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New Zealand's Production Structure: An International Comparison

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NEW ZEALAND TREASURY

WORKING PAPER 03/16

SEPTEMBER 2003

THE TREASURY

Kaitohutohu Kaupapa Rawa

NZ TREASURY WORKING PAPER 03/16

New Zealand's Production Structure: An International Comparison

MONTH/YEAR

September 2003

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ACKNOWLEDGEMENTS

We would like to thank John Creedy, Khoon Goh and Dean Hyslop for useful suggestions. Special thanks are due to Barry Voice at Statistics New Zealand. Thanks are also due to Jenny Fenwick and Claire Gardiner for their assistance with the data and David Law and Shaohong Xie for help with the graphs and tables.

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Abstract

The purpose of this paper is to compare New Zealand's production structure in the mid-1990s to that in other OECD countries using input output analysis. Comparable inter industry transactions tables to the New Zealand data are available for Australia, Belgium, Denmark, Finland, Germany, Norway and the United Kingdom. The composition of total supply and value added is examined across countries. Backward and forward linkages, indices of industry interconnectedness, a value added production multiplier, a cumulated primary input coefficient for compensation of employees and a measure of import content of final demand output are calculated, taking into account direct and indirect transactions. New Zealand's industrial structure is broadly similar to that in other OECD countries. Some differences arise as certain industries are more important in some countries. New Zealand's exports appear to be more diversified and have a large value added content. Moreover, the return to capital, as measured by the share of gross operating surplus in value added, is high.

JEL CLASSIFICATION C67 (input output models)
L16 (macroeconomic industrial structure)
O57 (comparative studies of countries)

KEYWORDS Input output models; industry importance; production structure; inter industry dependencies; country comparisons

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New Zealand's Production Structure: An International Comparison

1 Introduction

A recent comparison of market sector multifactor productivity in Australia and New Zealand showed similar rates of growth in both countries over the period 1988 to 2002. But the rate of physical capital accumulation has been lower in New Zealand since 1993 and has led to a lower capital-labour ratio (see Black, Guy and McLennan, 2003). One possible explanation for the lower capital-labour ratio in New Zealand may be a different industrial structure.

The purpose of this paper is to examine how New Zealand's production structure compares to that in other OECD countries. The methodology used is input output analysis. Input output tables contain detailed information about the process of production, the use of goods and services (products) and the income generated in that production (United Nations, 1993). They can be used to assess the composition of industries' total supply and value added, the degree of specialisation of industries and the contribution of primary inputs in the production of the economy.

The main findings of this paper can be summarised as follows. New Zealand's industrial structure is broadly similar to that in other OECD countries although some differences arise as certain industries are more important in some countries. New Zealand's exports appear to be more diversified and have a large value added content. Moreover, the return to capital, as measured by the share of gross operating surplus in value added, is high.

The remainder of the paper proceeds as follows. Section 2 provides a brief description of input output tables and data available. The composition of total supply and value added is discussed in section 3, while section 4 investigates inter industry linkages. Six measures of inter industry linkages are used: (i) backward and forward linkages, (ii) indices of industry interconnectedness, (iii) a value added index, (iv) a value added production multiplier, (v) a cumulated primary input coefficient for compensation of employees and (vi) a measure of import content of final demand output. Section 5 summarises and concludes.

2 Input output tables[1]

Inter industry tables provide a summary of the industrial structure of an economy for a given year. They contain information on the values of flows of goods and services between industries and sectors of the economy.

All commodity and industry flows in the input output tables are recorded in nominal terms at *basic prices*. The basic price of a good or service is the amount receivable by the producer minus any tax payable and plus any subsidy receivable. The p*roducer price* is the amount receivable by the producer minus any deductible goods and services tax (GST) or value added tax (VAT) invoiced to the purchaser. The *purchaser's price* is the amount paid by the purchaser, excluding any deductible GST or VAT in order to take delivery of a unit of a good or service. In the case of goods, the purchaser's price includes any trade margins and transport charges paid by the purchaser. Both basic and producer prices exclude transport charges invoiced separately by the producer.

The focus of input output analysis tends to be on inter industry transactions or the *industry by industry* flow matrix. Table 1 provides an example of such a matrix.[2] It shows the New Zealand inter industry transaction table for 1995-96 at the 49-industry level. The rows of the inter industry transactions table describe the distribution of an industry's output throughout the economy, while the columns describe the composition of inputs required by a particular industry to produce its output.

Rows 1 to 49 record how much each industry sells to other industries (columns 1 to 49) and final demand output (columns 51 to 57), where final demand (column 58) consists of household consumption (column 51), private non-profit final consumption (column 52), central and local government final consumption (columns 53 and 54), gross fixed capital formation (column 55), change in inventories (column 56) and exports (column 57). Column 50, labelled "total industry", is the sum of intermediate products supplied by a particular industry.[3] The column labelled "total economy" (column 59) is the sum of total sales of intermediate and final demand products.

Columns 1 to 49 show how much each industry purchases from other industries (rows 1 to 49) and other inputs to production (rows 50 to 56). Compensation of employees (row 52), operating surplus (row 53), consumption of fixed capital (54), other taxes on production (row 55) and subsidies (row 56) add up to total value added at basic prices (row 59). Entries along the principal diagonal (row 1, column 1; row 2, column 2; … row 49, column 49) of the intermediate input flow matrix (grey shaded area) show the amount of intra industry trade.

Table 1 also shows the link between total use in basic prices (row 57) and purchaser's prices (row 58).

From Table 1 gross domestic product (GDP) at market prices can be calculated. The sum of total use in purchaser's prices of final demand ($M 120,388) less total economy imports ($M 26,641) is equal to GDP ($M 93,747). Alternatively, GDP can be calculated as total industry value added in basic prices ($M 84,120) plus total economy taxes on products ($M 9,626).

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[1] For a detailed description of input output tables see United Nations (1993). For an excellent summary of input output methodology see section 3.2 and appendix 4 in Statistics New Zealand (2003).

[2] For more details and an introduction to inter industry transactions tables see Dixon (1996).

[3] The total value of intermediate output is equal to the total value of intermediate inputs; that is, aggregate intermediate supply is equal to aggregate intermediate demand.

Table 1: New Zealand inter industry transactions 1995-96 (dollar millions)

			Industries					Categories of final demand								
			1	2	48	49	50	51	52	53	54	55	56	57	58	59
			Horticulture and fruit growing	Livestock and cropping farming	…	Cultural and recreational services	Personal and other community services	Total Industry (columns 1 to 49)	Households	Private non-profit institutions serving households	Central Government	Local Government	Gross fixed capital formation	Change in inventories	Exports	Final Demand (columns 51 to 57)	Total economy (columns 50 + 58)
	1	Horticulture and fruit growing	21	43		1		573	198				3	11	685	897	1,469
	2	Livestock and cropping farming	29	432		2		3,408	41				7	-150	315	213	3,621
Industries		…															
	48	Cultural and recreational services	17	33		314	17	1,458	1,068	404	143		6	1	425	2,048	3,505
	49	Personal and other community services	1	2		20	104	761	772	251	35		13		87	1,158	1,919
	50	Imports	78	242		419	110	15,468	5,841		211		4,503	116	503	11,174	26,641
	51	Taxes on products	17	37		32	19	2,346	5,867		298		768		348	7,280	9,626
	52	Compensation of employees	321	315		761	650	39,450								0	39,450
Primary inputs	53	Operating surplus	210	402		494	250	29,621								0	29,621
	54	Consumption of fixed capital	132	494		212	93	12,407								0	12,407
	55	Other taxes on production	30	152		72	21	2,957								0	2,957
	56	Subsidies	-7	-6		-93	-1	-315								0	-315
	57	Total use in basic prices (rows 1 to 49 + 50)	766	2,228		2,027	888	101,054	48,553	1,122	13,754	2,371	19,122	1,182	27,002	113,107	214,161
	58	Total use in purchasers' prices (rows 57 + 51)	783	2,265		2,059	907	103,400	54,420	1,122	14,052	2,371	19,891	1,182	27,350	120,388	223,788
	59	Total value added (rows 52 to 56)	687	1,356		1,447	1,012	84,120								0	84,120
	60	Total supply in basic prices (rows 1 to 56)	1,469	3,621		3,505	1,919	187,520								0	187,520

The inter industry transactions table shows the composition of supply and use by industries. It can be used to construct input output coefficients to assess inter industry linkages that take into account direct *and* indirect transactions.

The basic input output identity can be expressed as follows

$$x = Ax + f \qquad (1)$$

where $x = [x_1, \ldots, x_N]'$ is the vector of gross output, N denotes the number of industries, $f = [f_1, \ldots, f_N]'$ is the vector of final demand and $A = [a_{ij}]$ is the matrix of technical coefficients.[4] Technical or input coefficients record the inputs directly required from one industry in order to produce one unit value of output of another industry. They are calculated as follows

$$a_{ij} = \frac{r_{ij}}{x_j} \qquad (2)$$

where $R = [r_{ij}]$ is the intermediate input flow matrix (shaded area in Table 1). Equation (1) thus states that gross output, x, is the sum of all intermediary output, Ax, and final demand, f.

Equation (1) can be solved for x to obtain

$$x = [I - A]^{-1} f \qquad (3)$$

if $[I - A]$ is non-singular and where I is the identity matrix.[5] The matrix $[I - A]^{-1}$ is called the inverted Leontief matrix or total requirement matrix. Total requirement coefficients show how much output is required directly and indirectly from each industry for every unit value of output produced for final use. The elements of $[I - A]^{-1}$ are denoted b_{ij}.

The inter industry transaction table and input output model are used to compare New Zealand's production structure to that in other OECD countries. Comparator countries include: Australia, Belgium, Denmark, Finland, Germany, Norway and the United Kingdom. The choice of countries was based on the following criteria: (i) availability of inter industry transactions at basic prices, (ii) aggregated at around 50 industries, (iii) produced for the mid-1990. A fourth criterion was language. Table 2 summarises the data and sources.

The data should be reasonably comparable although there are differences. For example, in New Zealand bank service charges (or financial intermediation services indirectly measured) are allocated directly to industries and final use, and hence included in intermediate consumption. In Belgium, Denmark, Finland, Norway and the United Kingdom financial intermediation services indirectly measured are reported separately. Another example is the treatment of remuneration of working proprietors in small family companies. In New Zealand remuneration of working proprietors in small family companies is put to profit distribution (and not wages and salaries). The System of National Accounts does not provide guidance on

[4] Subscript i refers to the industry in the i^{th} row and j to the industry in the j^{th} column.

[5] The condition that $[I - A]$ is non-singular means that $\lim_{T \to \infty} A^T = 0$ and the economic system produces the intermediate inputs needed to produce the intermediate inputs needed to produce the intermediate inputs needed, and so on … .

such payments and it is unlikely that the New Zealand practice is followed by all comparator countries.

Table 2: Summary of data and sources

Country	Source	Year	Number of industries
Australia	Australian Bureau of Statistics, http://www.abs.gov.au/	1996-97	35
Belgium	Federal Planning Bureau, http://www.plan.be/	1995	60
Denmark	Danmarks Statistik, http://www.dst.dk/dst/dstframeset_1024.asp	1996	52
Finland	Statistics Finland, http://www.stat.fi/index_en.html	1995	33
Germany	Statistiches Bundesamt Deutschland, http://www.destatis.de/	1995	59
New Zealand	Statistics New Zealand, http://www.stats.govt.nz/	1995-96	49
Norway	Statistisk sentralbyrå, http://www.ssb.no/	1997	23
United Kingdom	Office for National Statistics, http://www.statistics.gov.uk/	1995	17

3 Composition of total supply and value added[6]

The inter industry transactions matrix provides information on the supply and use of products by industries. The composition of total supply at basic prices is plotted in Figure 1 for Australia, Belgium, Denmark, Finland, Germany, New Zealand, Norway and the United Kingdom.

The share of intermediary output in total supply is largest for New Zealand at 45.5 percent, which is higher than in the United Kingdom (42.8 percent), Australia (42.4 percent) and Germany (42.1 percent). The share of intermediary output in total supply is lowest in Denmark, at 33.7 percent.

In all countries, the largest category of final demand is consumption, contributing between 25.7 percent (Belgium) and 37.7 percent (Australia) to total supply. The second largest category is exports. Australia, at 10.3 percent, has the lowest share of exports as a percent of total supply. In Belgium, the share of exports, at 25.5 percent, is only marginally lower than that of consumption (25.7 percent). Exports as a proportion of total supply are also high in Norway (20.4 percent), Finland (18.8 percent) and Denmark (18.5 percent). The share in New Zealand (14.1 percent) is comparable to that in the United Kingdom (14.4 percent).

Gross fixed capital formation as a percent of total supply varies between 6.1 percent (United Kingdom) and 11.7 percent (Denmark). In New Zealand, gross fixed capital formation make up 7.8 percent of industries' total supply. Inventories contribute positively to total supply in Norway (0.7 percent), New Zealand (0.6 percent), Finland (0.5 percent) and the United Kingdom (0.3 percent) and negatively in Australia (-0.3 percent).

[6] More detailed information on the categories of final demand and value added are contained in Tables A1 and A2 in the appendix.

Figure 1: Composition of total supply (in percent)

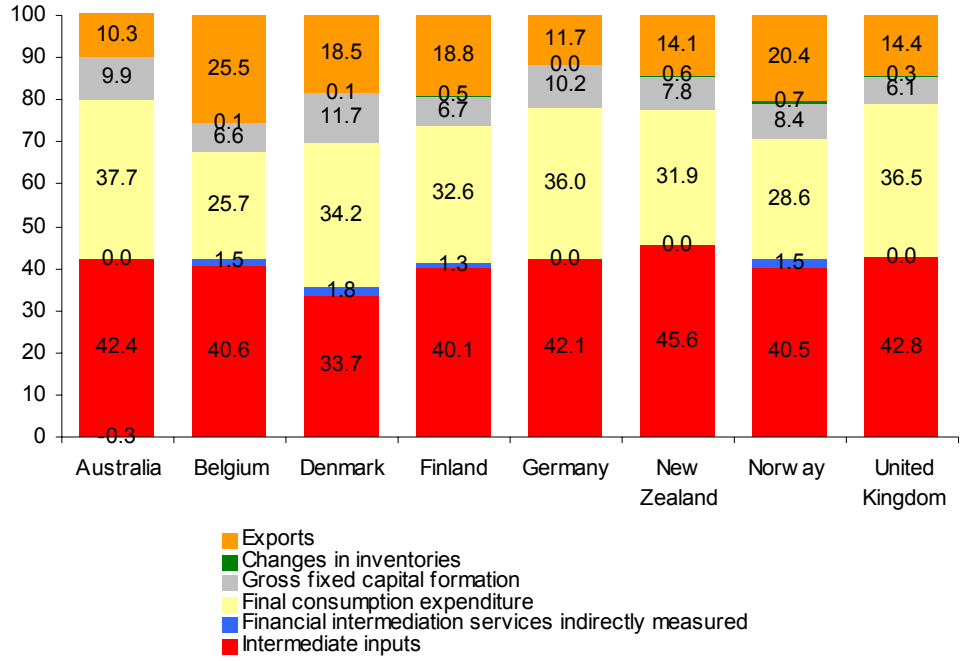


Figure 2 plots the composition of value added. The two largest components of value added are (i) compensation of employees, and (ii) gross operating surplus and mixed income.[7] The share of compensation of employees in value added is high in Germany (61.2 percent), the United Kingdom (60.4 percent) and Denmark (59.6 percent) and lowest in Norway (43.8 percent), Finland (44.8 percent) and New Zealand (46.9 percent). Adding employers' social contributions, which are reported separately in Finland and Norway, brings the labour component of value added in Finland and Norway closer in line with those in other countries.

The share of gross operating surplus and mixed income in value added, at 50 percent, is highest in New Zealand, followed by Norway (48.4 percent) and Finland (44.8 percent).

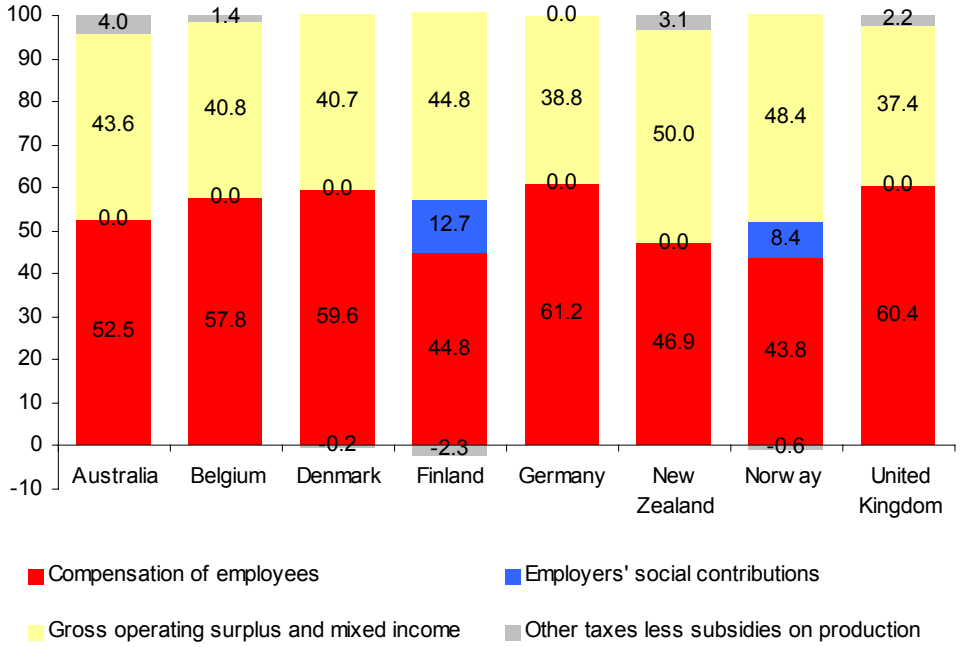
The composition of value added differs across countries because of differences in industrial structure, relative prices, the adoption of labour saving technology or more productive capital. In comparison to other OECD countries, the return to labour in New Zealand, as measured by compensation of employees, is low, while the return to capital, measured by gross operating surplus and mixed income is high. In part, this difference arises because for some industries, like agriculture, which is relatively more important in New Zealand, compensation of employees is small with most returns occurring in the form of operating surplus.

The share of compensation of employees fell in New Zealand in the mid-1980s, partly as a result of an increase in the number of self-employed following the downsizing of publicly owned companies and public sector organisations (Claus, 2003). As noted earlier, Statistics New Zealand allocates the renumeration of working proprietors in small family companies to profit distribution rather than wages and salaries. Adjusting for the number of self-employed raises the share of compensation of employees and lowers the proportion of gross operating surplus and mixed income, but still leaves compensation of employees lower than in other countries.

[7] Gross operating surplus and mixed income include consumption of fixed capital.

Other taxes less subsidies contribute positively to value added in Australia (4 percent), New Zealand (3.1 percent), the United Kingdom (2.2 percent) and Belgium (1.4 percent). The contribution is negative in Finland (-2.3 percent), Norway (-0.6 percent) and Denmark (-0.2 percent) as subsidies on production exceed other taxes. A look at the dis-aggregated data that underly Figure 2 shows that the agriculture, hunting and fishing industry is the main recipient of subsidies on production in Finland and Norway.

Figure 2: Composition of value added (in percent)



4 Inter industry linkages

To assess countries' industrial structures in terms of industry linkages this section applies input output coefficients. They are calculated from the inter industry transactions matrix and take into account both direct and indirect transactions. The production structures are examined using six types of measure: (i) backward and forward linkages, (ii) indices of industry interconnectedness, (iii) a value added index, (iv) a value added production multiplier, (v) a cumulated primary input coefficient for compensation of employees and (vi) a measure of import content of final demand output. To compare countries' production structures, these measures are calculated for each industry of the eight countries. The number of industries varies across countries and to facilitate comparison across economies, countries' industries are grouped into 16 industry categories, except for Norway, where the number of categories is 14 and the United Kingdom, where it is 17.[8] We then calculate category averages for all measures (apart for import content) and rank the averages from highest to lowest.[9] The graphs plot the inter industry linkages measures for each industry ranked according to their category averages.

[8] Details on the composition of countries' industry categories are contained in Table A3 in the appendix.

[9] We did not aggregate industries as this could lead to an aggregation bias, see Morimoto (1970) for details.

4.1 Backward and forward linkages[10]

Backward and forward linkages are descriptive measures of the economic interdependence of industries in terms of the magnitude of transactions. They can be interpreted as an estimate of the direct and indirect increase in output following an increase in final demand. Backward and forward linkages, which were first proposed by Rasmussen (1956), are calculated from the Leontief inverse or total requirement matrix $[I - A]^{-1}$.[11] The Leontief inverse is weighted by final demand (discussed further below).

