striking differences. The share of skilled labor is considerably higher in tradable service industries (46.9 percent) than in non-tradable service industries (34.5 percent). An explanation for this is that the share of skilled labor in manufacturing (all industries are tradable) is fairly low (23.2 percent). As a result, the majority of the skilled labor

working in tradable industries can be found in the service sector (71 percent), whereas the less skilled labor exposed to international trade primarily is working in the manufacturing sector (49 percent) and not in the service sector (44 percent).

Furthermore, it is noticeable that the share of women is much smaller in tradable industries and that the average earnings are significantly higher. The relatively high earnings in tradable industries could in part be explained by a smaller share of women and a larger share of skilled labor. We will return to this issue in Section 4.1.

**Table 4.** Number of employees divided into skilled and less skilled labor in industries that are (or potentially are) tradable, 2005.

	Tradable industries		Non-tradable industries	
<i>All sectors (01-93)</i>				
Total employment	1,719	(1,129)	2,408	(2,998)
Skilled labor	611	(370)	831	(1,072)
Less skilled labor	1,108	(759)	1,577	(1,926)
Share of skilled labor	35.5	(32.8)	34.5	(35.8)
Share of women	32.2	(29.1)	58.9	(54.8)
Average monthly earnings	27,170	(26,996)	22,240	(23,238)
<i>Services (40-93)</i>				
Total employment	926	(435)	2,408	(2,899)
Skilled labor	434	(214)	831	(1,051)
Less skilled labor	492	(221)	1,577	(1,848)
Share of skilled labor	46.9	(49.2)	34.5	(36.3)
Share of women	38.6	(39.9)	58.9	(55.2)
Average monthly earnings	29,024	(29,767)	22,240	(23,253)
<i>Manufacturing (15-37)</i>				
Total employment	706	(615)	0	(92)
Skilled labor	164	(144)	0	(20)
Less skilled labor	542	(470)	0	(72)
Share of skilled labor	23.2	(23.5)		(21.5)
Share of women	25.6	(23.0)		(42.6)
Average monthly earnings	25,147	(25,449)		(22,818)

*Notes:* Number of employees is expressed in thousands and the shares are in percent. Skilled labor is employees with some sort of post-secondary education. Average monthly earnings are expressed in SEK.

### 3.2 Tradable occupations

For certain service industries it might very well be the case that specific tasks and activities within the industry are tradable even though the industry as such is classified

as being non-tradable. One example could be the operation and maintenance of data systems in the retail trade industry. In order to make some assessment of the scope of such activities we use a similar approach as for the industries to determine the level of geographic concentration necessary for an occupation to be classified as tradable. We hence calculate locational Ginis for different occupations and employ the same threshold value as for the industries,  $Gini = 0.20$  (or  $Gini = 0.30$ ), to identify occupations that are (or potentially are) tradable.<sup>18</sup> Table 5 presents results for a number of major occupations classified according to the ISCO-88 standard.<sup>19, 20</sup>

**Table 5.** Share of employment by Gini coefficient class in different occupations, 2005.

ISCO code	Occupational group	Gini 1	Gini 2	Gini 3	Employment
11-13	Legislators, senior officials and managers	98.9	0.0	1.1	228,542
21	Physical, mathematical etc. professionals	0.0	42.2	57.8	153,245
22	Life science and health professionals	95.5	4.5	0.0	87,582
23	Teaching professionals	83.7	16.3	0.0	212,626
24	Other professionals	36.8	51.4	11.8	256,680
31	Physical and engineering associate professionals	71.9	25.4	2.6	194,594
32	Life science and health associate professionals	97.4	2.6	0.0	112,630
33	Teaching associate professionals	100.0	0.0	0.0	84,904
34	Other associate professionals	95.5	4.5	0.0	339,080
41	Office clerks	100.0	0.0	0.0	293,764
42	Customer services clerks	100.0	0.0	0.0	72,045
51	Personal and protective services workers	99.0	0.0	1.0	597,670
52	Salespersons and demonstrators	100.0	0.0	0.0	185,321
61	Skilled agricultural and fishery workers	0.0	38.1	61.9	46,756
71	Extraction and building trades workers	98.6	0.0	1.4	201,978
72	Metal, machinery and related trades workers	65.2	25.6	9.2	134,575
73-74	Other craft and related trades workers	40.4	32.7	26.9	29,238
81	Stationary-plant and related operators	0.0	10.9	89.1	52,891
82	Machine operators and assemblers	0.0	6.0	94.0	219,877
83	Drivers and mobile-plant operators	72.1	0.0	27.9	139,013
91	Sales and services elementary occupations	100.0	0.0	0.0	183,979
92-93	Other elementary occupations	0.0	30.5	69.5	52,173
11-93	All occupations	76.5	10.2	13.3	3,879,163

Notes: Gini 1 is less than 0.20, Gini 2 is between 0.20 and 0.30 and Gini 3 is greater than or equal to 0.30. The difference in total employment between Tables 2 and 5 is due to a large group of workers lacking occupational classification.

<sup>18</sup> In the case of occupations there is no natural reference point when deciding a reasonable threshold value for an occupation to be regarded as potentially tradable. For better or worse, we decide to stick with the same threshold value as for the industries.

<sup>19</sup> A complete list of calculated Gini coefficients and employment on occupational level for 2005 can be found in Table A2 in the Appendix.

<sup>20</sup> More details about the ISCO-88 standard and the Swedish version SSK 96 can be found on Statistics Sweden's homepage, [http://www.scb.se/Pages/List\\_\\_\\_\\_259304.aspx](http://www.scb.se/Pages/List____259304.aspx)



As expected, many of the qualified occupational groups having relatively high levels of education and those not working with health, social work or education appear to be tradable or potentially tradable. This is the case for, e.g. civil engineers, computing professionals, legal professionals and certain business professionals and economists, while teachers in primary and secondary education, medical doctors and nurses are classified as non-tradable occupations. In the service sector, there are a number of large, less qualified non-tradable occupational groups. In this category we find, e.g. nursing assistants, drivers and hotel and restaurant workers. According to Table 5, a high estimate is that around 24 percent of all employees are working in occupations that are (or potentially are) tradable.