The elements of the final demand weighted Leontief inverse are denoted by b_{ij}^{w} and calculated as follows

$$b_{ij}^{w} = b_{ij} \frac{f_i}{\sum_{i=1}^{N} f_i} \tag{4}$$

The average of the elements in column j[12]

$$b_{.j}^{w} = (1/N)\sum_{i=1}^{N} b_{ij}^{w} \tag{5}$$

shows the input requirements for a unit increase in the final demand for industry j's output given each industry's share in total final demand. It is called the *backward linkage* as it measures the impact on the supplier industries of a unit increase in final demand.[13] If the Leontief inverse was not weighted, the backward linkage would be an estimate of the direct and indirect increase in output to be supplied by an industry chosen at random following an increase in final demand for industry j's output. The weighting can thus be interpreted as applying a probability measure (Rasmussen, 1956).[14]

Expressing the backward linkage as an index

$$U_{.j}^{w} = \frac{(1/N)b_{.j}^{w}}{(1/N^2)\sum_{j=1}^{N} b_{.j}^{w}} = \frac{b_{.j}^{w}}{(1/N)\sum_{j=1}^{N} b_{.j}^{w}} \tag{6}$$

[10] The derivation of measures in sections 4.1 and 4.2 follows Chatterjee (1989) and Soofi (1992).

[11] In the case of Belgium, the matrix $[I - A]$ is singular, possibly because of rounding. The Leontief inverse is calculated as a generalised sweep inverse, using the Gauss command INVSWP($[I - A]$).

[12] Subscripts .j and i. denote column and row sums respectively.

[13] Hirschman (1958) labelled $U_{.j}^{w}$ and $U_{i.}^{w}$ (discussed further below) backward and forward linkages. Rasmussen (1956) used the term "power of dispersion" for $U_{.j}^{w}$ and "sensitivity of dispersion" for $U_{i.}^{w}$.

[14] As Rasmussen (1956) notes different weights may be applicable and it is also not necessary to apply the same system of weights to the backward and forward linkage.

allows inter industry comparisons to be made. The numerator in equation (6) measures the average stimulus to other industries, according to each industry's share in total final demand, resulting from a unit increase in the final demand for industry j's output. The denominator measures the average stimulus to the whole economy resulting from a unit increase in the final demand for the output of all industries.

Conversely, the index of *forward* linkage is given by

$$U_{i.}^{w} = \frac{(1/N)b_{i.}^{w}}{(1/N^{2})\sum_{i=1}^{N} b_{i.}^{w}} = \frac{b_{i.}^{w}}{(1/N)\sum_{i=1}^{N} b_{i.}^{w}} \qquad (7)$$

where the average of the elements in row i

$$b_{i.}^{w} = (1/N)\sum_{j=1}^{N} b_{ij}^{w} \qquad (8)$$

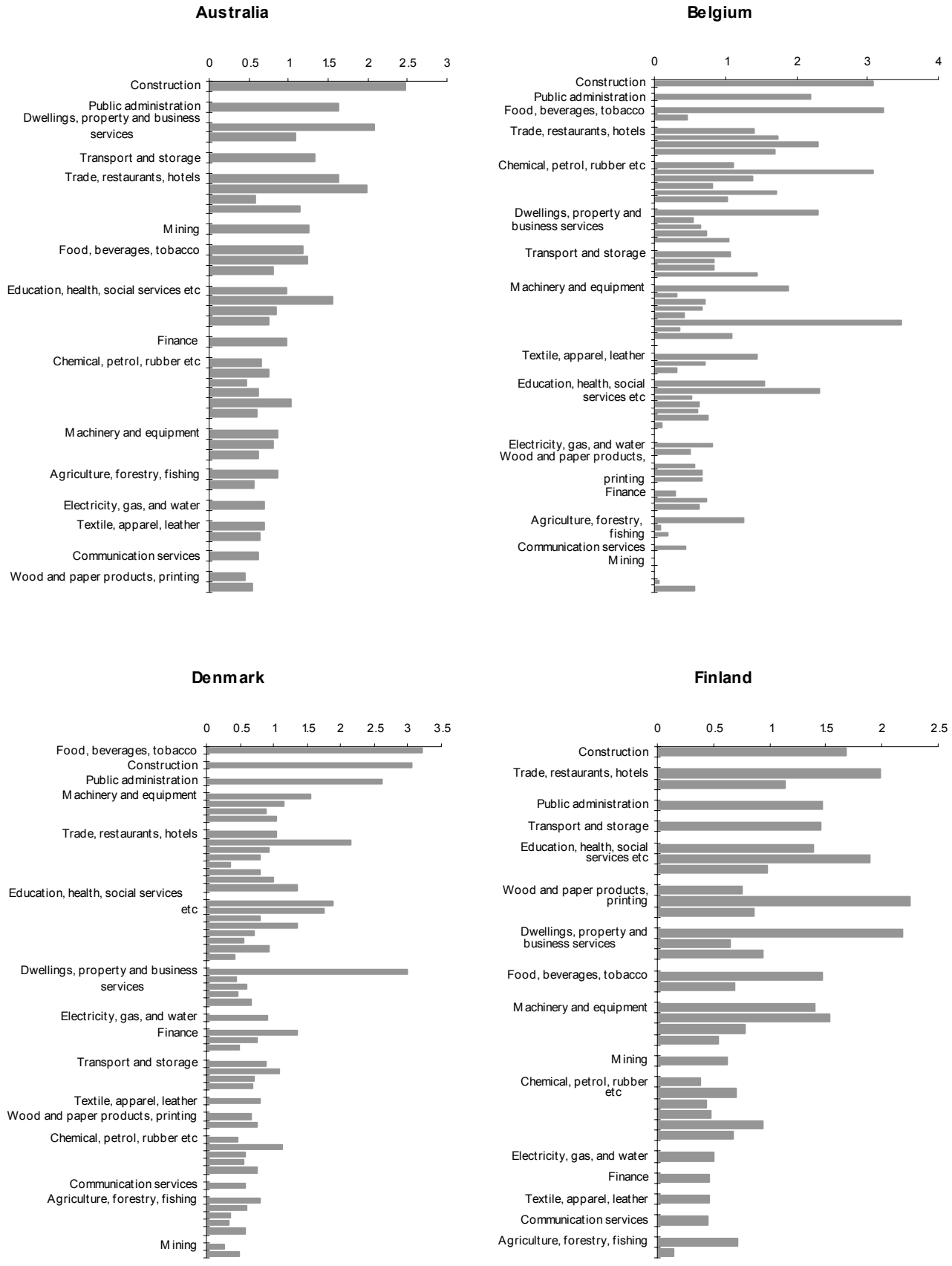
shows the increase in the output of sector i needed to supply the inputs required to produce an additional unit of final demand output given each industry's share in total final demand. Weighting the total requirement coefficient matrix is important for the forward index as it avoids a possible bias. The forward linkage would be subject to a bias noted in Chatterjee (1989) if the total requirement matrix wasn't weighted. This is because "for the row sum to measure the forward linkage in an unbiased fashion, it is necessary to make the assumption that the demands for all sectors increase by one unit. All sectors are unlikely in practice to be of equal importance in the structure of demand, so if a small sector j uses inputs from sector i disproportionately largely, the forward linkage index will be blown up artificially by the assumption of equal expansion of all sectors" (Chatterjee 1989, p. 96). Weighting the total requirement matrix avoids this problem.

The backward and forward linkages weighted by final demand are plotted in Figures 3 and 4. Construction; trade, restaurants, hotels; public administration; food, beverages, tobacco; and dwellings, property and business services have the largest backward linkages in New Zealand; that is, an increase in the final demand of these industries' output will have a large impact on industries that supply inputs in the production of these industries' output. Construction; trade, restaurants, hotels; public administration; food, beverages, tobacco; and dwellings, property and business services also have large backward linkages in Australia, Belgium, Denmark, Finland and Germany.

The industries with the lowest backward linkages in New Zealand are finance; and electricity, gas, and water. Electricity, gas, and water also has few backward linkages in other countries. But the finance industry is purchasing more inputs in other countries than in New Zealand, with a possible exception of Belgium, where finance has the third lowest backward linkage and Finland, where it ranks fourth lowest.

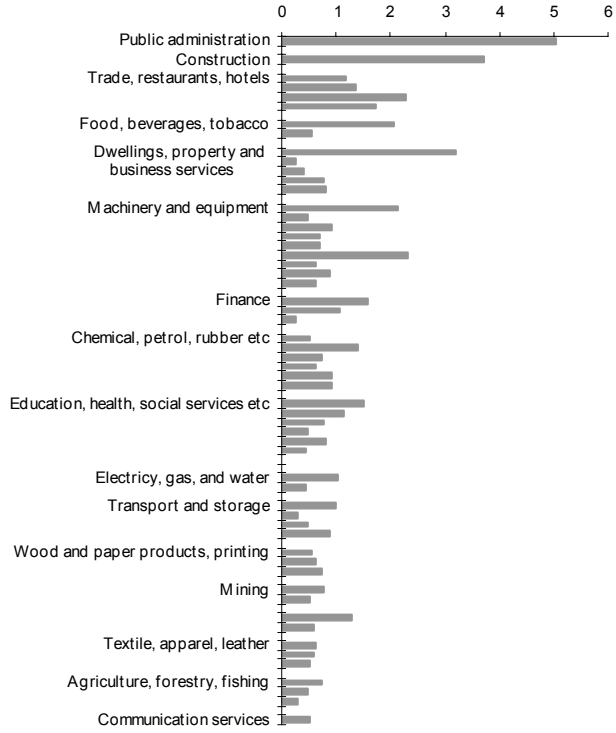
Construction; trade, restaurants, hotels; dwellings, property and business services; food, beverages, tobacco; and public administration also have the largest forward linkages in New Zealand. These industries also have large forward linkages in Australia, Belgium, Denmark, Finland and Germany. A large forward linkage means that output in these industries must increase following a rise in final demand output in other industries in order to provide the required inputs for the production of the additional unit of final demand.

Figure 3: Backward linkages (final demand weighted)[15]

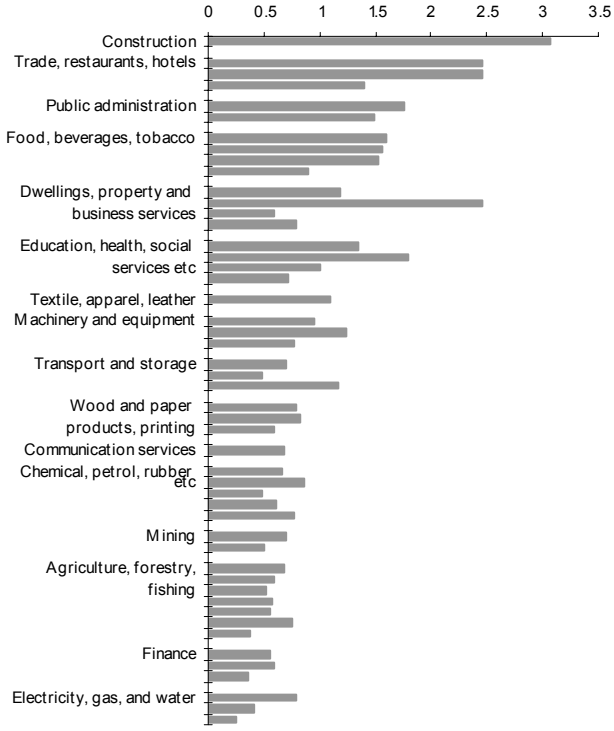


[15] NPISH in the United Kingdom figures stands for non-profit institutions serving households.

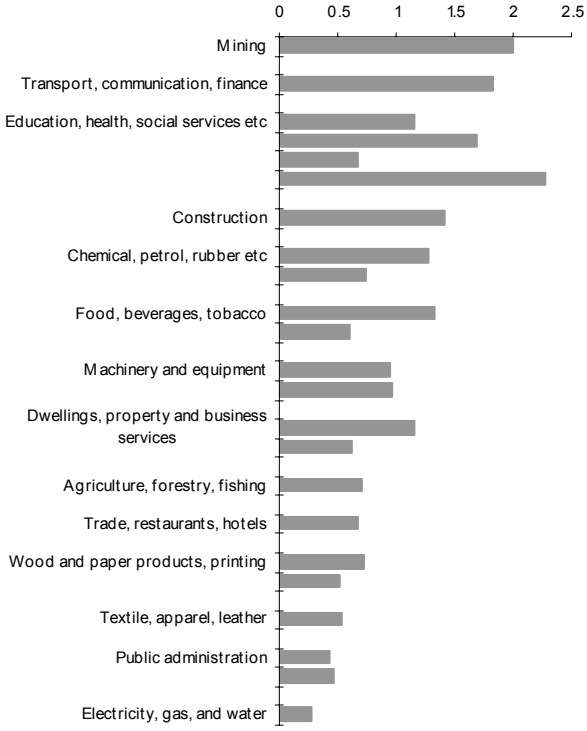
Germany



New Zealand



Norway



United Kingdom

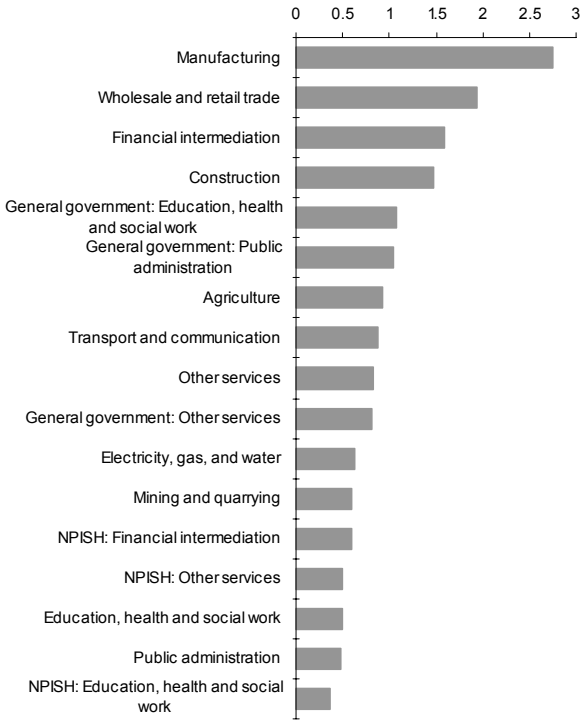
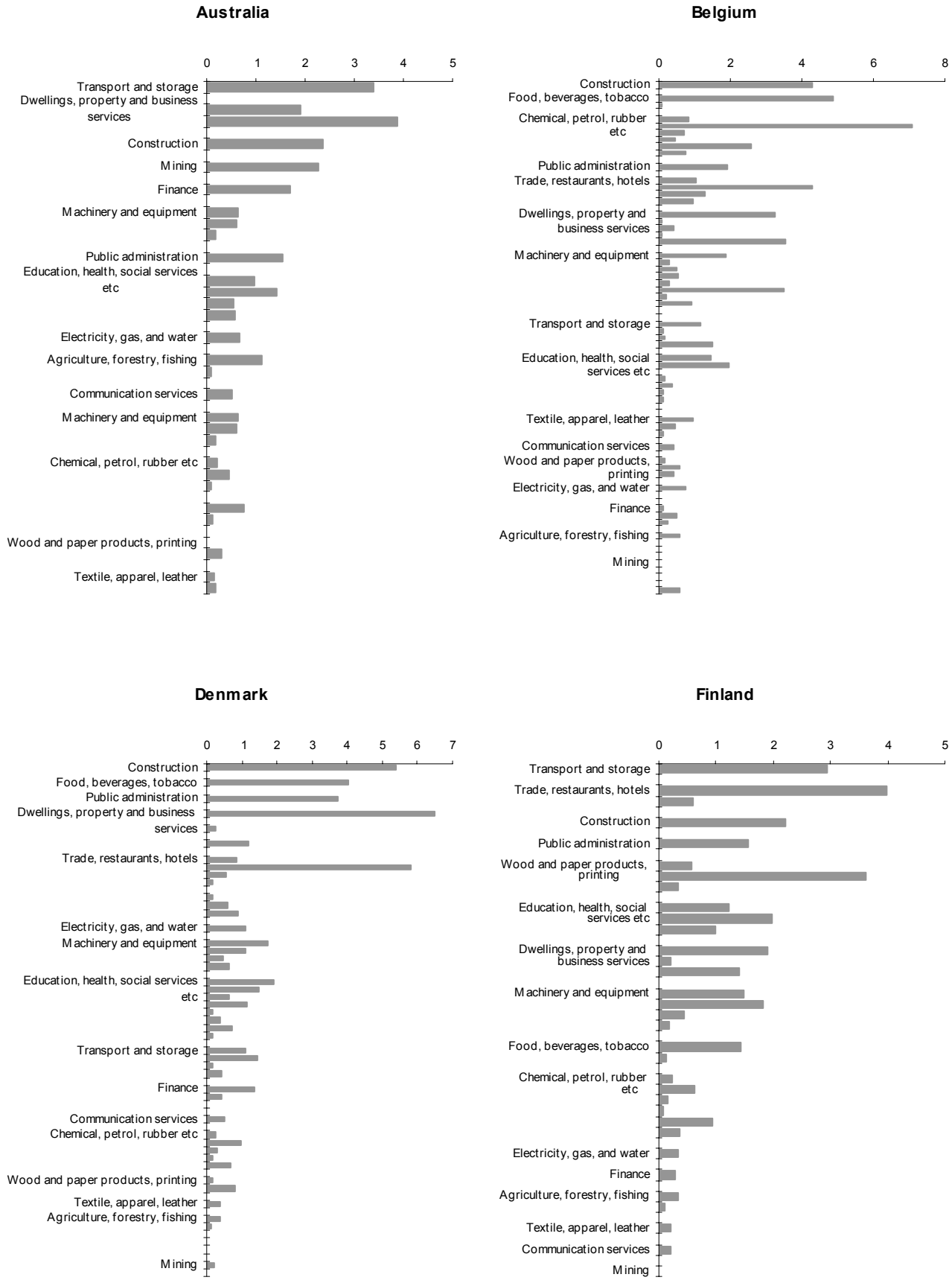
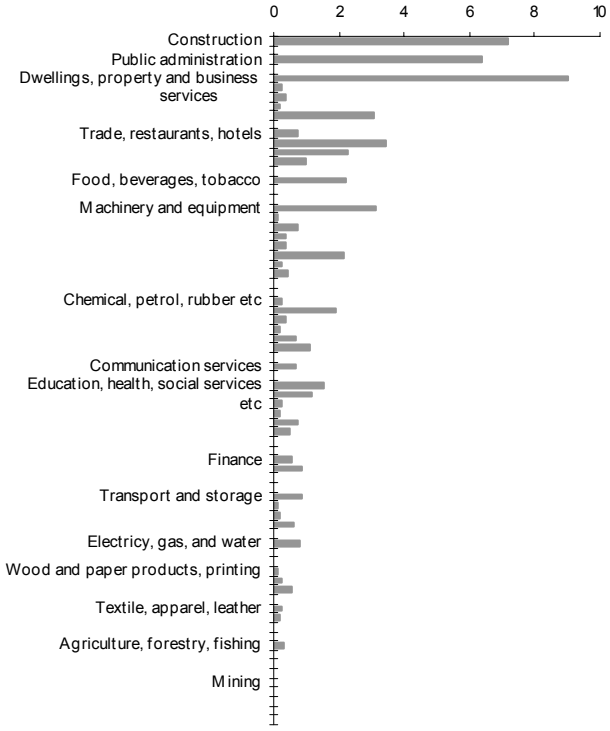


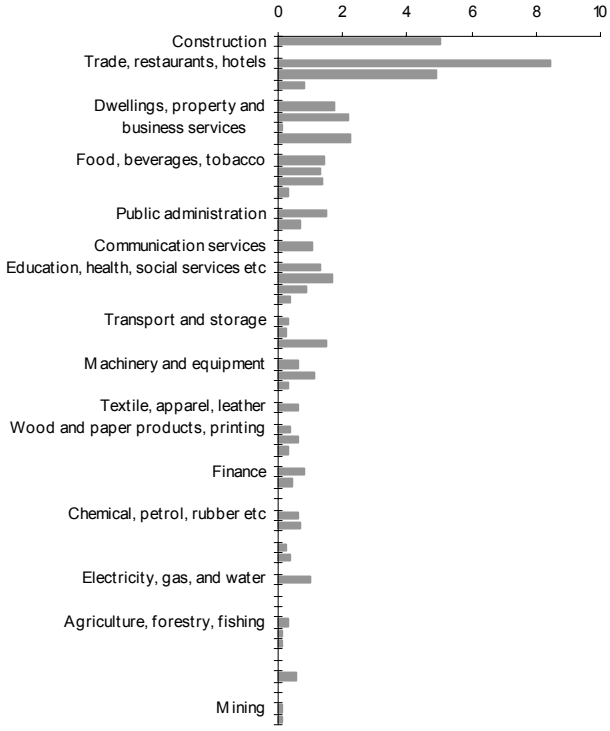
Figure 4: Forward linkages (final demand weighted)



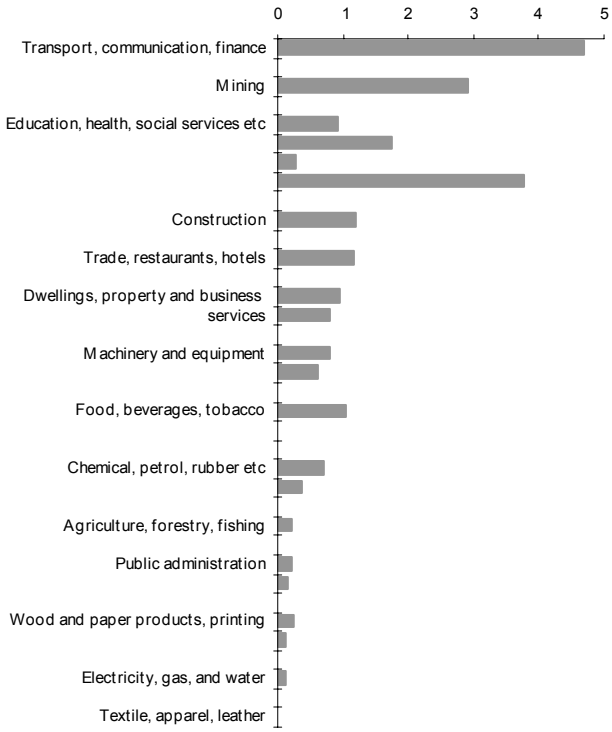
Germany



New Zealand



Norway



United Kingdom

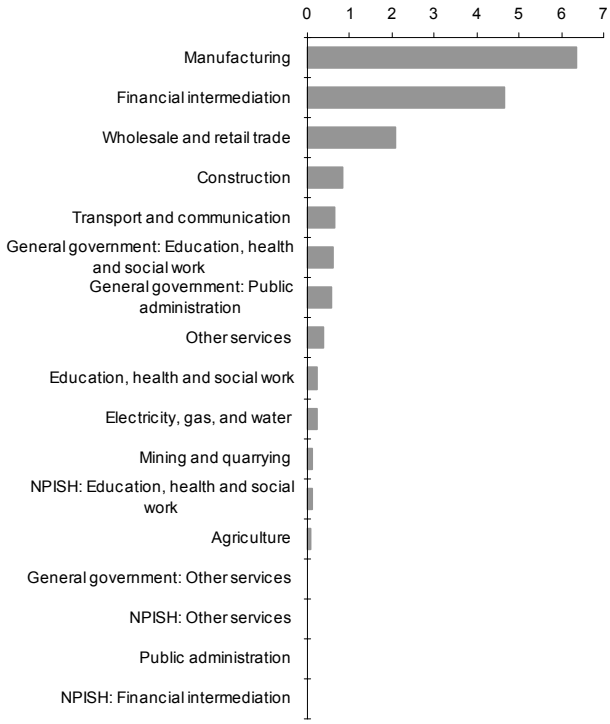
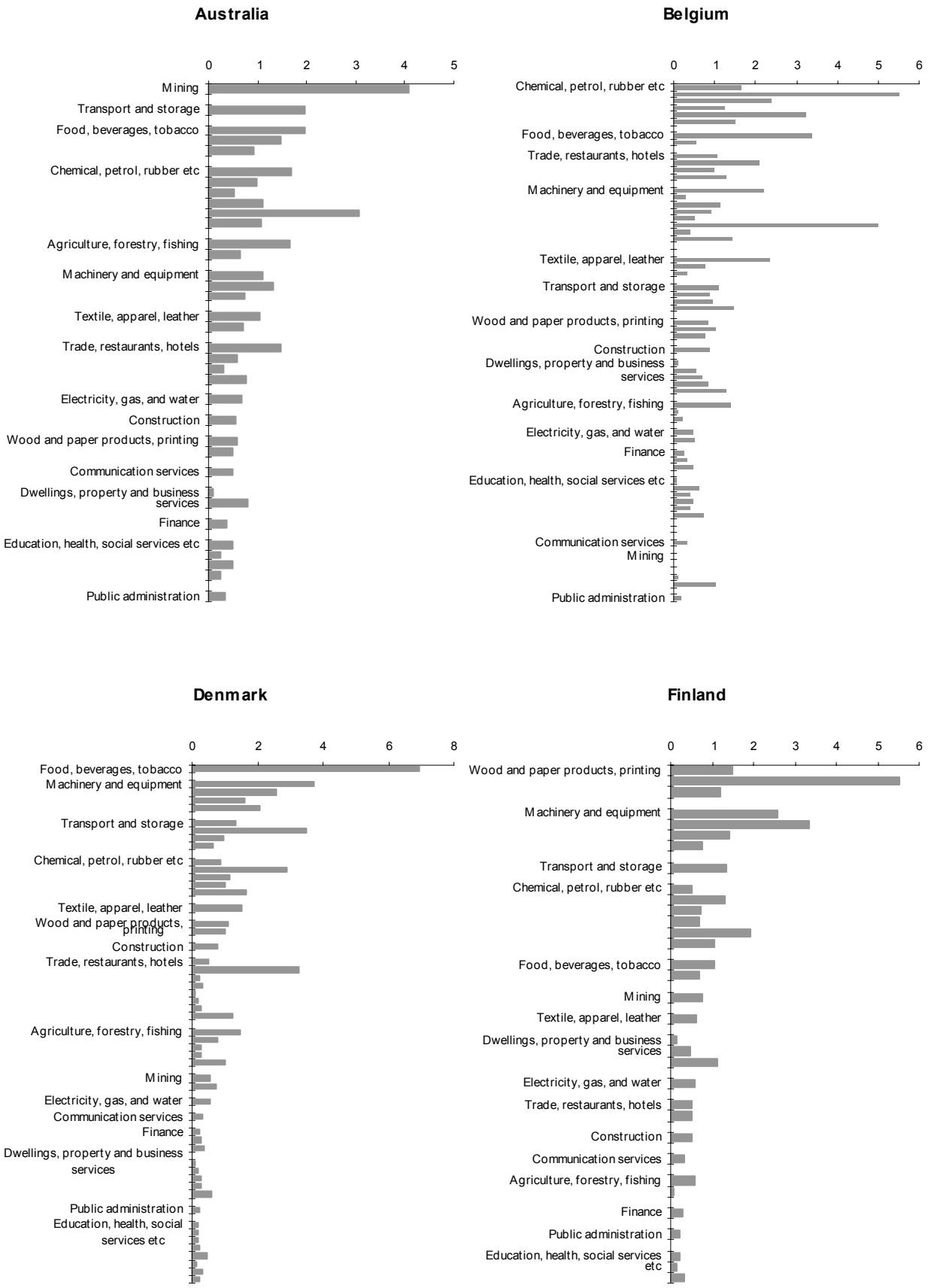
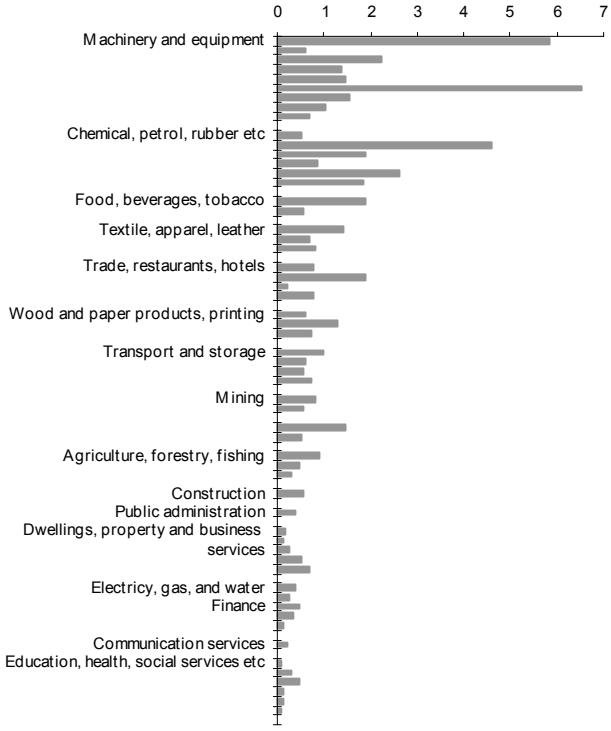


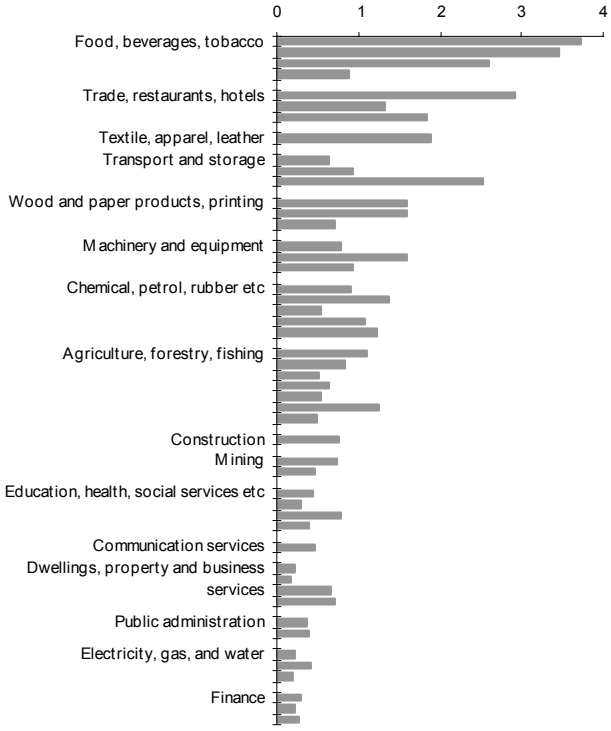
Figure 5: Backward linkages (export weighted)



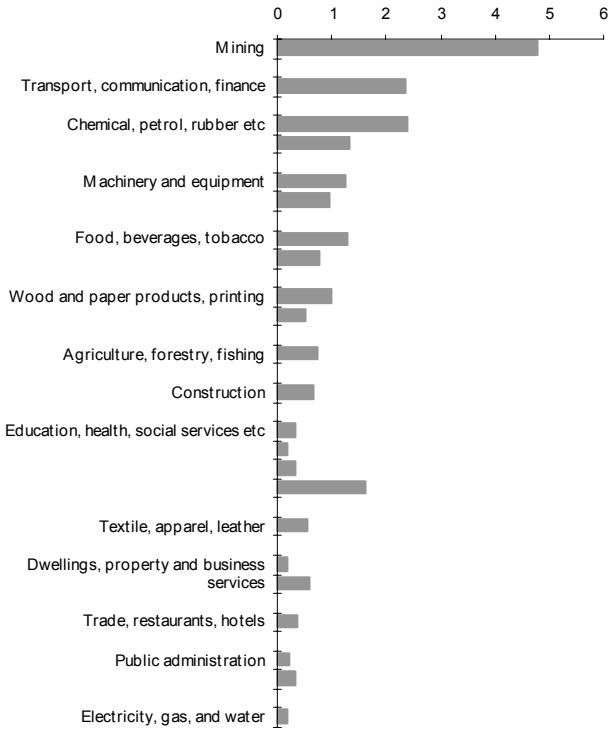
Germany



New Zealand



Norway



United Kingdom

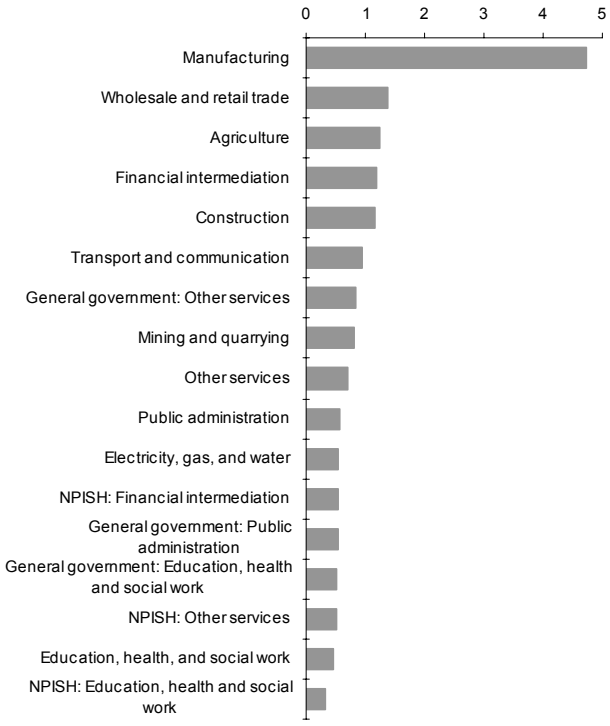
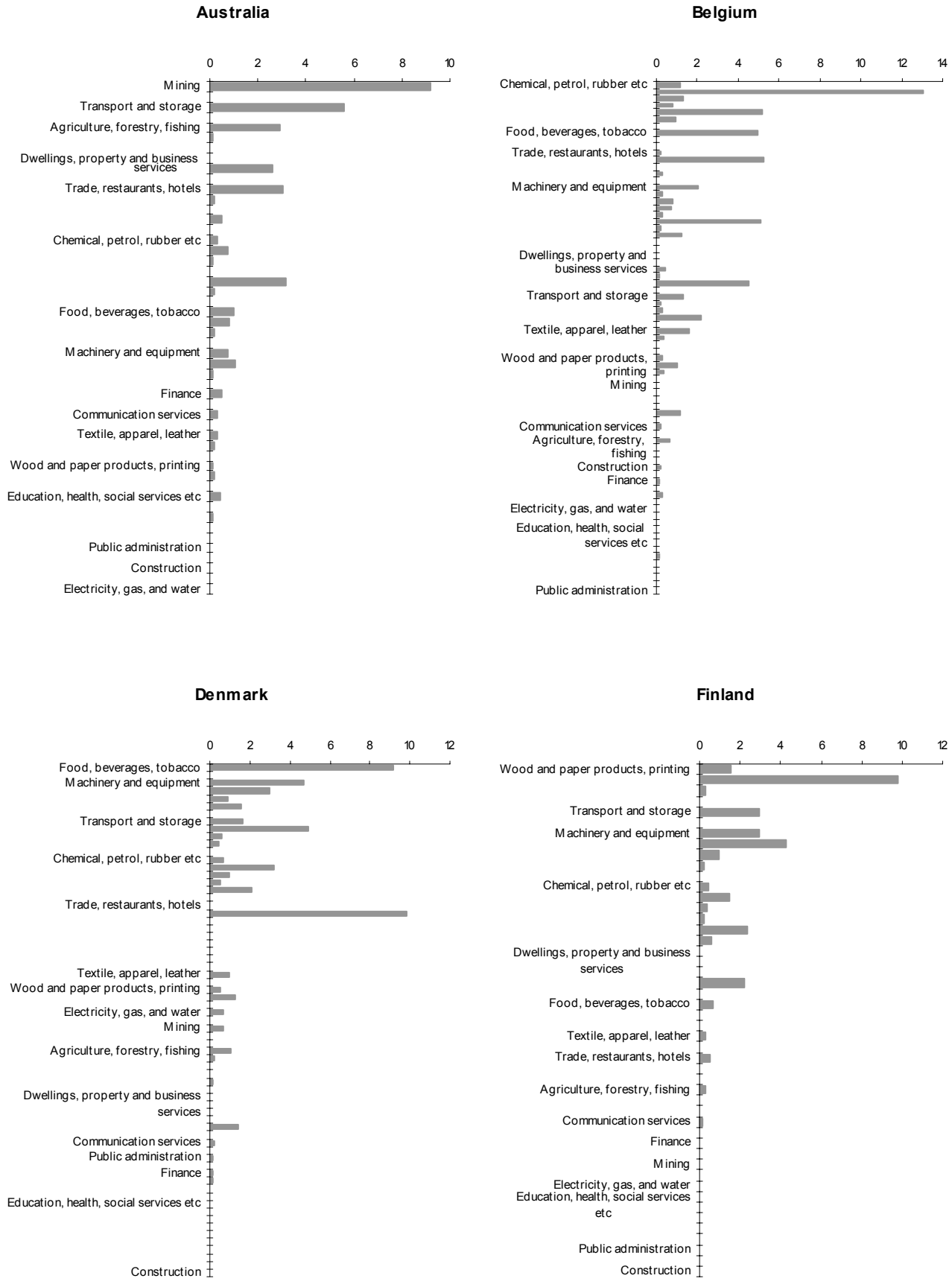
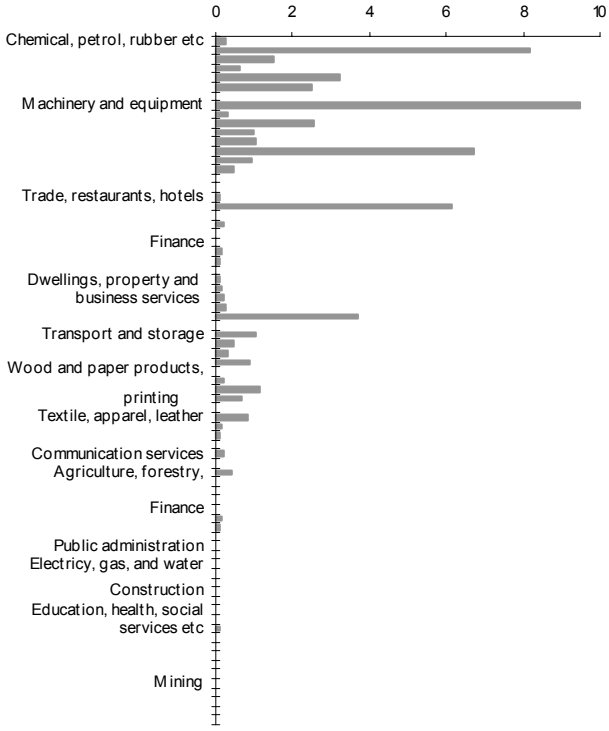


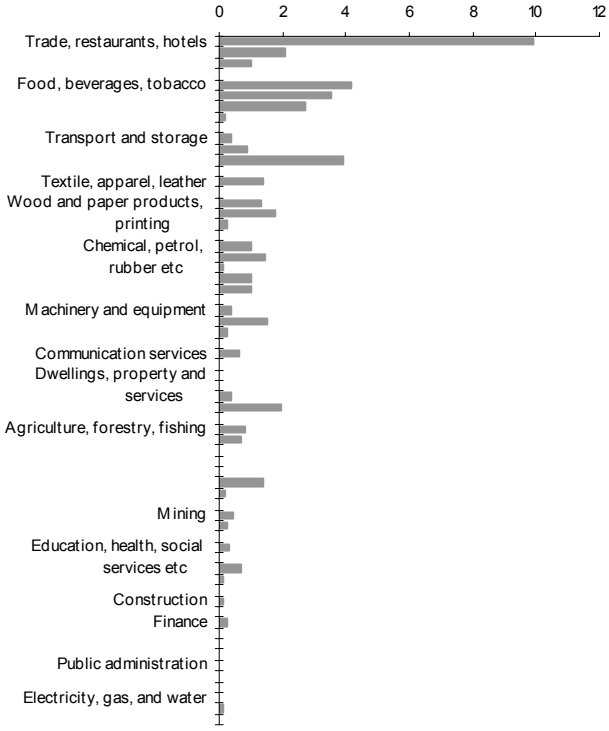
Figure 6: Forward linkages (export weighted)



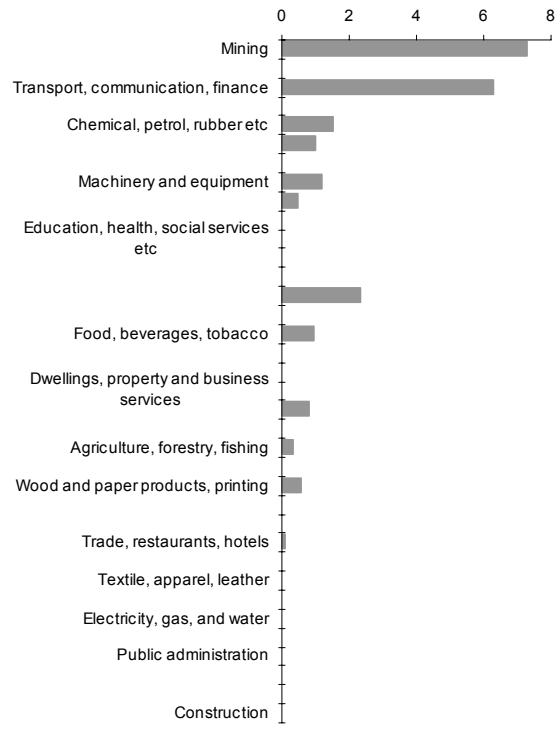
Germany



New Zealand



Norway



United Kingdom

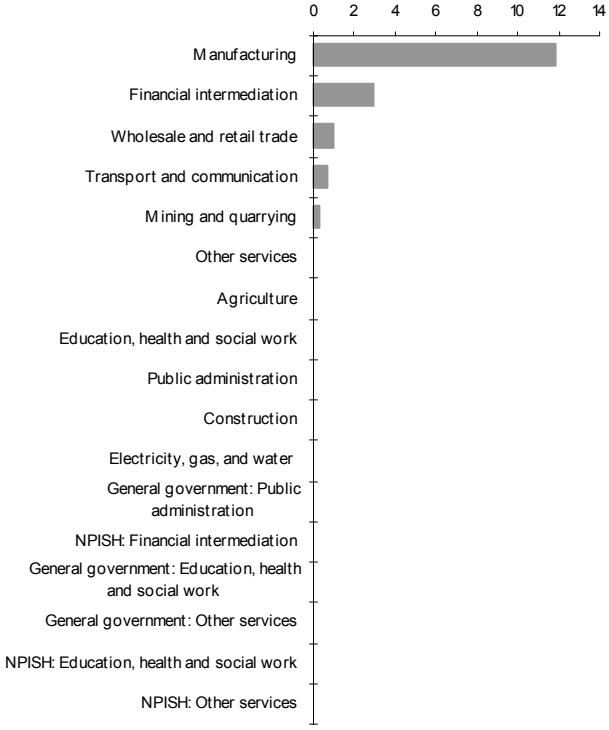


Figure 4 shows that finance has more forward than backward linkages in New Zealand. The relative importance of finance in New Zealand in terms of forward linkages is similar to that in Belgium, Finland and Germany, but lower than in Australia, Denmark, Norway and the United Kingdom.