Table 6 shows characteristics of employees in tradable and non-tradable occupations. As with those working in tradable industries, the share of women is smaller and average earnings are higher in tradable occupations compared to non-tradable occupations. In the service sector, the share of skilled labor and average earnings is considerably higher in tradable occupations than in non-tradable occupations. The opposite holds in the manufacturing sector.

**Table 6.** Number of employees divided into skilled and less skilled labor in occupations that are (or potentially are) tradable or non-tradable, 2005.

	Tradable occupations		Non-tradable occupations	
<i>All sectors (01-93)</i>				
Total employment	901	(507)	2,930	(3,323)
Skilled labor	341	(128)	1,031	(1,243)
Less skilled labor	560	(379)	1,899	(2,080)
Share of skilled labor	37.8	(25.3)	35.1	(37.4)
Share of women	26.9	(22.9)	55.6	(52.8)
Average monthly earnings	26,587	(24,742)	23,548	(24,165)
<i>Services (40-93)</i>				
Total employment	488	(202)	2,620	(2,905)
Skilled labor	264	(98)	942	(1,109)
Less skilled labor	224	(105)	1,678	(1,797)
Share of skilled labor	54.1	(48.3)	36.0	(38.2)
Share of women	31.8	(27.0)	58.6	(56.3)
Average monthly earnings	29,213	(29,179)	23,158	(23,736)
<i>Manufacturing (15-37)</i>				
Total employment	368	(269)	291	(389)
Skilled labor	71	(27)	84	(128)
Less skilled labor	297	(242)	207	(261)
Share of skilled labor	19.3	(10.1)	28.9	(32.9)
Share of women	22.1	(21.2)	29.4	(28.2)
Average monthly earnings	23,756	(22,116)	26,906	(27,306)

*Notes:* Number of employees is expressed in thousands and the shares are in percent. Skilled labor is employees with some sort of post-secondary education. Average monthly earnings are expressed in SEK.

Table 7 reports the share of employees working in an occupation that can be classified as tradable but where the industry is considered to be non-tradable. Slightly less than five percent of the employees belong to this category. One interpretation of this is that the share of employees potentially affected by international trade, other than those identified in the industry analysis, is fairly small.

**Table 7.** Share of employment in tradable industries and tradable occupations, 2005.

	Non-tradable industries		Tradable industries	
Non-tradable occupations	54.2	(69.2)	22.3	(17.6)
Tradable occupations	4.6	(3.7)	18.9	(9.5)

## 4. Wages and employment growth in tradable and in non-tradable industries

### 4.1 Wage premia and employment growth

Tables 4 and 6 show that the average wage is higher in tradable industries and in tradable occupations. Is this due to the fact that educational attainment is higher and the share of women is lower in tradable industries and tradable occupations than in non-tradable? To examine this we estimate a number of wage equations (Mincer equations), where the wage is determined by individual characteristics, such as education, experience and sex. In the wage equations we also control for, in a broader sense, in which sector and in which occupation an individual is active. Table 8 presents the results.

**Table 8.** Wage premia in tradable industries and in tradable occupations, 2005. Dependent variable:  $\ln(\text{monthly salary})$ .

Explanatory variables	All industries			Service NACE 40-93		
	(1)	(2)	(3)	(4)	(5)	(6)
Tradable industries	0.073 (140.75)			0.074 (141.06)		
Tradable occupations		0.056 (93.40)			0.066 (97.23)	
Tradable industries and tradable occupations			0.116 (155.63)			0.127 (153.10)
Tradable industries and non-tradable occupations			0.070 (123.46)			0.068 (114.74)
Non-tradable industries and tradable occupations			0.032 (38.78)			0.034 (39.31)
Adjusted $R^2$	0.551	0.550	0.554	0.548	0.547	0.552
Number of observations	2,310,431	2,299,900	2,299,900	1,897,571	1,887,081	1,887,081
Weighted observations	3,551,500	3,540,900	3,540,900	2,892,900	2,882,200	2,882,200

*Notes:* The estimated models also include standard variables such as experience, i.e. age minus the age at which an individual is expected to have finished his/her education, experience squared and dummy variables for sex and for five education levels as well as dummies for 39 sectors and 22 occupation categories. The excluded group in specification (3) and (6) is individuals employed in non-tradable industries and non-tradable occupations. The estimates are based on the sample individuals that are in Statistics Sweden's annual study on wages (Strukturlönestatistiken). For the public sector all individuals are included, while for the private business sector there is a stratified sample which consists of 50 percent of all employed in the private business sector. In order to take that into account, in the regressions we have weighted each individual included in the wage equations with its sampling weight.

From columns (1) and (4) it appears that wages are slightly more than 7 percent higher in tradable industries than in non-tradable industries and this applies to the economy as a whole as well as solely to the service sector. In columns (2) and (5) we observe a corresponding pattern for tradable occupations compared to non-tradable occupations, where the wage is around 6-7 percent higher in tradable occupations. Finally, columns (3) and (6) demonstrate that individuals working both in tradable industries and tradable occupations have 12-13 percent higher wages than individuals working in non-tradable industries and occupations. It is worth noting that the effect seems to be additive. Individuals working in tradable industries, but in non-tradable occupations, have 7 percent higher wages, and those who are employed in non-tradable industries, but in tradable occupations, have 3 percent higher wages than those working in both non-tradable industries and in non-tradable occupations. In other words, the results in Table 8 indicate that wages in tradable industries and tradable occupations are significantly higher than in non-tradable industries and non-tradable occupations.

Much of the discussion on increased internationalization has related to the effects on employment. In Table 9 we compare employment growth in the tradable and the non-tradable sector in Sweden between 1990 and 2005, where industries have been classified in accordance with the previously (in section 3.1) described division of industries. We have also divided the tradable sector into manufacturing (all industries are tradable) and tradable services.<sup>21</sup> Furthermore, we have divided the employed into skilled and less skilled labor, where skilled labor has some post-secondary education. In addition, in Table 9 we present changes in log employment on industry level within different sectors and for different types of labor; we test if the mean of employment growth on industry level within a sector is significantly different from zero.<sup>22</sup>

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<sup>21</sup> Moreover, the tradable sector includes some industries that belong to “Agriculture, forestry and fishing” and the industries in “Mining and quarrying”.

<sup>22</sup> Formally, we test whether the mean of  $\ln E_{i05}^j - \ln E_{i90}^j$  for different industries  $i$  and for different types of labor  $j$  within a sector, e.g. in the tradable sector, is significantly different from zero.

**Table 9.** Employment growth in tradable and in non-tradable sectors of skilled and less skilled labor between 1990 and 2005.

Sector	Total employment		Skilled labor		Less skilled labor		Number of industries
	Percent	Mean (t-ratio)	Percent	Mean (t-ratio)	Percent	Mean (t-ratio)	
Tradable	-8.3	-0.037 (-0.72)	58.3	0.506 (10.32)	-25.6	-0.189 (-3.53)	148
Non-tradable	-2.5	0.052 (0.91)	44.2	0.608 (8.74)	-16.7	-0.074 (-1.15)	35
Manufacturing	-21.0	-0.256 (-4.63)	47.1	0.386 (7.29)	-30.7	-0.388 (-6.86)	80
Tradable service	11.7	0.251 (3.58)	65.4	0.629 (9.63)	-13.1	0.058 (0.75)	57

*Notes:* The industries are defined on NACE 3-digit level. The t-ratios are from a test whether the means are significantly different from zero.

From Table 9 it is evident that, in general, there have been no significant changes in employment, neither in the tradable sector nor in the non-tradable sector. However, within the tradable sector we observe significant restructuring; the employment growth in tradable service has been positive, while the employment in the manufacturing sector has fallen substantially.<sup>23</sup> This pattern is also illustrated in Table 10 where we show the development of the employment in non-tradable service, tradable service and the manufacturing sector between 1990 and 2005. Within the tradable sector the skill-intensive tradable service has expanded, whereas the less skill-intensive manufacturing sector has contracted.<sup>24</sup> During the studied period the employment in non-tradable service has been almost constant.

The results in Table 9 indicate that overall the employment of skilled labor has increased both in the tradable and in the non-tradable sector. The employment of less skilled labor has decreased in the tradable sector and the main driving force behind that

<sup>23</sup> Here our results differ from Jensen and Kletzer (2005). They found that in the US tradable industries have, on average, lower (and negative) growth rates than non-tradable industries over the studied period (1998-2002). The reason for this is that the employment growth in tradable service, although positive, does not differ from the employment growth in non-tradable service; in the US growing employment in tradable service is not making up for the falling employment in manufacturing.

<sup>24</sup> Interestingly, the Swedish export of services has, during the period of study, been faster than the Swedish export of goods, and moreover, relatively high in comparison with other OECD countries (Eliasson et al. 2010).

development has been the considerable reduction in the employment of less skilled labor in the manufacturing sector. Furthermore, it is worth noting in Table 10 that the largest increase in skill intensity has taken place in tradable service.

**Table 10.** Employment in non-tradable service, tradable service and manufacturing, 1990-2005.

Year	Non-tradable service			Tradable service			Manufacturing		
	Thou- sands	Share	Skill ratio	Thou- sands	Share	Skill ratio	Thou- sands	Share	Skill ratio
1990	2,470	58.9	23.4	829	19.1	31.7	894	21.3	12.5
1995	2,114	57.9	28.5	782	20.9	37.3	752	20.6	16.3
2000	2,193	56.4	30.9	932	23.5	41.8	765	19.7	19.5
2005	2,408	59.6	34.5	926	22.4	46.9	706	17.5	23.2
$\Delta 05-90$	-62	0.7	11.2	97	3.3	15.2	-187	-3.8	10.7

*Notes:* Employment in primary industries (NACE code 01-14) is excluded. Skill ratio is share of skilled labor, where skilled labor is employees with some sort of post-secondary education. Shares and skill ratios are in percent.

In sum, significant structural changes towards increased employment of skilled labor at the expense of less skilled labor seems to have occurred in Sweden during the studied 15-year period. This pattern appears to have been particularly pronounced in the tradable sector. Is this development entirely an outcome of larger supply of skilled labor or is it also due to increased relative demand for skilled labor?

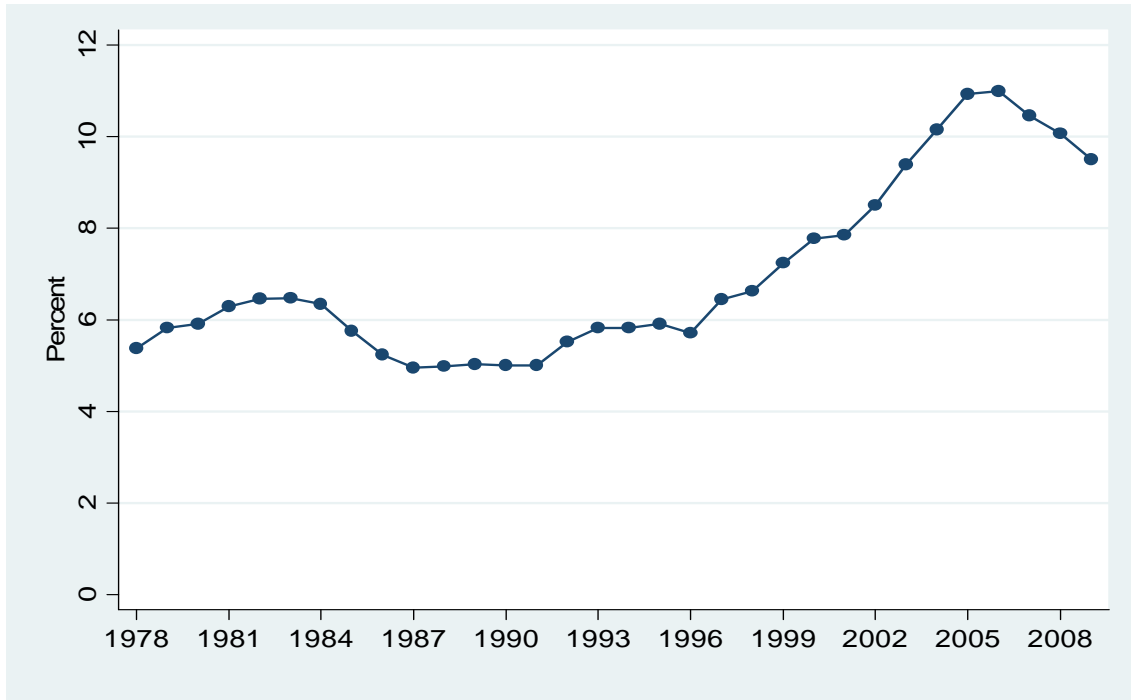
#### **4.2 Supply and demand side determinants of employment growth in different skill groups**

Figure 3 shows that during the late 1990s the supply of skilled labor in Sweden grew substantially. The figure describes the number of university degrees as a share of the population group aged 20-24 years between 1978 and 2009. Until 1996 the share swings around 6 percent and then it rises to 11 percent in 2006 and eventually it falls back to 9.5 percent in 2009.