Alternatively, exports can be used as a weighting factor. Backward and forward linkages then show the effect on industries of a unit increase in export demand. The results of weighting backward and forward linkages by exports are reported in Figures 5 and 6. New Zealand's most important exporting industries in terms of backward (Figure 5) and forward (Figure 6) linkages are food, beverages, tobacco; trade, restaurants, hotels; transport and storage; and textile, apparel, leather. Transport and storage is also important in Australia, Denmark and Finland. The effects of a unit increase in export demand on the transport and storage industry in Norway and the United Kingdom are more difficult to assess because of the industry aggregation in these countries. Trade, restaurants, hotels appear to be more important for exporting in New Zealand, and to some extent in the United Kingdom, than in the other countries.

4.2 Industry interconnectedness

Indices of industry interconnectedness focus on the number of direct and indirect transactions between industries and provide an indication of the degree of outsourcing and diversification in an economy. More purchases of intermediate products by industries indicate an increase in outsourcing, while a rise in the number of sales to other industries suggests an increase in diversification; that is, an expansion of an existing industry into other commodities or markets.[16]

Following Soofi (1992), two measures of industry interconnectedness are calculated: (i) a measure of concentration and (ii) entropy as a measure of variation.[17] The concentration measure is calculated from the *unweighted* total requirement matrix and thus focuses on the intermediate sector. The entropy based measure of dispersion is more descriptive of the characteristics of the economy as a whole as it takes into account final demand sales.

The backward concentration index is defined as

$$G_{.j}(b_{ij}) = \left[N\left(1 - \sum_{i=1}^{N} (c_{.j,ij})^2 \right) \right]^{1/2} \qquad (9)$$

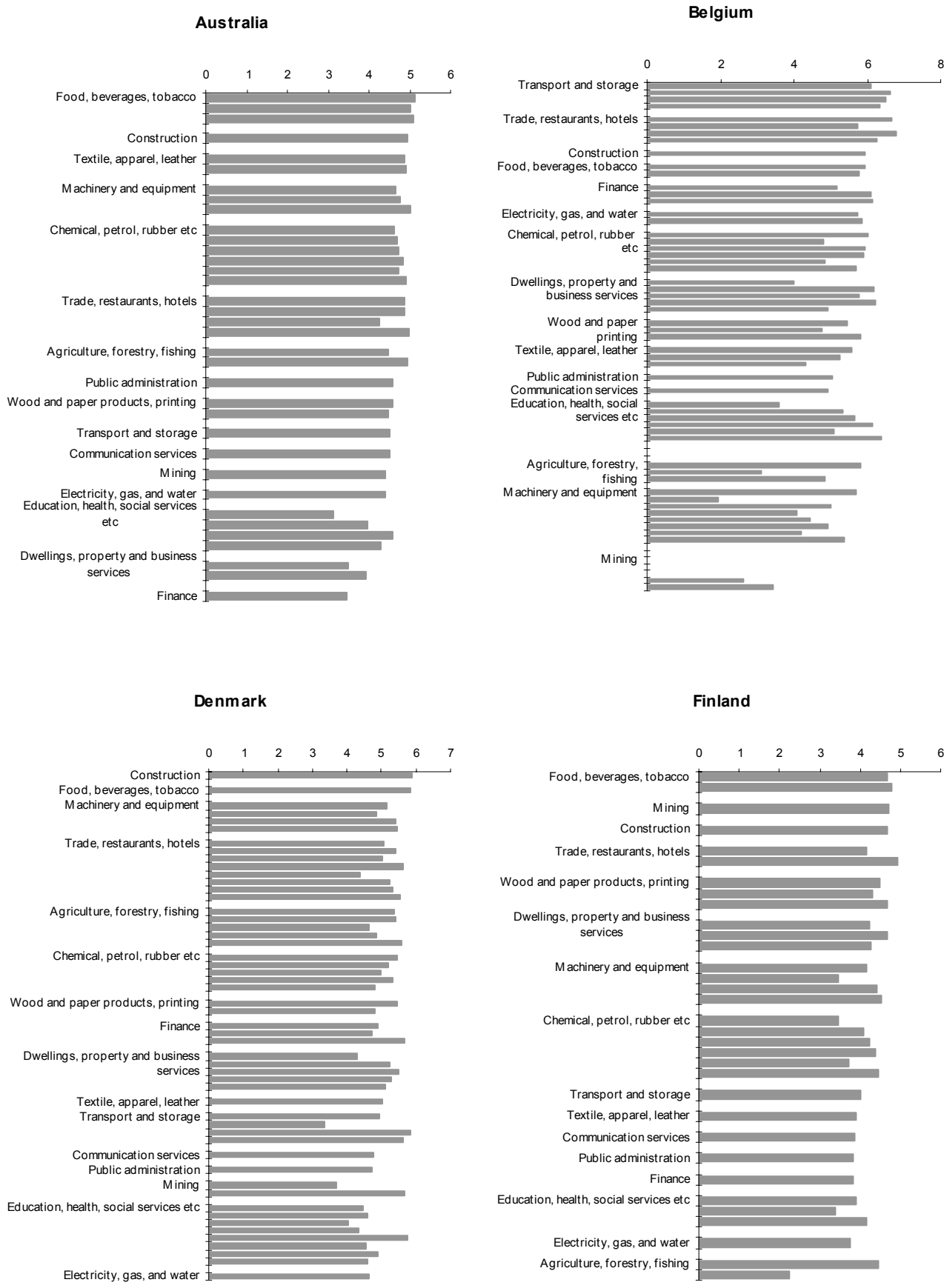
and the forward index as

$$G_{i.}(b_{ij}) = \left[N\left(1 - \sum_{j=1}^{N} (c_{i.,ij})^2 \right) \right]^{1/2} \qquad (10)$$

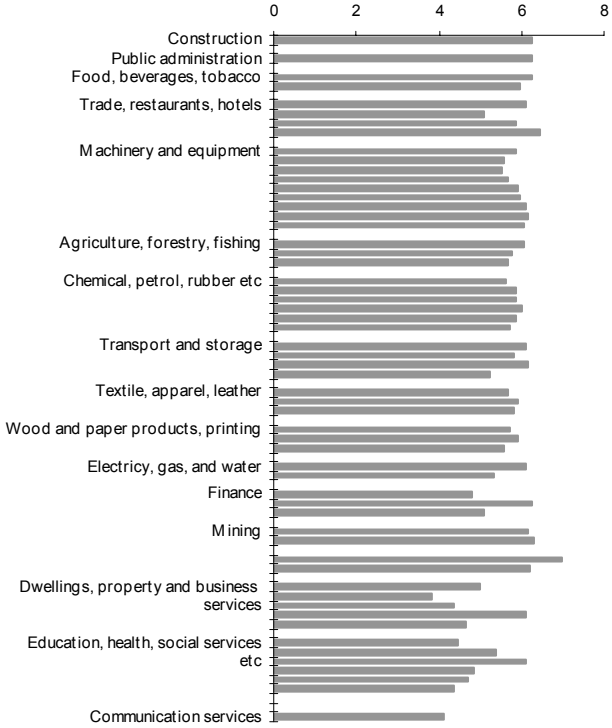
[16] Diversification may be related or unrelated. Related diversification occurs when an industry (firm) expands into similar product lines. Unrelated diversification takes place when the products are very different from each other, for example a food processing firm manufacturing leather footwear as well. Diversification may arise for a variety of reasons: to take advantage of complementarities in production and existing technology; to exploit economies of scope; to reduce exposure to risk; to stabilize earnings and overcome cyclical business conditions; etc. See the OECD's *Glossary of industrial organization economics and competition law* www.oecd.org/pdf/M00007000/M00007651.pdf.

[17] Entropy is explained further below.

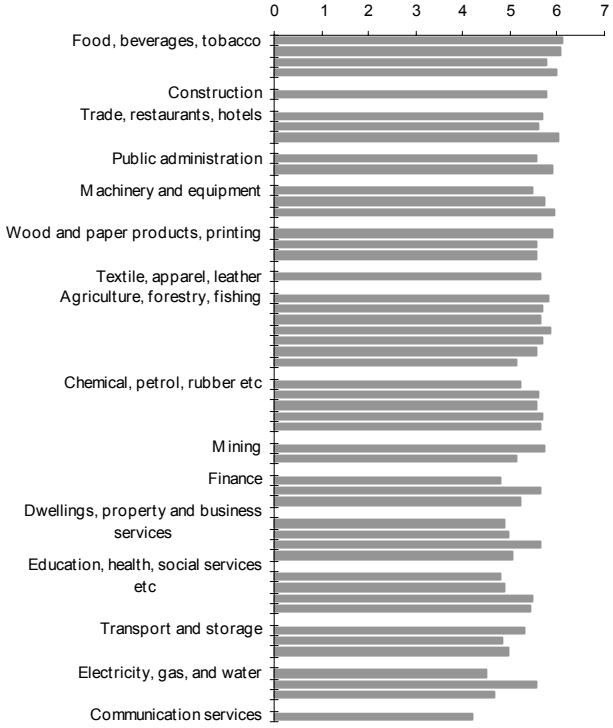
Figure 7: Backward concentration index



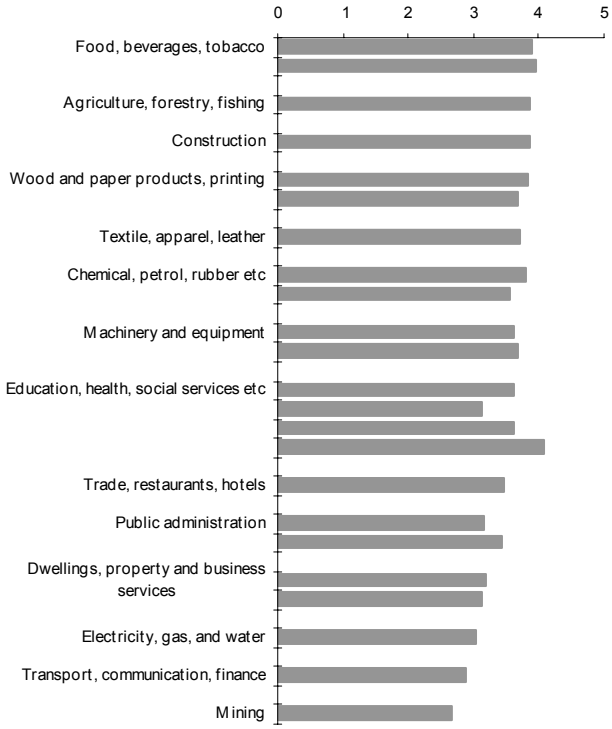
Germany



New Zealand



Norway



United Kingdom

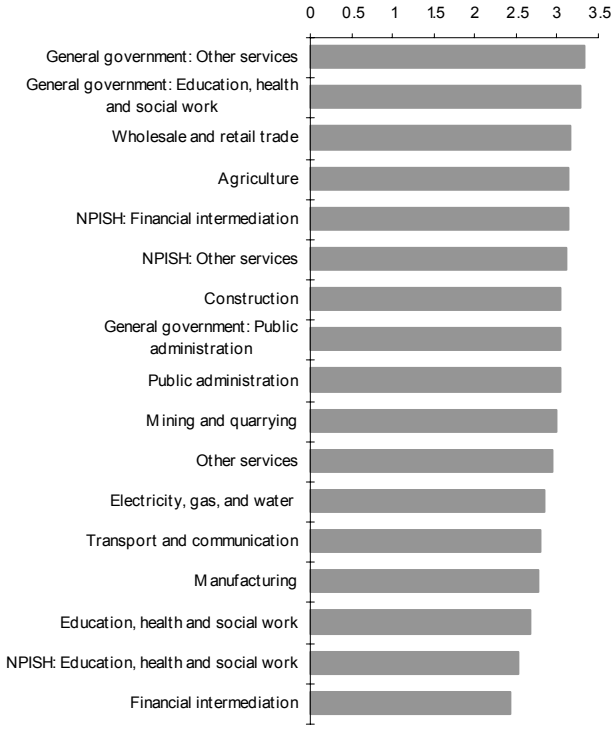
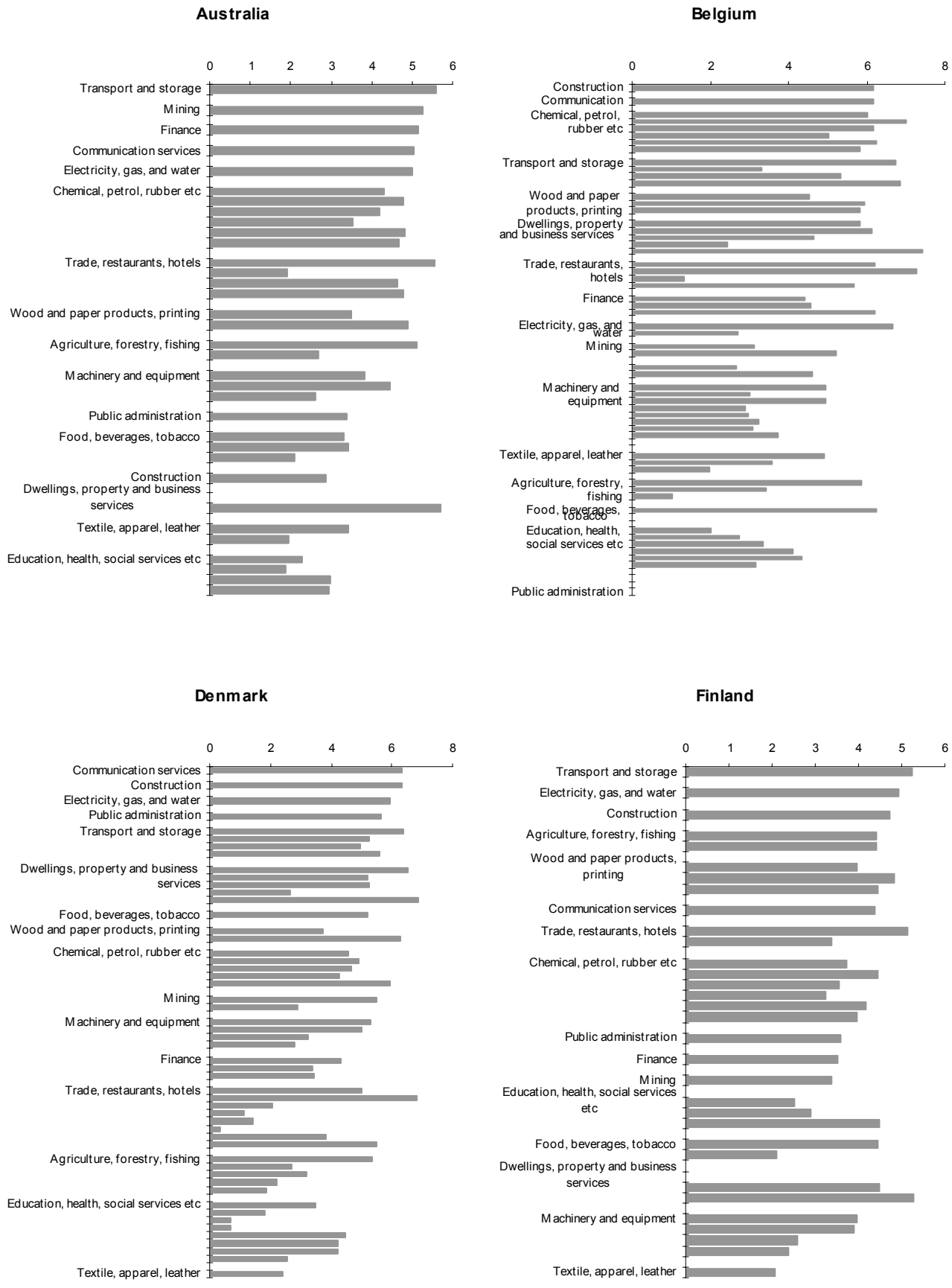
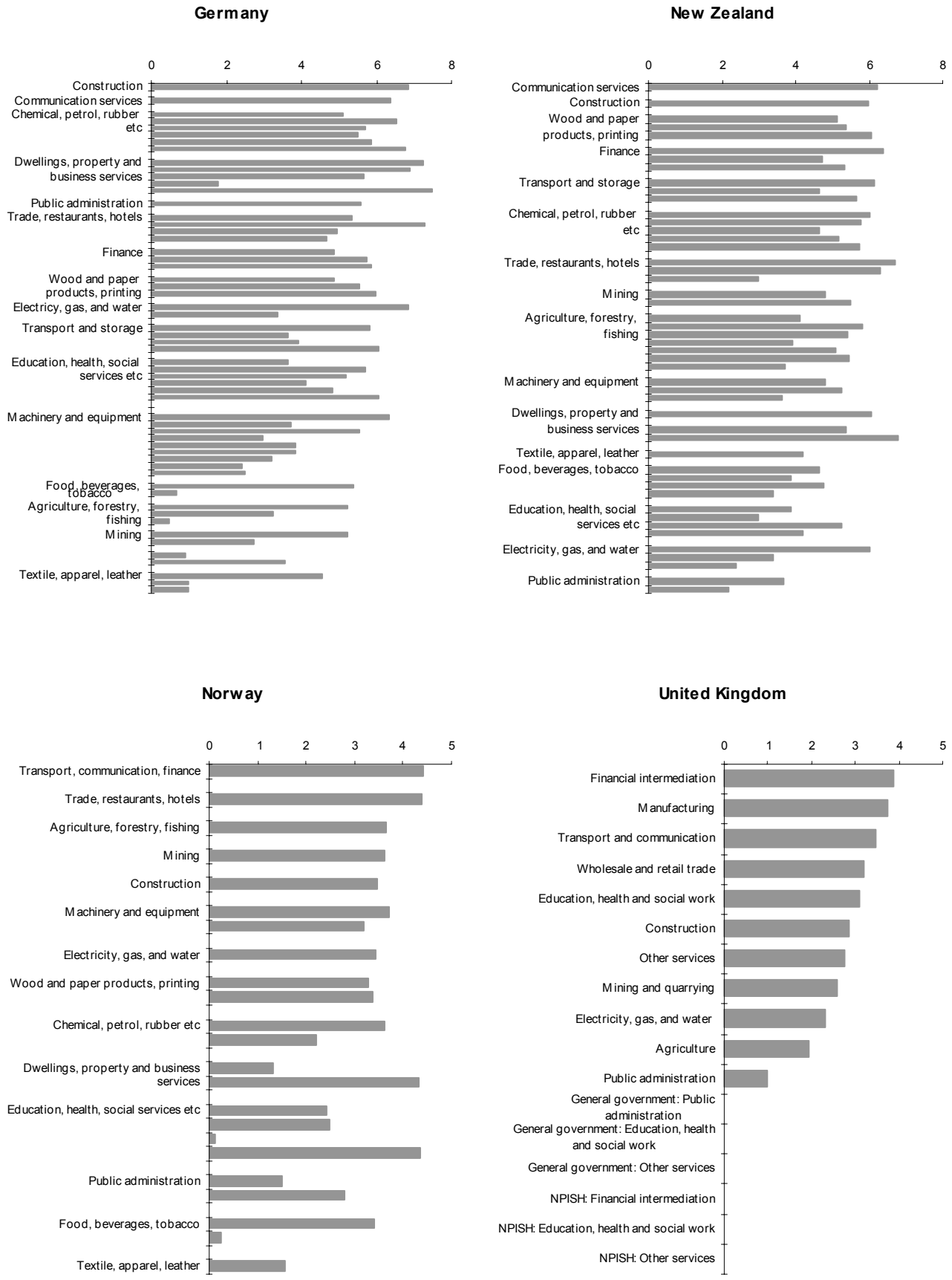