This supply side effect may explain the employment changes we observe in Table 10 within the tradable sector. To employ the increased supply of skilled labor the more

skill-intensive tradable service has grown whereas the employment in less skill intensive manufacturing has fallen.<sup>25</sup>

**Figure 3.** Number of university degrees as a share of population aged 20-24, 1978-2009.



Source: Swedish Agency for Higher Education and Statistics Sweden, Population Statistics.

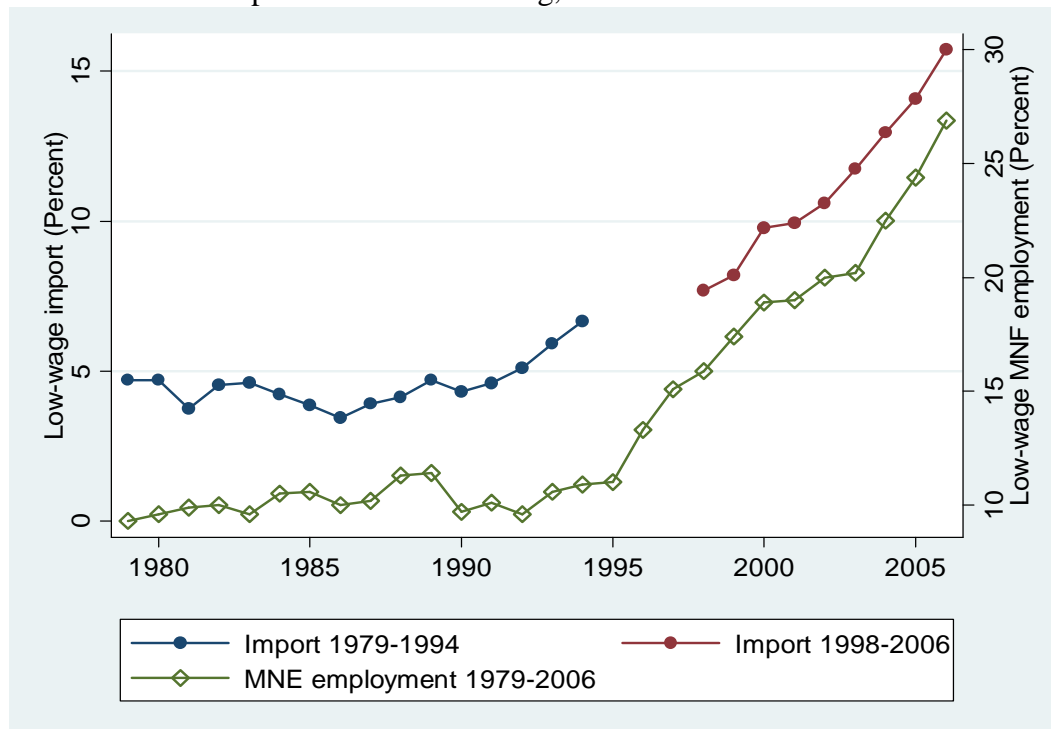
On the demand side, a factor that often has been put forward as something that has contributed greatly to increased relative demand for skilled labor is technical change. It has been said to be skill-biased, which means that at given relative wages between skilled and less skilled labor the technical change lead to increased relative demand for skilled labor. An important reason adduced to faster productivity growth among skilled labor than among less skilled labor is the increasing use of computers. Another factor which may have led to reduced demand for less skilled labor is the increased internationalization, in particular, growing imports from and increased foreign direct

<sup>25</sup> Such structural changes within the tradable sector are consistent with the Rybczynski theorem in international trade theory. Also, in accordance with that theorem, factor prices appear to have been unchanged. We estimated the relative wage between skilled and less skilled labor (the university wage premium) each year in Sweden between 1996 and 2006 using a standard Mincer equation. We then found that, despite the large increase in the endowment of skilled labor, the wage of an individual with post-secondary education (3 years), on average, has been fairly constant during the period (slightly more than 30 percent higher) relative to an individual with only secondary education (3 years). The Rybczynski theorem and factor price insensitivity are discussed in standard textbooks in international trade, e.g. Feenstra and Taylor (2008) pp.152-158.

investments in low-wage countries, i.e. countries relatively well-endowed with less skilled labor.

Several studies, international as well as Swedish, have found evidence for a positive relation between the degree of technical change and increased relative demand for skilled labor.<sup>26</sup> Also, growing imports from and increased foreign direct investments in low-wage countries appear to have contributed to increased relative demand for skilled labor, yet not to the same extent as technical change.<sup>27</sup> However, as seen from Figure 4 below, it seems that the latter effects have recently been of greater importance.<sup>28</sup>

**Figure 4.** Manufacturing import from low-wage countries as a share of consumption in Sweden and employment share in affiliates in low-wage countries in Swedish owned multinational enterprises in manufacturing, 1980-2006.



*Note:* Low-wage countries are all countries except the “old” OECD countries, i.e. Australia, Austria, Belgium, Canada, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, New Zealand, Norway, Portugal, Switzerland, Spain, the United Kingdom, and the United States.

*Source:* Statistics Sweden, Foreign Trade Statistics and Growth Analysis, Swedish Controlled Enterprises with Subsidiaries Abroad.

<sup>26</sup> See, e.g. Berman, Bound and Griliches (1994) and Machin and Van Reenen (1998).

<sup>27</sup> Evidence is provided by, e.g. Anderton and Brenton (1998) for the UK and Hansson (2000) for Sweden that have analyzed the effects of imports from low-wage countries and by, e.g. Head and Ries (2002) for Japan and Hansson (2005) for Sweden that have examined the impact of outward foreign direct investments to low-wage countries on the relative demand for skilled labor.

<sup>28</sup> This view has recently been emphasized by Krugman (2008).



In the 1990s both imports from and foreign direct investments in low-wage countries took off. During the 1980s the imports of manufacturing from low-wage countries as a share of consumption is barely 5 percent. In the beginning of the 1990s the share tends to grow and between 1998 and 2006 it doubles from 8 percent to 16 percent.<sup>29</sup> A similar pattern can be observed in the employment in low-wage countries of affiliates of Swedish owned manufacturing enterprises (MNEs). The employment share of affiliates in low-wage countries is relatively stable at around 10 percent until 1995 and subsequently it increases to almost 27 percent in 2006.

The evidence provided above suggests that both factors on the demand and on the supply side have played significant roles for the employment growth pattern we observe in Table 9 in manufacturing between 1990 and 2005. Bearing in mind, as we noticed in Table 4, that most of the less skilled labor in Sweden is employed in the tradable manufacturing sector, there is much which points towards that we will, even in the future, experience a continuous, relatively rapid structural change, in terms of decreasing total employment and less skilled labor replaced by skilled labor, within manufacturing. How the employment within tradable service will be manifested in the future depends very much on how well the business sector is able to keep up with competition in activities which are intensive in the use of skilled labor. Today Sweden appears to have a comparative advantage in such industries, both in manufacturing and in the service sector.<sup>30</sup> Succeeding in upholding and developing these positions suggests that it is reasonable to expect a further expansion of the tradable service sector.

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<sup>29</sup> The break in the import series is due to a change in the classification of the country of origin in connection with the Swedish membership in the EU 1995. As from 1995 onwards, imports cleared through the Customs in another EU country are recorded (erroneously) as imports from the transit country. Moreover, the data on imports for the period 1995-97 is not comparable with data for the subsequent period 1998-2006 and has therefore been excluded in the figure. Nonetheless, we observe a clear upward trend in imports from low-wage countries.

<sup>30</sup> See Hansson et al. (2007) chapter 3.

## 5. Concluding remarks

By measuring how regionally concentrated various activities are within Sweden, we can partially surmount the problems with insufficient service trade statistics and identify tradable industries and tradable occupations. By using this method we find that the number of employees in tradable services appears to be at least as many as in manufacturing. Remarkably, a larger share of the skilled labor exposed to international trade is working in the service sector than in manufacturing, while a majority of the less skilled labor working in tradable industries is employed in manufacturing.

Also, it appears that the average wage is higher in tradable industries and in tradable occupations and this is simply not due to the fact that the share of skilled labor is higher or that the share of women is lower in tradable industries and occupations. Even if we take individuals' education, experience and sex into account, we find that those that work in tradable industries and occupations have 12-13 percent higher wages than those that work in non-tradable industries and occupations.

When it comes to employment growth, we observe that the employment has increased in tradable service, while it has fallen in manufacturing (the whole sector is regarded as tradable). Moreover, the employment of skilled labor has risen in most parts of the economy, and particularly in the tradable sector, we notice an increase of skilled labor at the expense of less skilled labor.

It appears that the substantial growth in the supply of skilled labor since the mid-1990s has played an important role in shifting employment from manufacturing towards more skill intensive tradable service industries. Also, factors which lead to increased relative demand of skilled labor, such as skill-biased technical change, and recently increased competition from and offshoring to low-wage countries, seem to have had a considerable impact on the creation of skilled jobs and the displacement of less skilled jobs in the tradable sector.

Merely the fact that large parts of the service sector are tradable (or potentially tradable) does not imply that the employment there is automatically at risk of being moved out to low-wage countries.<sup>31</sup> Since the activities within the tradable service sector in general have relatively high shares of skilled labor the prospects depend on the Swedish competitiveness in such industries in the future. On the other hand, it is reasonable to expect higher job turnover and that the conditions will be more and more similar to those which are prevalent in manufacturing. In manufacturing we will most likely observe a development similar to that which we have witnessed in recent years, with decreasing employment, in particular of less skilled labor, as a result of increased competition from low-wage countries.

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<sup>31</sup> Blinder (2007b) is of another opinion. He asserts that many jobs in the service sector will move out from the US and other developed countries because (i) so many are employed in the service sector today (ii) even more service tasks will be possible to transfer electronically in the future owing to technical change (iii) the number of Indian and Chinese workers that will be capable to provide us with such service tasks will increase significantly in the nearest future.

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**Table A.1** Geographic concentration of industries and employment in industries, 2005 and 1990.