Figure 8: Forward concentration index




Germany
0
2
4
6
8
Construction
Communication services
Chemical, petrol, rubber etc
Dwellings, property and business services
Public administration
Trade, restaurants, hotels
Finance
Wood and paper products, printing
Electricy, gas, and water
Transport and storage
Education, health, social services etc
Machinery and equipment
Food, beverages, tobacco
Agriculture, forestry, fishing
Mining
Textile, apparel, leather
New Zealand
0
2
4
6
8
Communication services
Construction
Wood and paper products, printing
Finance
Transport and storage
Chemical, petrol, rubber etc
Trade, restaurants, hotels
Mining
Agriculture, forestry, fishing
Machinery and equipment
Dwellings, property and business services
Textile, apparel, leather
Food, beverages, tobacco
Education, health, social services etc
Electricity, gas, and water
Public administration
Norway
0
1
2
3
4
5
Transport, communication, finance
Trade, restaurants, hotels
Agriculture, forestry, fishing
Mining
Construction
Machinery and equipment
Electricity, gas, and water
Wood and paper products, printing
Chemical, petrol, rubber etc
Dwellings, property and business services
Education, health, social services etc
Public administration
Food, beverages, tobacco
Textile, apparel, leather
United Kingdom
0
1
2
3
4
5
Financial intermediation
Manufacturing
Transport and communication
Wholesale and retail trade
Education, health and social work
Construction
Other services
Mining and quarrying
Electricity, gas, and water
Agriculture
Public administration
General government: Public administration
General government: Education, health and social work
General government: Other services
NPISH: Financial intermediation
NPISH: Education, health and social work
NPISH: Other services

where $c_{.j,ij} = \frac{b_{ij}}{\sum_{i=1}^{N} b_{ij}} = \frac{b_{ij}}{b_{.j}}$ and $c_{i.,ij} = \frac{b_{ij}}{\sum_{j=1}^{N} b_{ij}} = \frac{b_{ij}}{b_{i.}}$ for all i and j.

The larger is the measure of concentration, the more industries' transactions or the higher the degree of outsourcing and diversification. Conversely, the smaller the measure of concentration is, the fewer inter industry sales or purchases.[18]

Figures 7 and 8 plot the backward and forward concentration index. Food, beverages, tobacco; construction; trade, restaurant, hotels; and public administration in New Zealand are important in terms of how much they purchase from other industries directly and indirectly (backward linkage, Figure 3), but also in terms of the number of industries they buy products from (backward concentration index, Figure 7). In contrast, in other countries, the relative importance of industries appears to differ more than in New Zealand depending on whether backward linkages or the backward concentration index is used. One interpretation is that industries in New Zealand tend to purchase many inputs from many industries, whereas in other countries, industries tend to either buy many inputs from some industries or purchase some inputs from many industries.[19]

The relative importance of industries changes in New Zealand measured in terms of forward concentration compared to forward linkages. The forward concentration index, which shows the dispersion across industries of a unit increase in final demand output on industries' sales to other industries, is largest for communication services in New Zealand. The importance of communication services also increases in other countries in terms of the number of industries selling to relative to the magnitude of sales.

Overall, the importance of dwellings, property and business services generally declines across countries when adjustment is made for the magnitude of transactions. The relative importance of finance increases in New Zealand and Belgium, and to a lesser extent in Finland, when measured by the number of industries transacting with rather than the value of sales and purchases.

An alternative measure of industry interconnectedness is entropy. Entropy, which has its origin in physics, is a measure of disorder.[20] The higher (lower) is the entropy, the more (less) integrated and thus specialised industries are.

The row entropy of sector i is calculated as follows

$$H_{i.}(b_{ij}^{w}) = \sum_{i=1}^{N} d_{i.,ij} \log\left(\frac{1}{d_{i.,ij}}\right) \qquad (11)$$

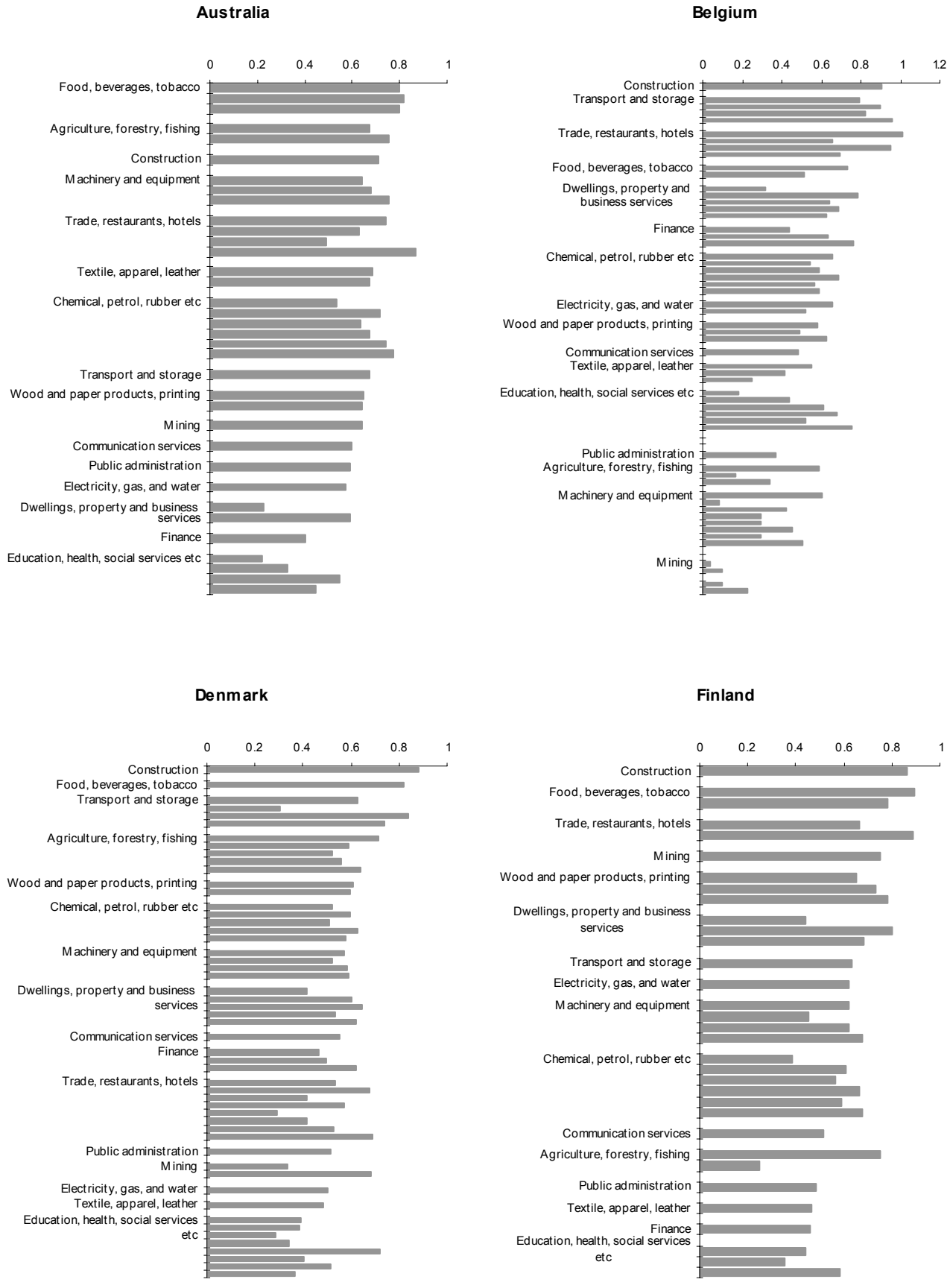
and the column entropy of sector j as

[18] The index would probably be more adequately called a "de-concentration" index.

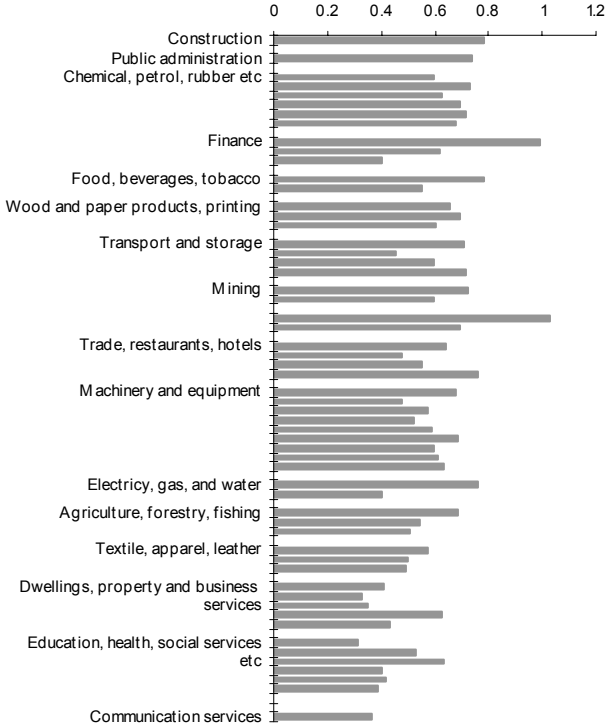
[19] The indexes will be affected by the extent to which countries take out secondary production.

[20] Consider, for example, two gases, one with all A molecules and one with all B molecules. Mixing the two gases leads to a final mixture of A and B molecules that is less ordered than the initial system of pure A and B molecules. The mixed state is more probable than the unmixed state, i.e. it has a higher entropy, because there are more ways of distributing the molecules of A and B so as to yield mixed states than there are ways to yield pure states. The two gases in the example can be interpreted as industries in an economy.

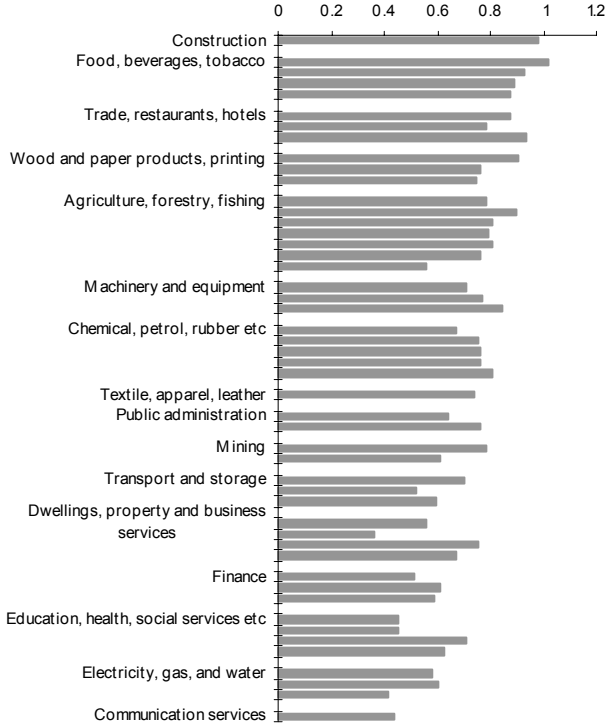
Figure 9: Row entropy (final demand weighted)



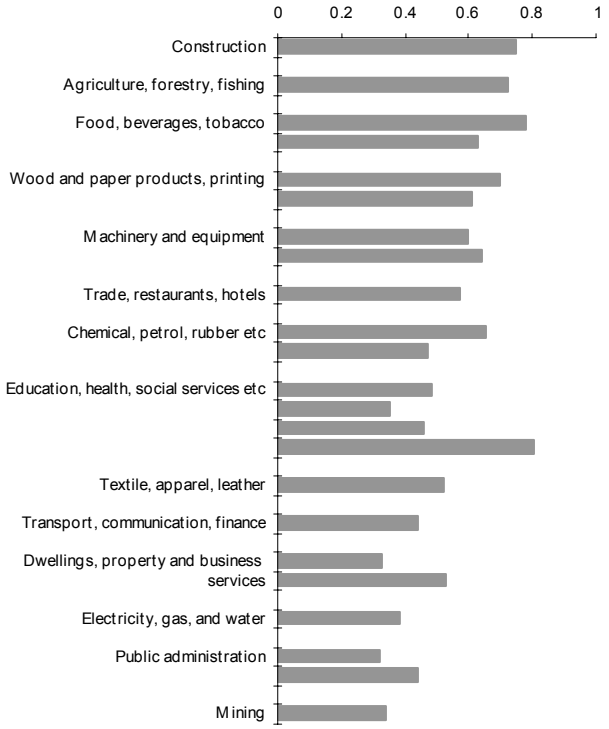
Germany



New Zealand



Norway



United Kingdom

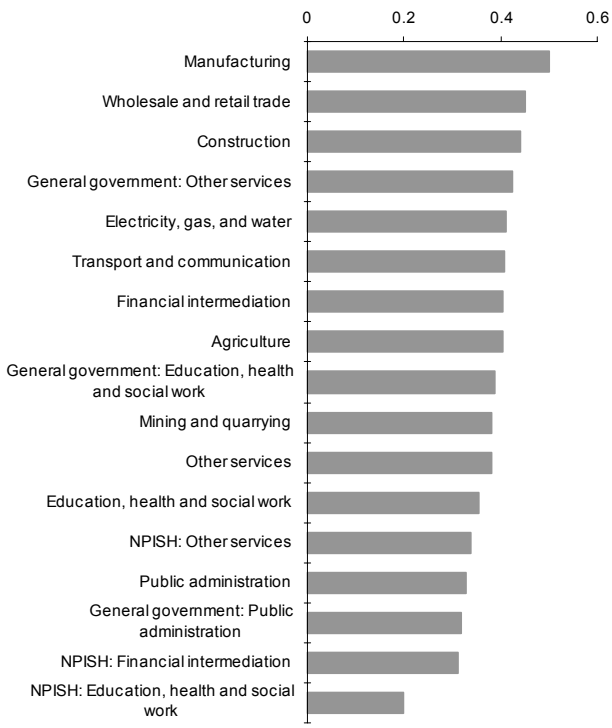
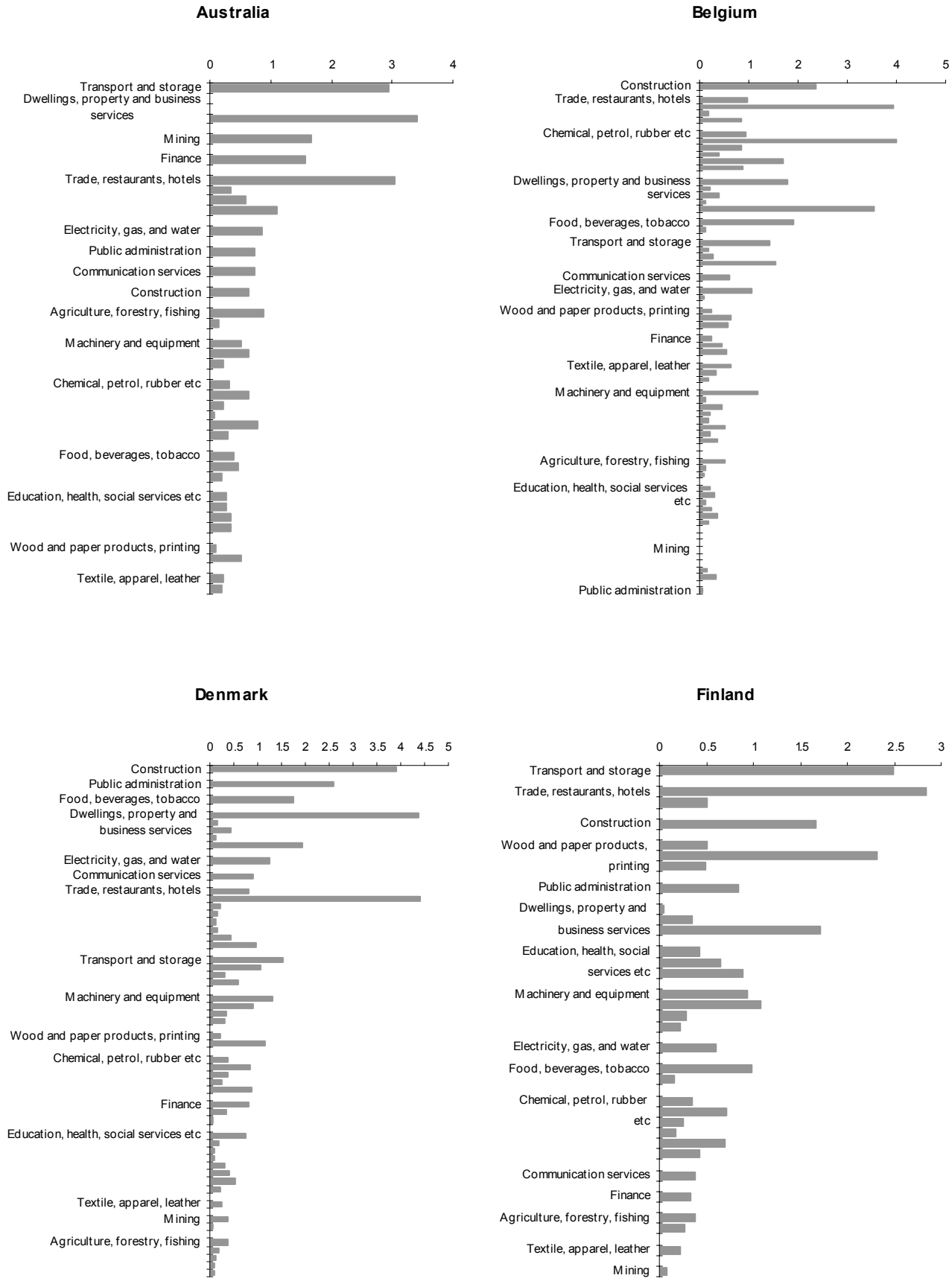
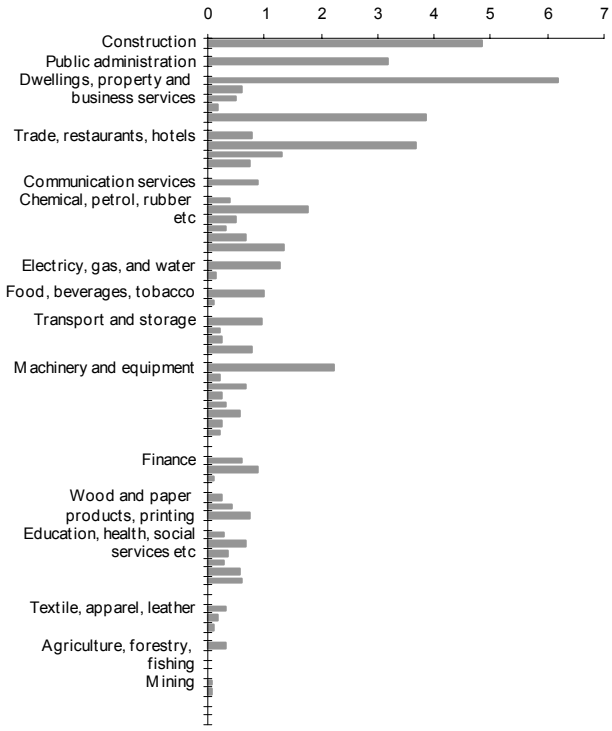


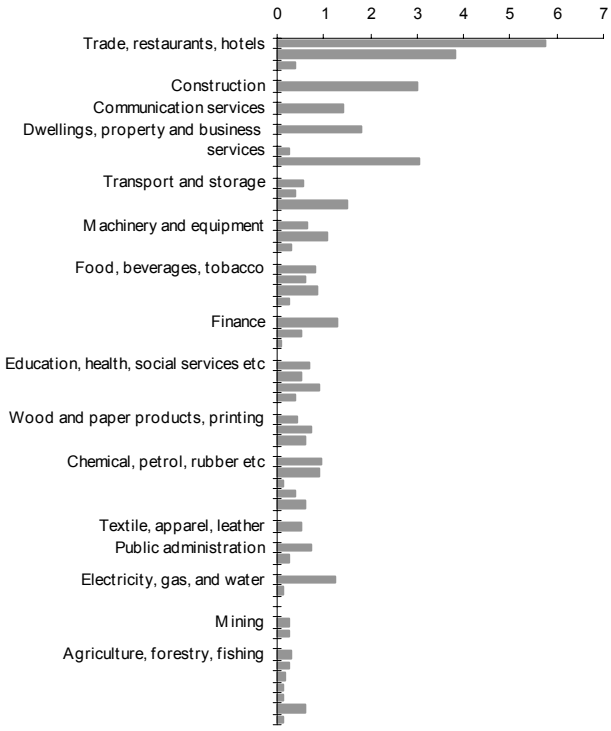
Figure 10: Column entropy (final demand weighted)



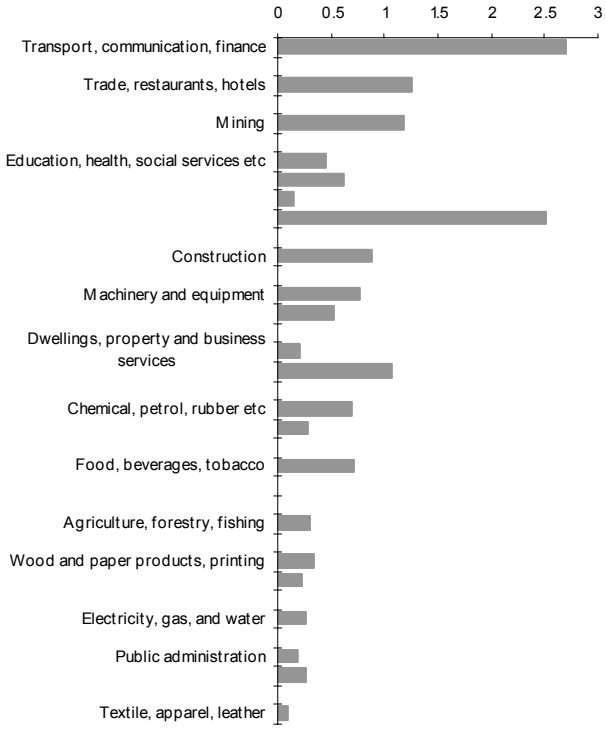
Germany



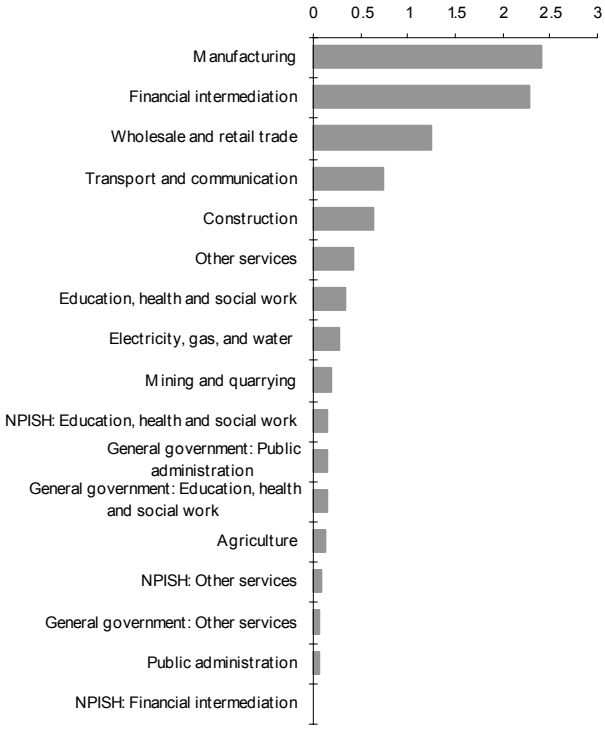
New Zealand



Norway



United Kingdom



$$H_{.j}(b_{ij}^{w}) = \sum_{j=1}^{N} d_{.j,ij} \log\left(\frac{1}{d_{.j,ij}}\right) \qquad (12)$$

where $d_{i.,ij} = \frac{b_{ij}^{w}}{\sum_{j=1}^{N} b_{ij}^{w}} = \frac{b_{ij}^{w}}{b_{i.}^{w}}$ and $d_{.j,ij} = \frac{b_{ij}^{w}}{\sum_{i=1}^{N} b_{ij}^{w}} = \frac{b_{ij}^{w}}{b_{.j}^{w}}$ for all i and j .

Note that $d_{..,ij} \log\left(\frac{1}{d_{..,ij}}\right)$ is generally replaced by $\lim_{d_{..,ij} \to 0}\left[d_{..,ij} \log\left(\frac{1}{d_{..,ij}}\right)\right] = 0$ for $d_{..,ij} = 0$ (Theil 1971).

The row and column entropy are conceptually similar to the backward and forward concentration index, but take into account final demand. Figures 9 and 10 plot the row and column entropy measures. Taking into account final demand sales has the effect of raising the relative importance of wood and paper products, printing; and agriculture, forestry, fishing in New Zealand in terms of backward industry connectedness (Figure 9). The relative importance of agriculture, forestry, fishing also increases in Australia.

Moreover, a comparison of the row and column entropy (Figures 9 and 10) with the backward and forward concentration index (Figures 7 and 8) shows that taking into account final demand lowers the relative importance of finance in New Zealand, Belgium and Finland. This suggests that the finance industry in New Zealand, Belgium and Finland probably offers similar products to that in other countries and provides services across all industries in the economy, but the amount of credit channelled through the financial system for final demand is lower.

The measures discussed so far rank industries by sales and purchases with other industries. To take into account inter industry transactions as well as deliveries to final demand, an extended version of the entropy measure can be used. The entropy of total sales flows is calculated by normalising

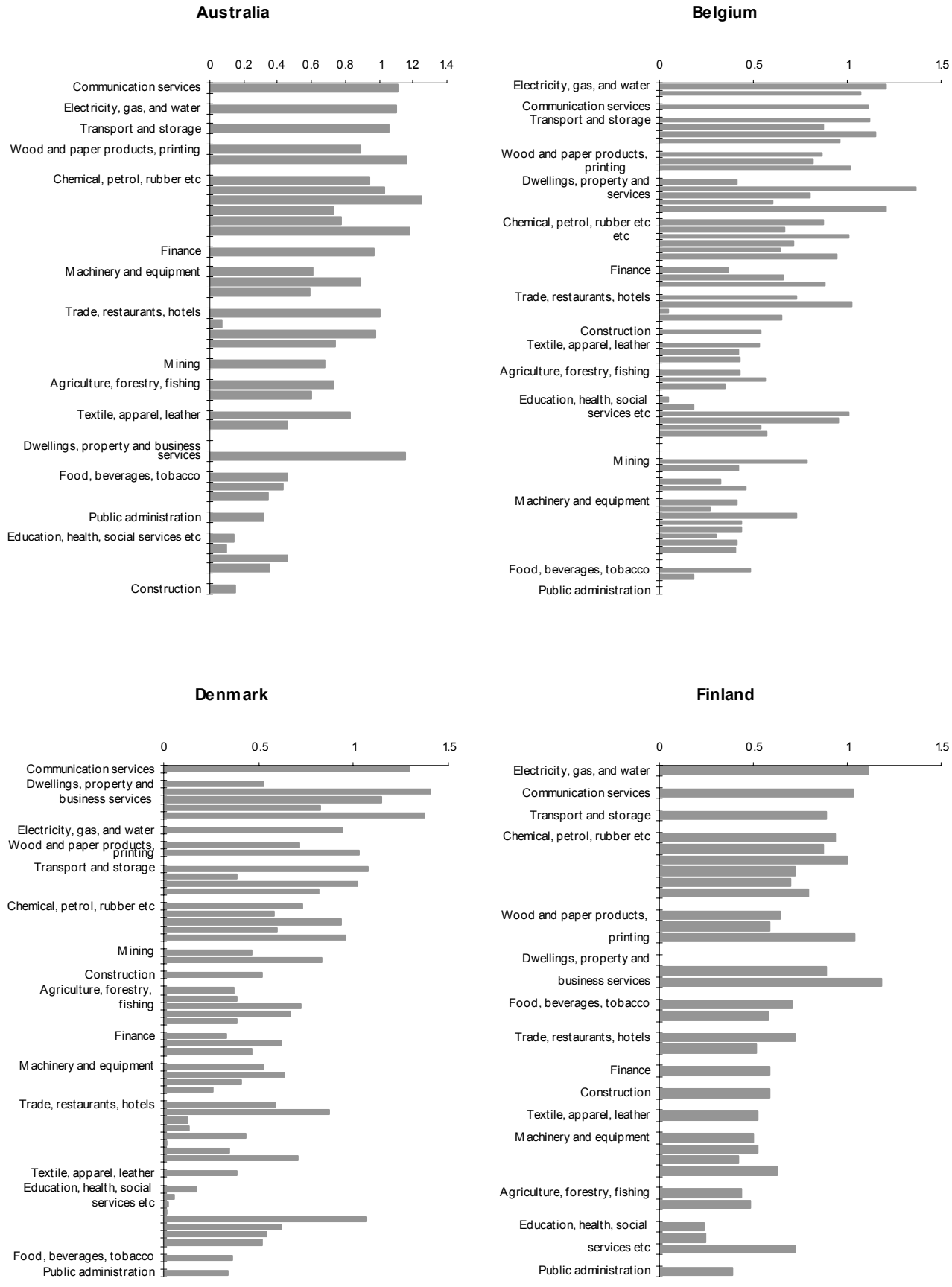
$$x_i = a_{i1}x_1 + a_{i2}x_2 + \ldots + a_{iN}x_N + f_i \qquad (13)$$

and then dividing both sides of (13) by x_i and applying the following entropy formula to the proportions, af_{ij}^{w},

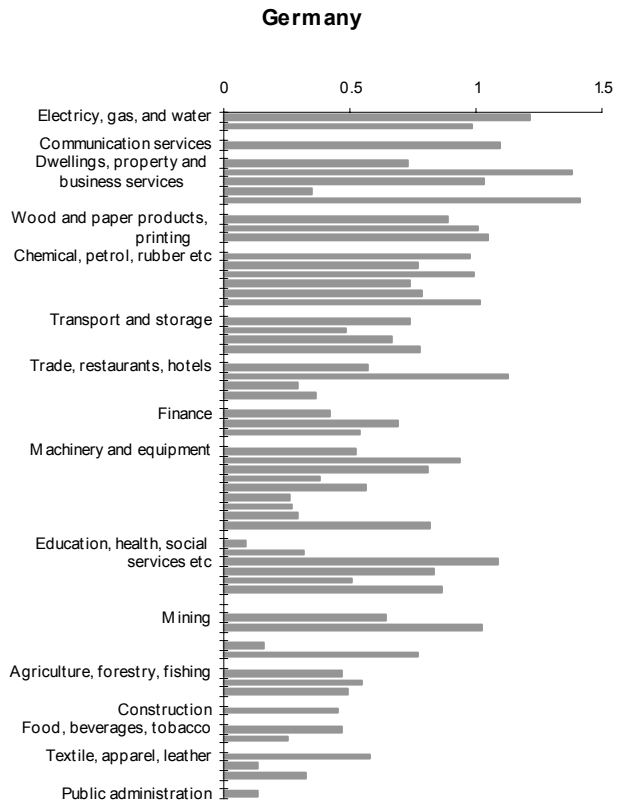
$$H_{.j}(af_{ij}^{w}) = \sum_{j=1}^{N} af_{ij}^{w} \log\left(\frac{1}{af_{ij}^{w}}\right) \qquad (14)$$

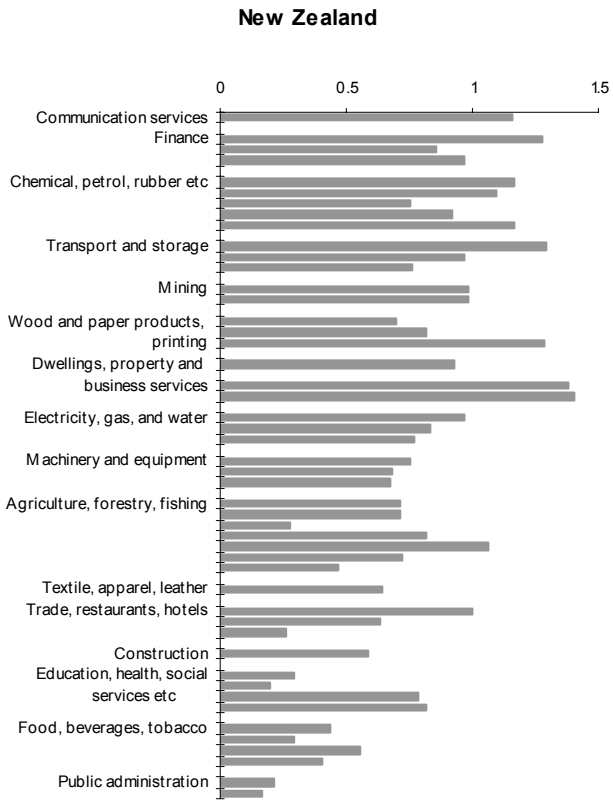
The entropy for total sales flows is plotted in Figure 11. When taking into account intermediate and final sales, communication services; finance; chemical, petrol, rubber etc; and transport and storage have the largest entropy in New Zealand. That is, a large number of households and exporters, for example, will buy additional output from these industries following an increase in these industries' output. Moreover, other industries will also buy additional output from these industries in the form of intermediate products.

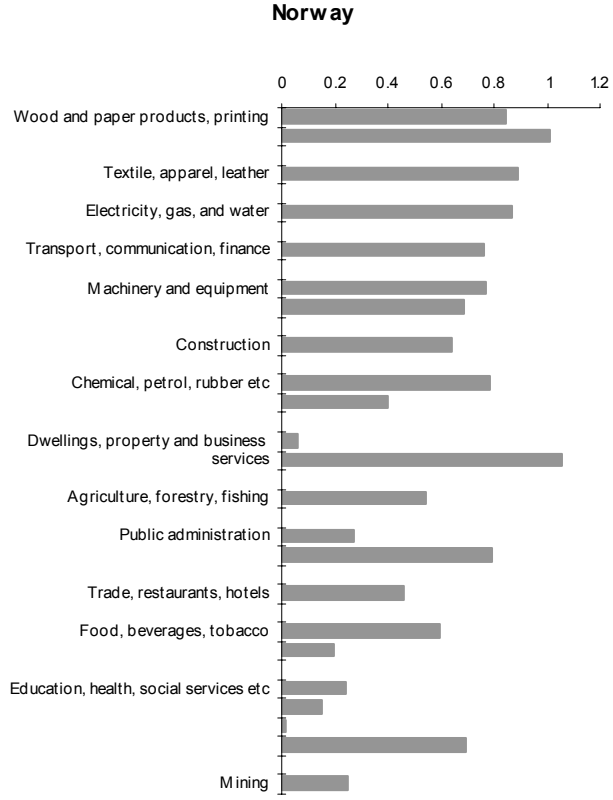
Figure 11: Entropy for total sales flows[21]

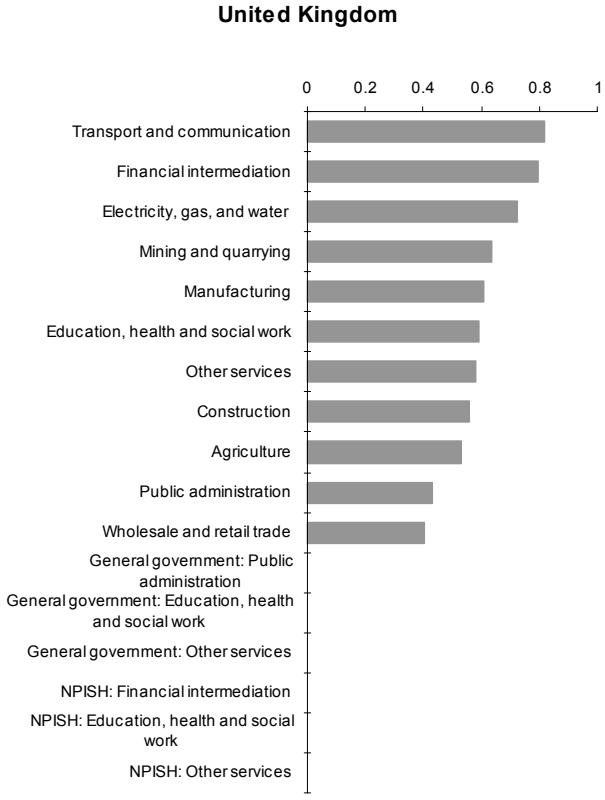


[21] The row entropy for total sales flows could not be calculated for mining in Finland.


Germany
0
0.5
1
1.5
Electricy, gas, and water
Communication services
Dwellings, property and business services
Wood and paper products, printing
Chemical, petrol, rubber etc
Transport and storage
Trade, restaurants, hotels
Finance
Machinery and equipment
Education, health, social services etc
Mining
Agriculture, forestry, fishing
Construction
Food, beverages, tobacco
Textile, apparel, leather
Public administration


New Zealand
0
0.5
1
1.5
Communication services
Finance
Chemical, petrol, rubber etc
Transport and storage
Mining
Wood and paper products, printing
Dwellings, property and business services
Electricity, gas, and water
Machinery and equipment
Agriculture, forestry, fishing
Textile, apparel, leather
Trade, restaurants, hotels
Construction
Education, health, social services etc
Food, beverages, tobacco
Public administration


Norway
0
0.2
0.4
0.6
0.8
1
1.2
Wood and paper products, printing
Textile, apparel, leather
Electricity, gas, and water
Transport, communication, finance
Machinery and equipment
Construction
Chemical, petrol, rubber etc
Dwellings, property and business services
Agriculture, forestry, fishing
Public administration
Trade, restaurants, hotels
Food, beverages, tobacco
Education, health, social services etc
Mining


United Kingdom
0
0.2
0.4
0.6
0.8
1
Transport and communication
Financial intermediation
Electricity, gas, and water
Mining and quarrying
Manufacturing
Education, health and social work
Other services
Construction
Agriculture
Public administration
Wholesale and retail trade
General government: Public administration
General government: Education, health and social work
General government: Other services
NPISH: Financial intermediation
NPISH: Education, health and social work
NPISH: Other services

The entropy for total sales flows is high across all countries for communication services and generally large for chemical, petrol, rubber etc; and transport and storage. The entropy for total sales flows is also high for finance in the United Kingdom. The finding that finance ranks more highly in New Zealand for the total sales entropy than the column entropy supports the hypothesis that finance is more important in terms of lending to industries than for final demand.

The relative importance of electricity, gas, and water is lower in New Zealand compared to other countries. Electricity, gas, and water has the highest entropy for total sales flows in Belgium, Finland and Germany. It ranks second in Australia and third in Denmark, Norway and the United Kingdom. In New Zealand electricity, gas, and water has the eighth largest entropy for total sales flows. A lower degree of inter industry connectedness for this industry is in line with the finding in Black, Guy and McLellan (2003) of a decline in productivity in the electricity, gas, and water over the 1993-2002 period.

4.3 Value added index[22]

To assess the effect of a change in final demand on value added, the value added index can be used. Changes in value added give an indication of the effect on GDP as GDP is the sum of value added and taxes on products. The value added index is measured as follows

$$BV_{.j} = \frac{b^{v}_{.j}}{(1/N)\sum_{j=1}^{N} b^{v}_{.j}} \qquad (15)$$

where $b^{v}_{.j} = \sum_{i=1}^{N} b_{ij} \frac{v_i}{x_i}$ is the input requirement for a unit increase in the final demand for industry j's output, weighted by each industry's ratio of value added v_i to gross output x_i. The value added index can be interpreted as an estimate of the increase in value added that results from higher final demand for industry j's output.