NACE code	Industry	Gini 2005	Gini 1990	Employment 2005	Employment 1990
011	Growing of crops	0.391	0.295	12,419	4,782
012	Farming of animals	0.433	0.646	19,907	1,729
013	Growing of crops combined with farming of animals	0.380	0.365	11,662	85,654
014	Agricultural service activities	0.246	0.383	7,256	11,762
019	Small-scale farming	0.362	0.445	2,301	362
020	Forestry and logging	0.559	0.569	24,178	34,491
050	Fishing and operation of fish farms	0.544	0.540	1,348	2,377
100	Mining of coal and extraction of peat	0.719	0.841	594	569
131	Mining of iron ores	0.994	0.982	2,777	3,606
132	Mining of non-ferrous metal ores	0.973	0.964	1,894	3,621
140	Other mining and quarrying	0.463	0.419	2,470	3,472
151	Production, processing and preserving of meat	0.525	0.457	14,930	18,968
152	Processing and preserving of fish and fish products	0.774	0.785	2,105	2,537
153	Processing and preserving of fruit and vegetables	0.657	0.739	3,686	5,895
154	Manufacture of vegetable and animal oils and fats	0.875	0.804	1,257	1,281
155	Manufacture of dairy products	0.429	0.349	8,270	10,137
156	Manufacture of grain mill and starch products	0.498	0.646	1,727	1,717
157	Manufacture of prepared animal feeds	0.670	0.762	942	1,099
158	Manufacture of other food products	0.299	0.307	23,056	32,781
159	Manufacture of beverages	0.581	0.568	5,574	5,989
160	Manufacture of tobacco products	0.668	0.740	1,093	1,220
170	Manufacture of textiles	0.560	0.572	7,171	14,376
180	Manufacture of wearing apparel	0.547	0.566	2,275	11,324
190	Tanning and dressing of leather etc	0.706	0.725	1,264	2,485
201	Sawmilling and planing of wood, impregnation of wood	0.619	0.604	14,966	18,813
202	Manufacture of veneer sheets etc	0.767	0.784	1,740	3,118
203	Manufacture of builders' carpentry and joinery	0.546	0.559	18,009	22,002
204	Manufacture of wooden containers	0.530	0.597	2,153	2,580
205	Manufacture of other products of wood and cork	0.543	0.593	2,013	4,213
211	Manufacture of pulp, paper and paperboard	0.690	0.660	28,207	39,583
212	Manufacture of articles of paper and paperboard	0.612	0.592	10,184	15,299
221	Publishing	0.248	0.238	24,887	37,409
222	Printing and service activities related to printing	0.246	0.234	20,214	36,014
230	Manufacture of coke, petroleum products and nuclear fuel	0.805	0.731	2,801	2,608
241	Manufacture of basic chemicals	0.547	0.637	10,601	14,163
243	Manufacture of paints etc	0.566	0.551	3,759	3,398
244	Manufacture of pharmaceuticals etc	0.551	0.596	19,303	11,153
245	Manufacture of soap and detergents etc	0.601	0.599	1,904	2,469
246	Manufacture of other chemical products	0.579	0.619	3,222	3,803
251	Manufacture of rubber products	0.708	0.724	5,548	9,116
252	Manufacture of plastic products	0.483	0.516	19,321	24,102
261	Manufacture of glass and glass products	0.803	0.771	4,213	9,399
262	Manufacture of ceramic goods other etc	0.671	0.628	2,194	3,367
265	Manufacture of cement, lime and plaster	0.869	0.834	681	1,565
266	Manufacture of articles of concrete, plaster and cement	0.382	0.331	6,735	10,579
267	Cutting, shaping and finishing of stone	0.591	0.578	1,060	1,425
268	Manufacture of other non-metallic mineral products	0.747	0.712	1,928	3,508
271	Manufacture of basic iron and steel and of ferro-alloys	0.869	0.877	13,027	17,245
272	Manufacture of tubes	0.925	0.928	8,109	6,947

273	Other first processing of iron and steel	0.854	0.856	3,289	6,254
274	Manufacture of basic precious and non-ferrous metals	0.841	0.833	6,735	7,809
275	Casting of metals	0.839	0.712	3,577	856
281	Manufacture of structural metal products	0.427	0.332	13,358	19,329
282	Manufacture of tanks, reservoirs and containers of metal etc	0.585	0.539	1,322	5,126
284	Forging, pressing, stamping and roll forming of metal etc	0.473	0.388	2,897	2,525
285	Treatment and coating of metals etc	0.398	0.352	32,514	19,670
286	Manufacture of cutlery, tools and general hardware	0.598	0.571	12,519	15,503
287	Manufacture of other fabricated metal products	0.543	0.387	13,911	39,657
291	Manufacture of machinery for mechanical power	0.530	0.610	18,061	18,499
292	Manufacture of other general purpose machinery	0.460	0.398	30,789	34,381
293	Manufacture of agricultural and forestry machinery	0.556	0.623	3,484	4,144
294	Manufacture of machine-tools	0.541	0.579	7,666	11,218
295	Manufacture of other special purpose machinery	0.498	0.438	26,191	31,643
296	Manufacture of weapons and ammunition	0.958	0.949	3,532	6,062
297	Manufacture of domestic appliances n.e.c.	0.810	0.721	6,390	11,600
300	Manufacture of office machinery and computers	0.621	0.574	3,772	12,416
311	Manufacture of electric motors, generators and transformers	0.806	0.644	6,050	7,567
312	Manufacture of electricity distribution and control apparatus	0.715	0.677	7,581	10,016
313	Manufacture of insulated wire and cable	0.702	0.724	3,528	4,981
314	Manufacture of accumulators, primary cells and batteries	0.952	0.891	486	1,621
315	Manufacture of lighting equipment and electric lamps	0.693	0.633	2,894	4,373
316	Manufacture of electrical equipment n.e.c.	0.366	0.463	3,200	6,123
321	Manufacture of electronic components	0.587	0.723	3,198	4,599
322	Manufacture of television and radio transmitters etc	0.538	0.613	20,048	25,768
323	Manufacture of television and radio receivers etc	0.616	0.602	1,723	1,260
331	Manufacture of medical, surgical and orthopaedic equipment	0.452	0.502	10,137	12,229
332	Manufacture of instruments for measuring, testing, navigating	0.402	0.511	9,981	8,962
333	Manufacture of industrial process control equipment	0.491	0.649	1,594	1,790
334	Manufacture of optical instruments and photographic equipment	0.486	0.532	1,530	1,924
341	Manufacture of motor vehicles	0.730	0.731	43,148	45,833
342	Manufacture of bodies for motor vehicles and trailers	0.851	0.777	8,710	13,017
343	Manufacture of parts for motor vehicles and engines	0.626	0.658	27,338	19,683
351	Building and repairing of ships and boats	0.629	0.619	5,095	6,963
352	Manufacture of railway and tramway locomotives etc	0.624	0.680	4,177	6,742
353	Manufacture of aircraft and spacecraft	0.837	0.853	8,464	15,369
354	Manufacture of motorcycles and bicycles	0.755	0.759	1,184	1,559
361	Manufacture of furniture	0.651	0.651	18,774	27,100
362	Manufacture of jewellery and related articles	0.475	0.556	740	1,255
364	Manufacture of sports goods	0.722	0.820	697	981
365	Manufacture of games and toys	0.661	0.861	601	783
366	Miscellaneous manufacturing n.e.c.	0.263	0.587	23,427	3,590
370	Recycling	0.430	0.812	2,176	725
401	Production and distribution of electricity	0.232	0.192	20,424	28,325
403	Steam and hot water supply	0.209	0.476	5,410	2,623
410	Collection, purification and distribution of water	0.354	0.270	2,382	2,328
451	Site preparation	0.189	0.184	21,141	16,525
452	Building of complete constructions or parts thereof etc	0.078	0.064	119,378	188,171
453	Building installation	0.073	0.070	69,255	67,869