The value added index is plotted in Figure 12. The increase in value added following a rise in final demand in New Zealand is largest for electricity, gas, and water; mining; public administration; dwellings, property and business services; education, health, social services etc; finance; communication services; and trade, restaurants, hotels. These industries are also generally important contributors to value added in the comparator countries. In part, the services industries are high value adding industries across countries because of the high labour component in these industries.

[22] We would like to thank Barry Voice from Statistics New Zealand for suggesting the calculation of this index.

4.4 Value added production multiplier

An alternative measure to assess the effects of a change in final demand on value added, is the value added production multiplier. The value added production multiplier is measured as follows

$$D_{.j} = v_j b^{w}_{.j} \qquad (16)$$

where $b^{w}_{.j} = \sum_{i=1}^{N} b^{w}_{ij}$ is the input requirement for a unit increase in the final demand for sector j's output, weighted by each sector's share in total final demand, and v_j is the share of value added in industry j's output. The sum of value added production multipliers across industries is one. $D_{.j}$ hence shows the direct and indirect contribution of a unit increase in final demand to value added in industry j relative to other industries.

The value added production multiplier weighted by final demand is plotted in Figure 13. The contribution to a unit increase in final demand in New Zealand is largest for trade, restaurants, hotels; construction; public administration; dwellings, property and business services; and education, health, social services etc. The contribution of these industries is also generally large in the other countries.

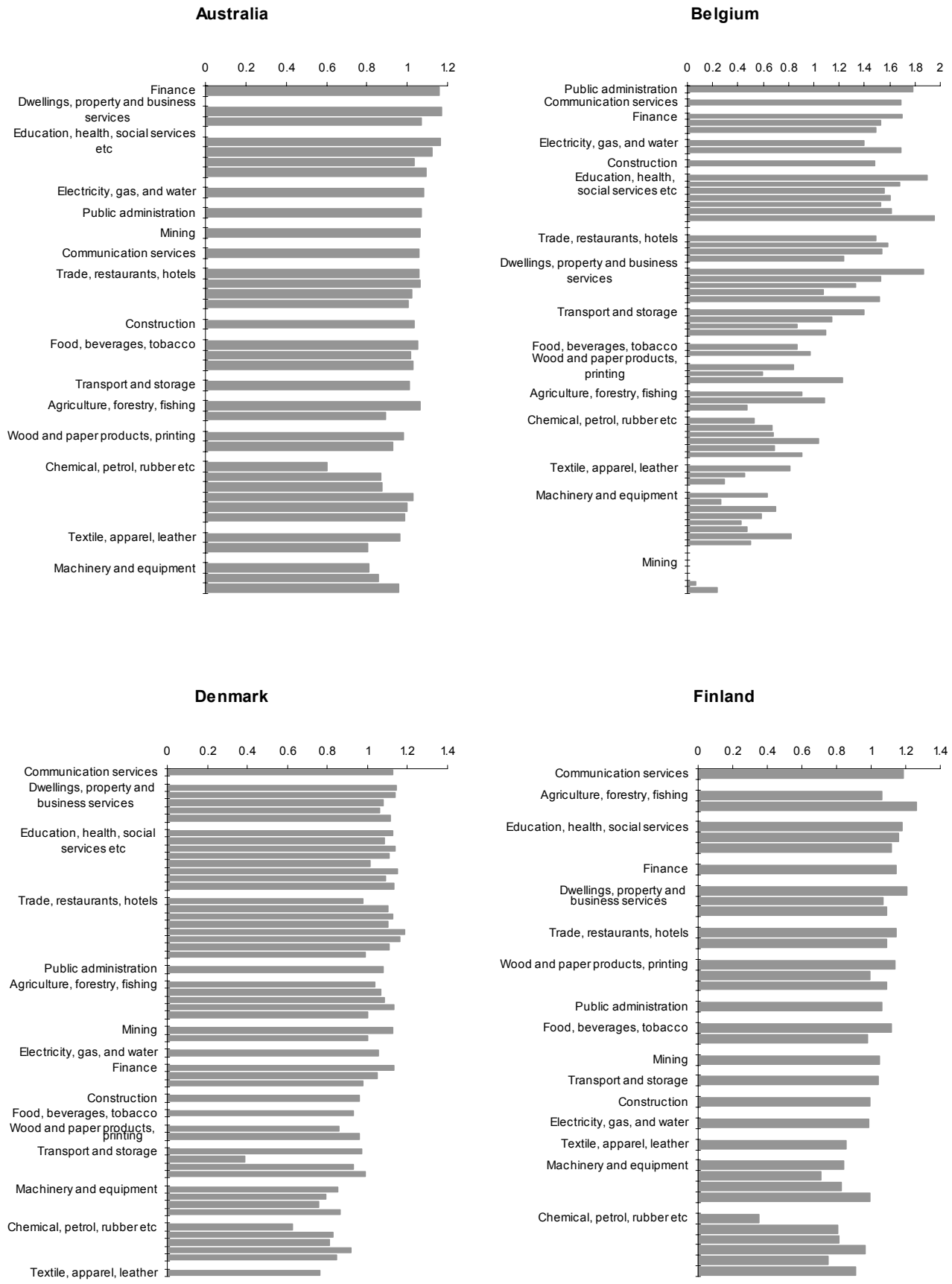
Figure 14 shows the contribution of industries to value added from a unit increase in exports. Weighting by exports increases the relative contribution of transport and storage in all countries, apart for Norway, where it remains the same. The value added production multiplier weighted by exports reveals the main exporting industries in each country. For example, the contribution to value added from exports is largest for mining in Australia and Norway, for wood, paper products, printing in Finland and machinery and equipment; and chemical, petrol, rubber etc in Germany.

Exports appear to be more diversified in New Zealand and Belgium. To measure the spread of the production multiplier we can use the coefficient of variation, which is calculated as follows

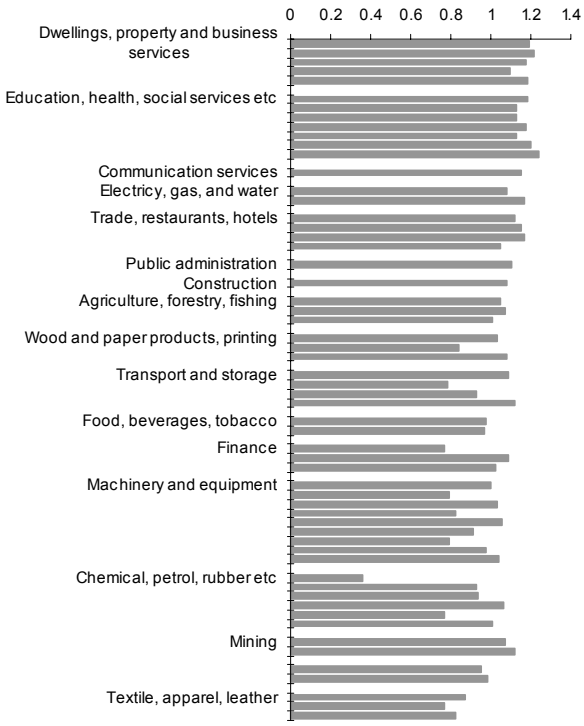
$$\text{coefficient of variation} = \frac{\left[(1/N) \sum_{j=1}^{N} \left[D_{.j} - (1/N) \sum_{j=1}^{N} D_{.j} \right]^2 \right]^{\frac{1}{2}}}{(1/N) \sum_{j=1}^{N} D_{.j}} \qquad (16)$$

The coefficient of variation of the value added production multiplier weighted by exports is 0.003 in New Zealand and 0.004 in Belgium. This compares to 0.007 in Denmark, 0.009 in Finland and Germany, 0.012 in Australia, 0.032 in the United Kingdom and 0.061 in Norway. In Belgium and New Zealand, the contribution to value added from a unit increase in export demand is largest for trade, restaurants, hotels.

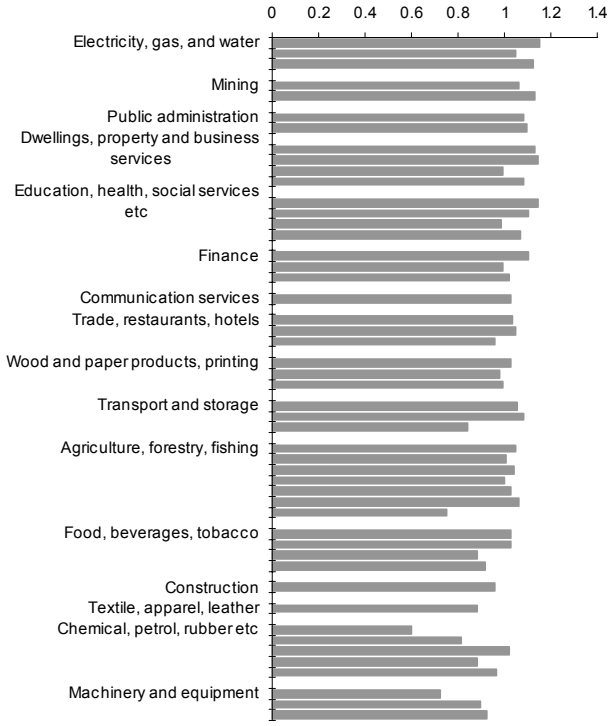
Figure 12: Value added index



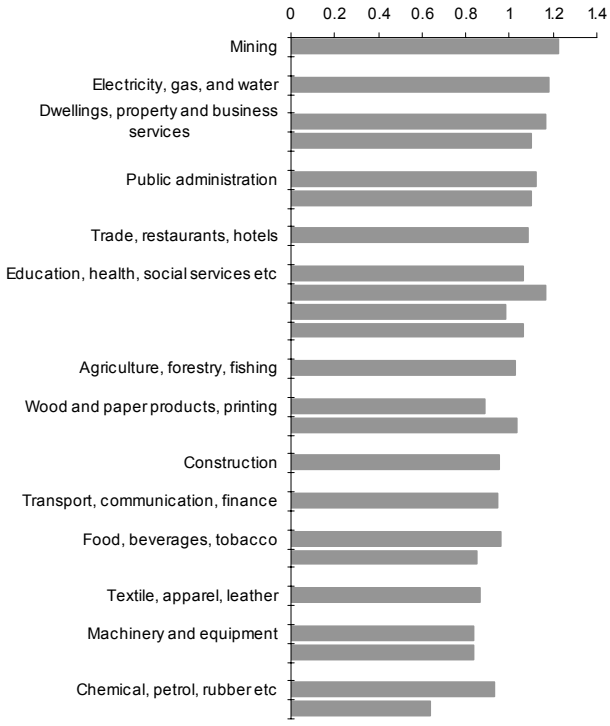
Germany



New Zealand



Norway



United Kingdom

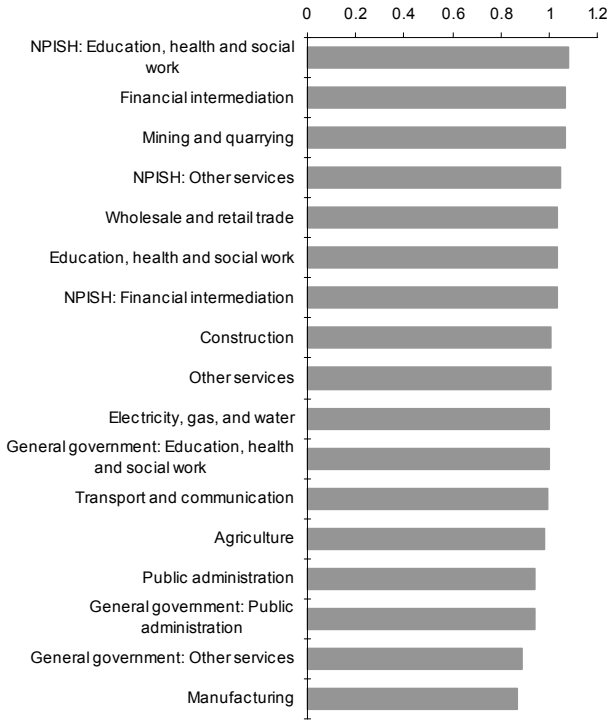
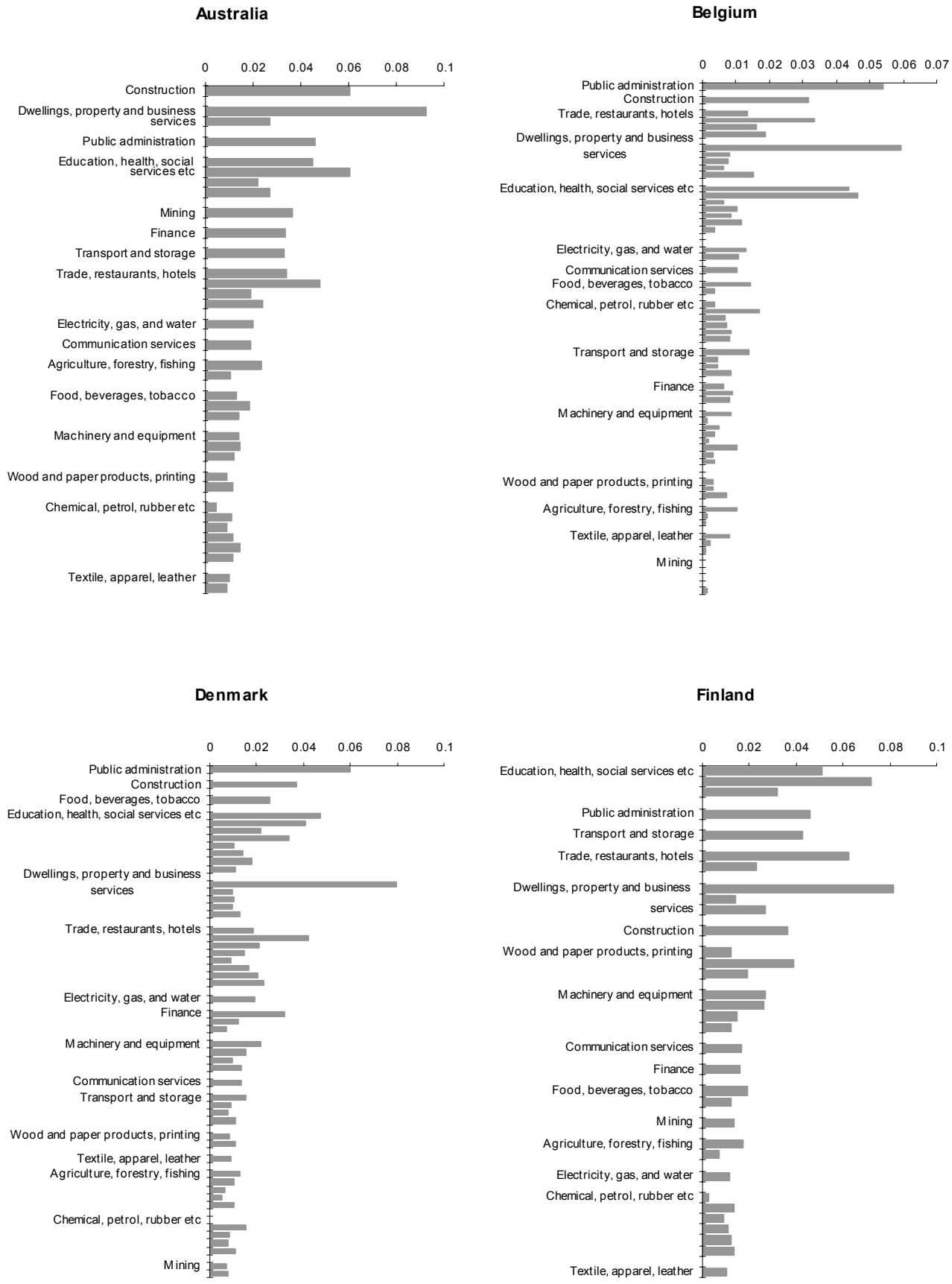
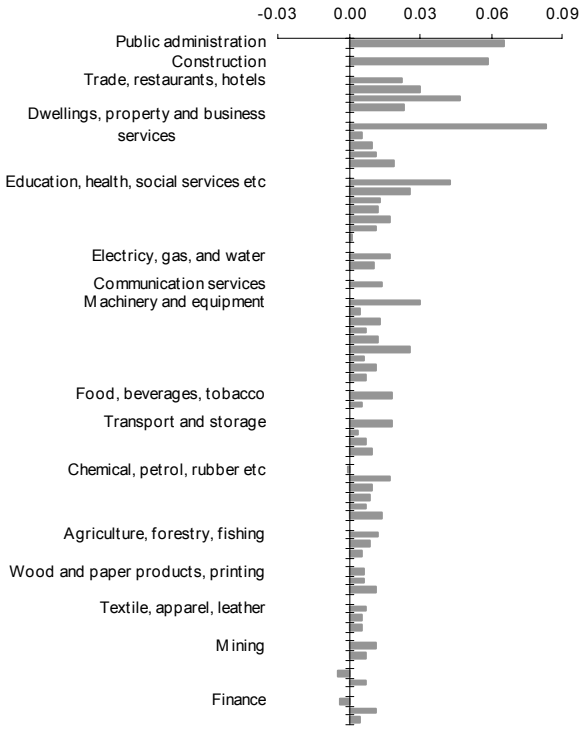


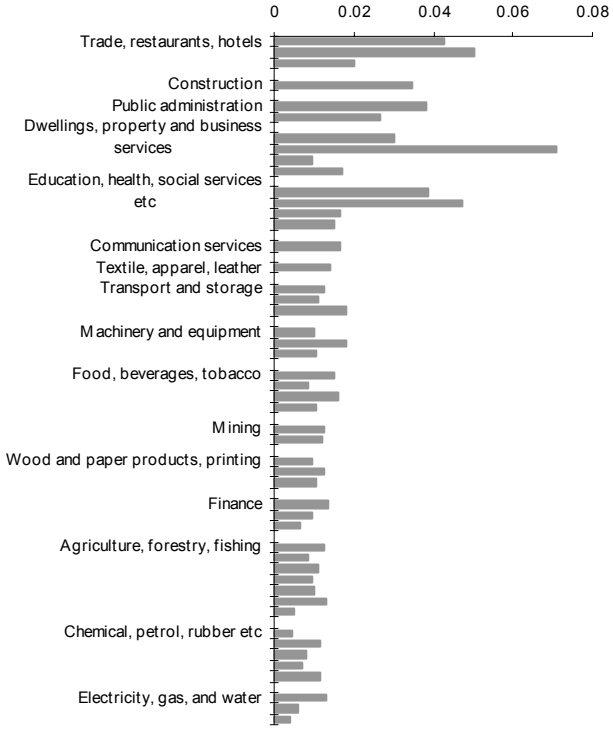
Figure 13: Value added production multiplier (final demand weighted)