454	Building completion	0.086	0.066	37,108	37,057
455	Renting of construction or demolition equipment etc	0.314	0.309	3,052	2,179
501	Sale of motor vehicles	0.122	0.123	30,786	31,259
502	Maintenance and repair of motor vehicles	0.113	0.104	24,168	24,095
503	Sale of motor vehicle parts and accessories	0.248	0.287	9,141	7,097
504	Sale, maintenance and repair of motorcycles etc	0.288	0.327	1,869	1,017
505	Retail sale of automotive fuel	0.157	0.143	13,848	15,005
511	Wholesale on a fee or contract basis	0.332	0.408	8,503	10,486
512	Wholesale of agricultural raw materials and live animals	0.408	0.378	4,419	7,599
513	Wholesale of food, beverages and tobacco	0.283	0.199	26,658	27,971
514	Wholesale of household goods	0.290	0.348	51,385	42,835
515	Wholesale of non-agricultural intermediate products etc	0.186	0.189	48,028	56,960
518	Wholesale of machinery, equipment and supplies	0.243	0.331	54,078	56,619
519	Other wholesale	0.308	0.519	1,235	3,459
521	Retail sale in non-specialized stores	0.065	0.071	80,097	107,372
522	Retail sale of food, beverages and tobacco in specialized stores	0.115	0.103	15,262	18,200
523	Retail sale of pharmaceutical goods, cosmetic and toilet articles	0.101	0.064	14,132	13,152
524	Other retail sale of new goods in specialized stores	0.074	0.061	119,236	105,229
525	Retail sale of second-hand goods in stores	0.223	0.199	1,899	1,451
526	Retail sale not in stores	0.447	0.711	10,372	4,580
527	Repair of personal and household goods	0.159	0.143	5,071	6,963
551	Hotels	0.167	0.148	29,573	36,455
552	Camping sites and other provision of short-stay accommodation	0.514	0.582	2,482	1,263
553	Restaurants	0.127	0.196	70,108	60,657
555	Canteens and catering	0.322	0.392	8,215	6,329
601	Transport via railways	0.378	0.258	8,422	20,034
602	Other land transport	0.059	0.059	110,497	116,545
611	Sea and coastal water transport	0.891	0.612	11,247	12,948
612	Inland water transport	0.467	0.557	1,471	959
621	Scheduled air transport	0.575	0.655	5,782	9,463
622	Non-scheduled air transport	0.549	0.650	1,651	445
631	Cargo handling and storage	0.456	0.417	9,222	3,042
632	Other supporting transport activities	0.313	0.318	14,609	16,963
633	Activities of travel agencies and tour operators etc	0.303	0.326	10,765	10,521
634	Activities of other transport agencies	0.333	0.333	22,406	15,720
641	Post and courier activities	0.119	0.110	40,405	59,177
642	Telecommunications	0.343	0.223	26,209	41,649
651	Monetary intermediation	0.278	0.206	41,986	59,361
652	Other financial intermediation	0.531	0.521	10,757	8,223
660	Insurance and pension funding	0.365	0.367	20,553	22,288
671	Activities auxiliary to financial intermediation	0.469	0.590	6,339	3,158
672	Activities auxiliary to insurance and pension funding	0.404	0.436	5,173	1,518
702	Letting of own property	0.081	0.140	45,469	46,745
703	Real estate activities on a fee or contract basis	0.188	0.199	23,765	18,492
711	Renting of automobiles	0.370	0.359	1,517	1,648
712	Renting of other transport equipment	0.429	0.514	720	1,026
713	Renting of other machinery and equipment	0.170	0.210	6,755	7,924
714	Renting of personal and household goods n.e.c.	0.219	0.191	1,733	1,469
721	Hardware consultancy	0.322	0.700	1,698	985
722	Software consultancy	0.327	0.402	75,241	23,165
723	Data processing	0.517	0.416	9,095	5,319
724	Data base activities	0.606	0.707	1,593	827
725	Maintenance and repair of office and computing	0.396	0.271	3,434	2,205

	machinery				
726	Other computer related activities	0.581	0.550	1,339	1,132
731	Research and development on natural sciences and engineering	0.436	0.526	20,888	18,701
732	Research and development on social sciences and humanities	0.609	0.587	2,906	5,080
741	Legal, accounting and auditing activities etc	0.267	0.292	75,734	55,809
742	Architectural and engineering activities and consultancy	0.230	0.218	58,115	51,554
743	Technical testing and analysis	0.259	0.257	6,179	6,281
744	Advertising	0.311	0.383	24,833	16,912
745	Labour recruitment and provision of personnel	0.164	0.188	40,726	10,271
746	Investigation and security activities	0.262	0.318	15,884	11,310
747	Industrial cleaning	0.128	0.125	48,382	52,614
748	Miscellaneous business activities n.e.c.	0.260	0.411	42,128	18,982
751	Administration of the State	0.129	0.148	145,563	99,440
752	Provision of services to the community as a whole	0.235	0.233	75,240	106,252
753	Compulsory social security activities	0.173	0.068	17,985	18,996
801	Primary education	0.040	0.067	299,432	157,894
802	Secondary education	0.110	0.158	53,608	51,011
803	Higher education	0.300	0.422	45,973	26,243
804	Adult and other education	0.106	0.100	40,690	32,875
851	Human health activities	0.082	0.091	306,467	444,134
852	Veterinary activities	0.271	0.297	3,229	1,707
853	Social work activities	0.135	0.058	376,304	444,861
900	Sewage and refuse disposal, sanitation and similar activities	0.161	0.192	12,701	9,618
911	Activities of business and employers' organizations	0.462	0.557	4,979	5,447
912	Activities of trade unions	0.320	0.348	8,058	10,245
913	Activities of other membership organizations	0.068	0.080	48,503	43,878
921	Motion picture and video activities	0.476	0.488	6,082	3,618
922	Radio and television activities	0.457	0.511	10,044	6,930
923	Other entertainment activities	0.311	0.327	19,185	12,847
924	News agency activities	0.544	0.642	2,112	601
925	Library, archives, museums and other cultural activities	0.162	0.140	17,128	14,954
926	Sporting activities	0.142	0.131	28,866	19,812
927	Other recreational activities	0.166	0.249	12,852	13,239
930	Other service activities	0.075	0.111	35,074	22,459



**Table A.2** Geographic concentration of occupations and employment in occupations, 2005.

ISCO code	Occupation	Gini 2005	Employment 2005
111	Legislators and senior government officials	0.354	1,257
112	Senior officials of special-interest organisations	0.414	1,171
121	Directors and chief executives	0.137	21,818
122	Production and operations managers	0.040	59,435
123	Other specialist managers	0.182	66,756
131	Managers of small enterprises	0.048	78,341
211	Physicists, chemists and related professionals	0.405	7,264
212	Mathematicians and statisticians	0.522	1,867
213	Computing professionals	0.322	79,479
214	Architects, engineers and related professionals	0.270	64,691
221	Life science professionals	0.232	3,903
222	Health professionals (except nursing)	0.108	45,224
223	Nursing and midwifery professionals	0.176	38,471
231	College, university and higher education teaching professionals	0.297	34,657
232	Secondary education teaching professionals	0.085	59,628
233	Primary education teaching professionals	0.062	90,994
234	Special education teaching professionals	0.086	15,339
235	Other teaching professionals	0.117	12,078
241	Business professionals	0.263	92,088
242	Legal professionals	0.314	15,884
243	Archivists, librarians and related information professionals	0.179	9,126
244	Social science and linguistics professionals	0.398	6,590
245	Writers and creative or performing artists	0.281	40,034
246	Religious professionals	0.118	4,197
247	Public service administrative professionals	0.155	47,516
248	Administrative professionals of special-interest organisations	0.350	7,888
249	Psychologists, social work and related professionals	0.063	34,148
311	Physical and engineering science technicians	0.127	132,535
312	Computer associate professionals	0.257	39,973
313	Optical and electronic equipment operators	0.221	9,516
314	Ship and aircraft controllers and technicians	0.388	7,049
315	Safety and quality inspectors	0.089	7,563
321	Agronomy and forestry technicians	0.367	2,971
322	Health associate professionals (except nursing)	0.064	35,506
323	Nursing associate professionals	0.141	64,656
324	Life science technicians	0.166	9,503
331	Pre-primary education teaching associate professionals	0.074	78,681
332	Other teaching associate professionals	0.101	6,230
341	Finance and sales associate professionals	0.179	173,177
342	Business services agents and trade brokers	0.179	18,337
343	Administrative associate professionals	0.197	64,706
344	Customs, tax and related government associate professionals	0.107	20,202
345	Police officers and detectives	0.100	15,695
346	Social work associate professionals	0.093	31,828
347	Artistic, entertainment and sports associate professionals	0.207	13,890
348	Religious associate professionals	0.252	1,476
411	Office secretaries and data entry operators	0.107	41,404
412	Numerical clerks	0.077	56,525
413	Stores and transport clerks	0.185	65,114
414	Library and filing clerks	0.133	5,723
415	Mail carriers and sorting clerks	0.149	28,254

419	Other office clerks	0.058	96,895
421	Cashiers, tellers and related clerks	0.133	25,324
422	Client information clerks	0.170	46,941
511	Travel attendants and related workers	0.411	6,492
512	Housekeeping and restaurant services workers	0.090	53,000
513	Personal care and related workers	0.093	495,558
514	Other personal services workers	0.081	13,153
515	Protective services workers	0.168	31,240
522	Shop and stall salespersons and demonstrators	0.044	185,514
611	Market gardeners and crop growers	0.228	17,811
612	Animal producers and related workers	0.381	16,945
613	Crop and animal producers	0.422	6,583
614	Forestry and related workers	0.584	4,746
615	Fishery workers, hunters and trappers	0.531	685
711	Miners, shot firers, stonecutters and carvers	0.653	2,758
712	Building frame and related trades workers	0.102	86,665
713	Building finishers and related trades workers	0.067	91,450
714	Painters, building structure cleaners and related trades workers	0.096	21,171
721	Metal moulders, welders, sheet-metal workers etc	0.275	34,451
722	Blacksmiths, tool-makers and related trades workers	0.373	12,383
723	Machinery mechanics and fitters	0.174	53,900
724	Electrical and electronic equipment mechanics and fitters	0.145	34,366
731	Precision workers in metal and related materials	0.178	4,358
732	Potters, glass-makers and related trades workers	0.505	1,597
734	Craft printing and related trades workers	0.154	7,454
741	Food processing and related trades workers	0.255	9,564
742	Wood treaters, cabinet-makers and related trades workers	0.461	2,799
743	Garment and related trades workers	0.342	3,484
811	Mineral-processing-plant operators	0.509	1,422
812	Metal-processing-plant operators	0.753	14,988
813	Glass, ceramics and related plant operators	0.760	1,634
814	Wood-processing- and papermaking-plant operators	0.591	22,032
815	Chemical-processing-plant operators	0.503	6,432
816	Power-production and related plant operators	0.252	5,784
817	Industrial-robot operators	0.592	609
821	Metal- and mineral-products machine operators	0.432	49,486
822	Chemical-products machine operators	0.264	13,126
823	Rubber- and plastic-products machine operators	0.573	14,182
824	Wood-products machine operators	0.648	14,491
825	Printing-, binding- and paper-products machine operators	0.338	13,567
826	Textile-, fur- and leather-products machine operators	0.530	7,219
827	Food and related products machine operators	0.381	21,529
828	Assemblers	0.353	54,147
829	Other machine operators and assemblers	0.452	32,189
831	Locomotive-engine drivers and related worker	0.346	4,953
832	Motor-vehicle drivers	0.073	100,327
833	Agricultural and other mobile-plant operators	0.319	32,755
834	Ships' deck crews and related workers	0.478	2,141
912	Helpers and cleaners	0.058	69,576
913	Helpers in restaurants	0.056	58,810
914	Doorkeepers, newspaper and package deliverers and related workers	0.084	19,209
915	Garbage collectors and related labourers	0.164	9,150
919	Other sales and services elementary occupations	0.185	27,813
921	Agricultural, fishery and related labourers	0.320	2,575
931	Mining and construction labourers	0.237	2,922

932	Manufacturing labourers	0.313	33,694
933	Transport labourers and freight handlers	0.240	13,024