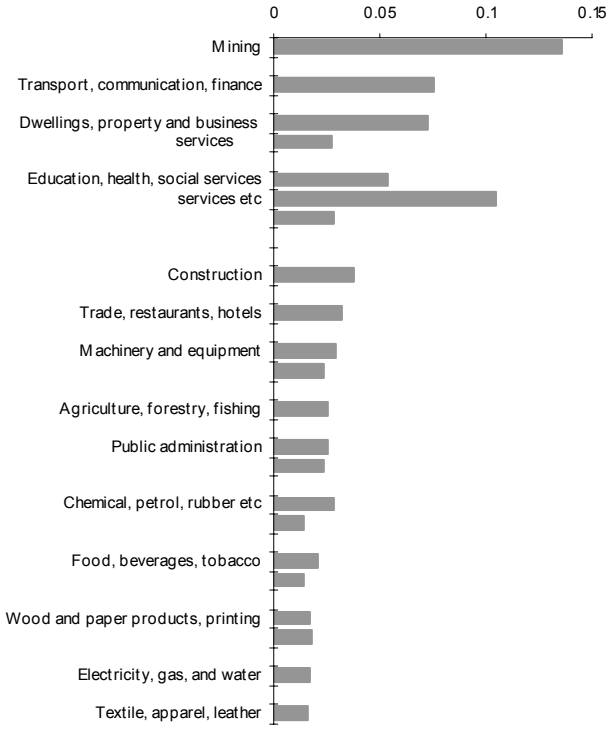
Germany



New Zealand



Norway



United Kingdom

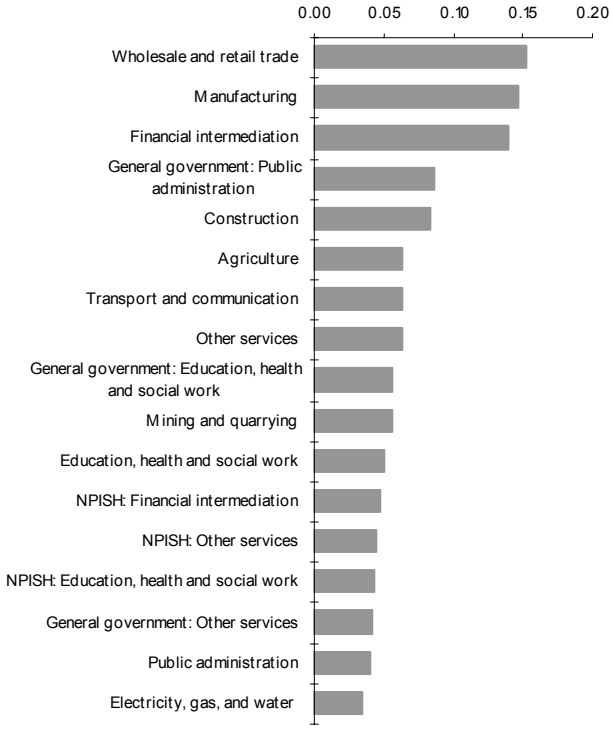
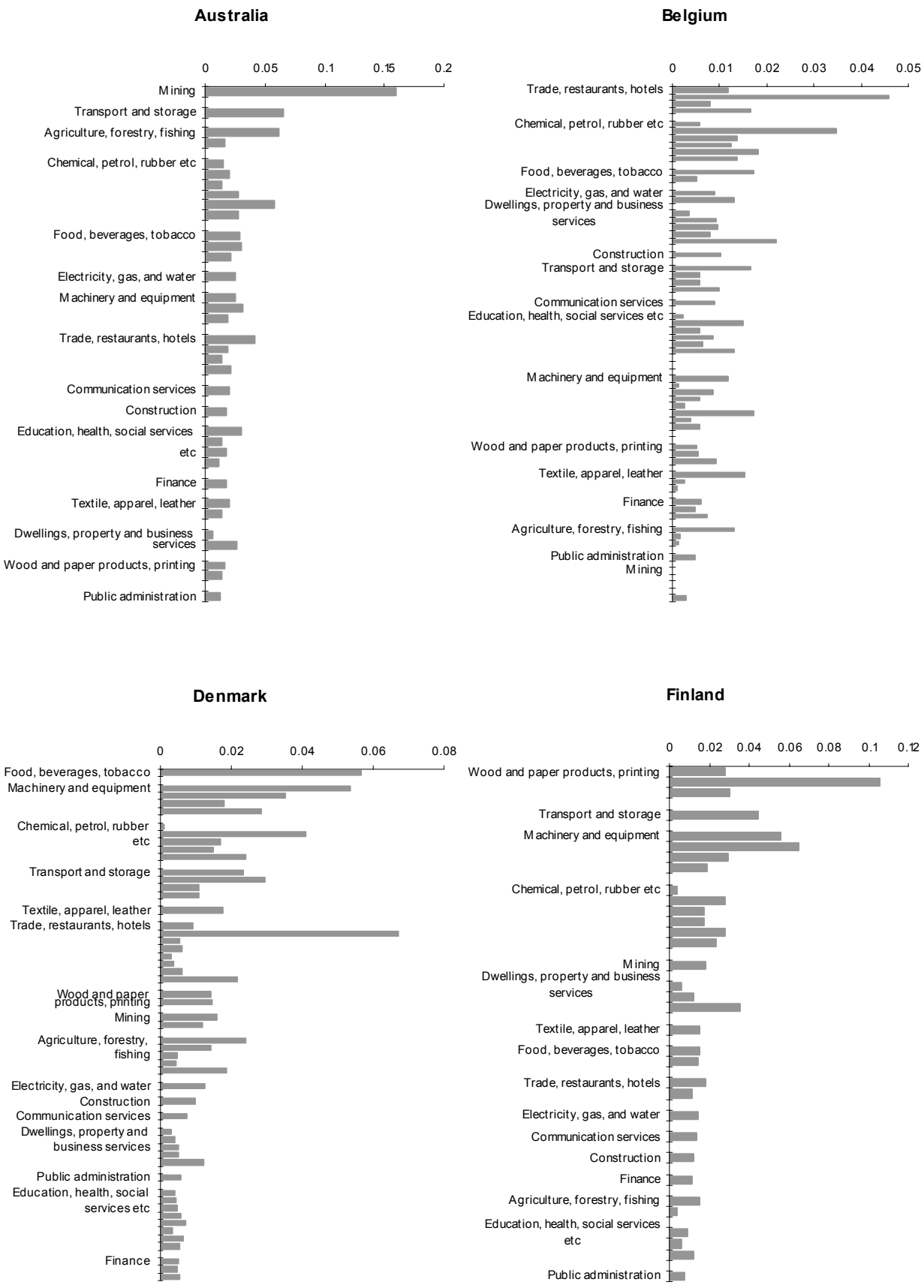
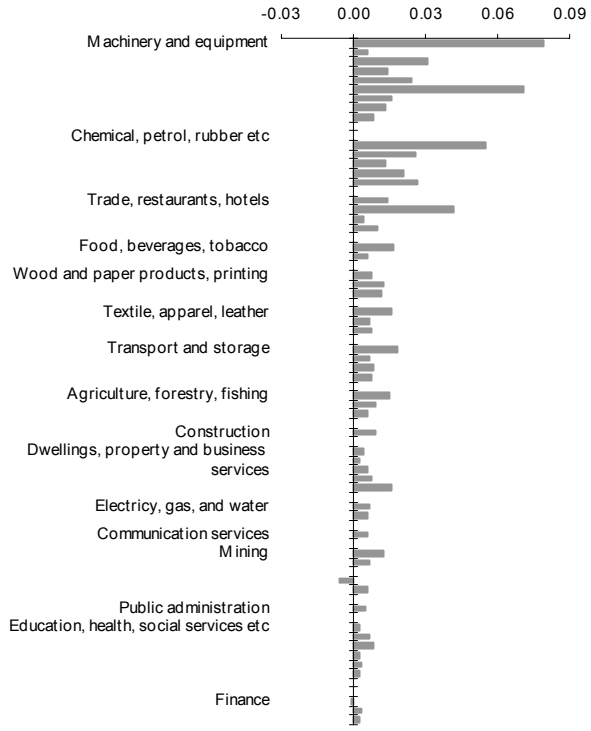


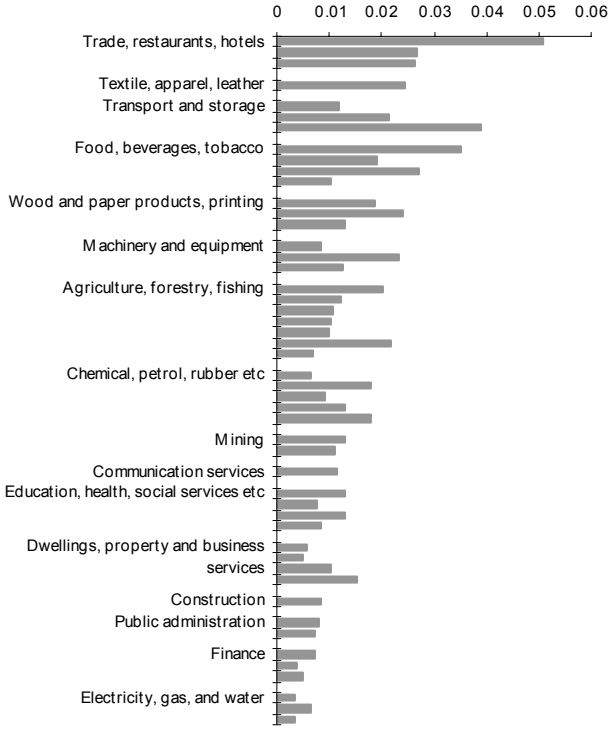
Figure 14: Value added production multiplier (export weighted)



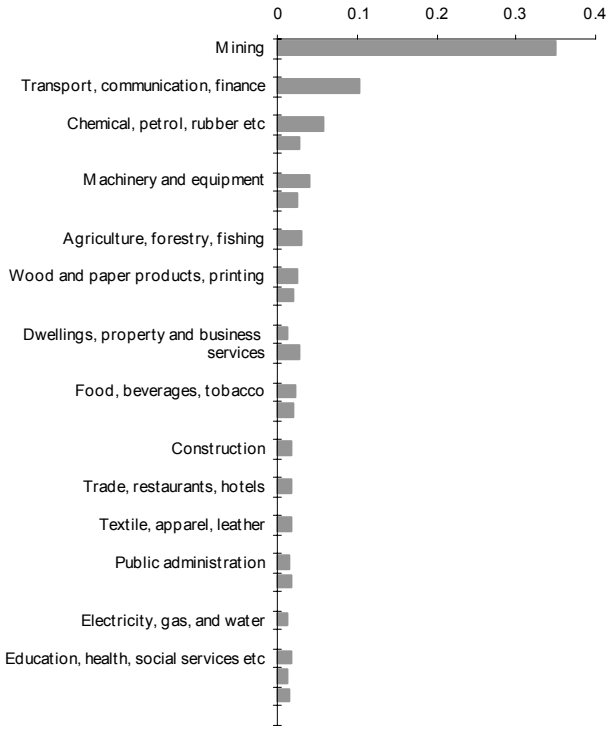
Germany



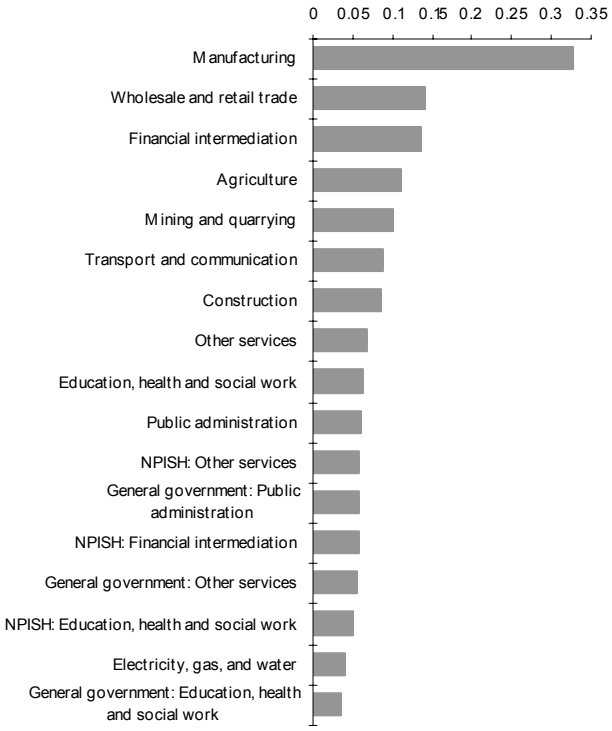
New Zealand



Norway



United Kingdom



4.5 Cumulated primary input coefficient for compensation of employees[23]

Wages and salaries are a large component of value added (Figure 2). To assess the relative importance of industries in terms of their contribution to employment, the cumulated primary input coefficient for compensation of employees can be used. The coefficient measures the effect of an increase in gross output by one industry on wages and salaries for the economy as a whole. It takes into account direct payments by an industry for salaries and wages and indirect payments, i.e. compensation of employees by industries that produce commodities used in that industry. The cumulated primary input coefficient for primary input l of industry j, E_{lj}, is calculated as follows

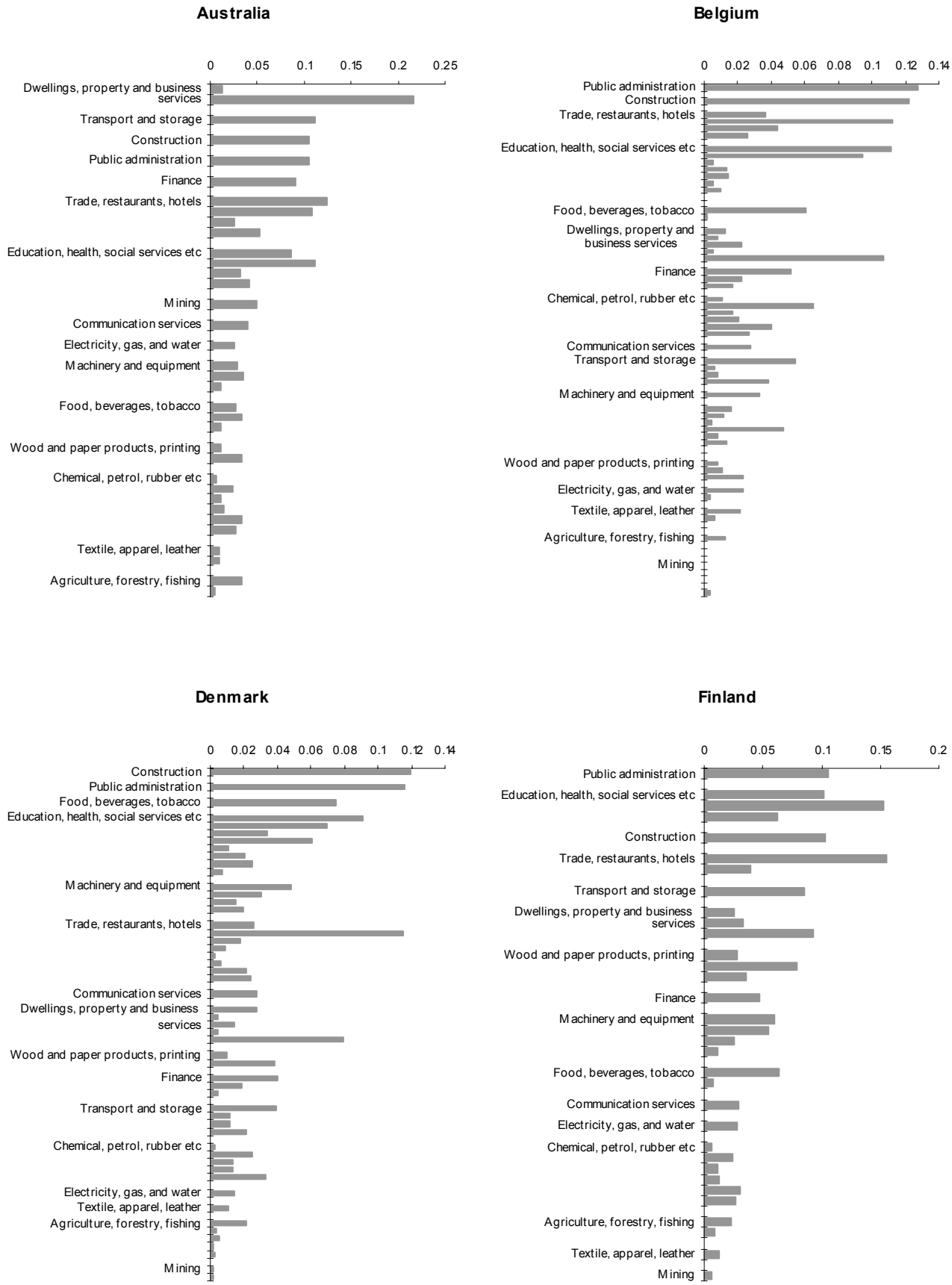
$$E_{lj} = \frac{m_{lj} x_j}{\sum_{j=1}^{N} p_{lj} + \sum_{k=1}^{K} p_{lk}} \qquad (17)$$

where p_{lj} denotes the primary input l absorbed by industry j, p_{lk} is the primary input l absorbed by final demand category k and K denotes the number of final demand categories. $M = [m_{lj}]$ with $M = P^w B$, where $P^w = [p_{lj}^w]$ is the matrix of industries' primary inputs weighted by their total gross output, i.e. $p_{lj}^w = \frac{p_{lj}}{x_j}$.

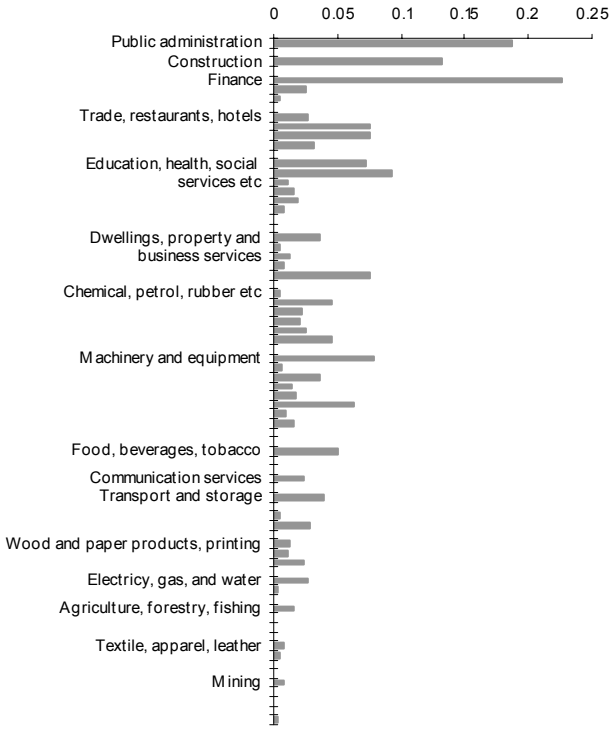
The cumulated primary input coefficient for compensation of employees is shown in Figure 15. In New Zealand, it is largest for construction; trade, restaurants, hotels; education, health, social services etc; public administration; and dwellings, property and business services. The coefficients for these industries ranges between 0.12 (construction) and 0.5 (dwelling, property and business services); that is, given the existing production structure, doubling gross output of construction would increase compensation of employees for the whole economy by 12 percent. The coefficient for compensation of employees for construction; trade, restaurants, hotels; education, health, social services etc; public administration; and dwellings, property and business services is also generally large in the other countries. The contribution of agriculture, forestry, fishing is relatively low in all countries.

[23] See Statistics New Zealand (1989) for more details on cumulated primary input coefficients.

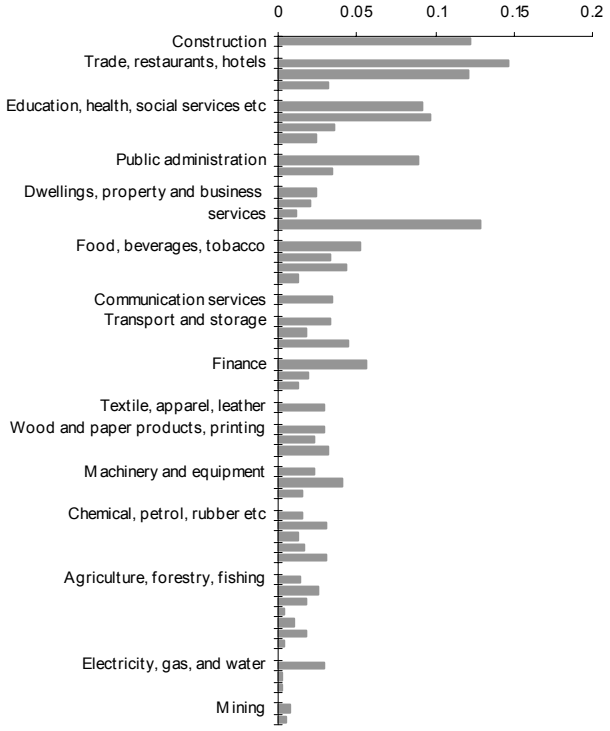
Figure 15: Cumulated primary input coefficients of industries for compensation of employees



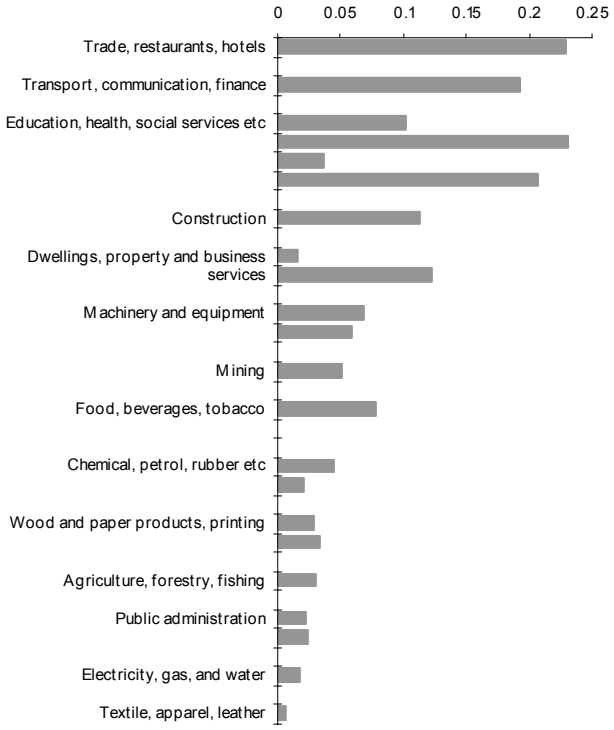
Germany



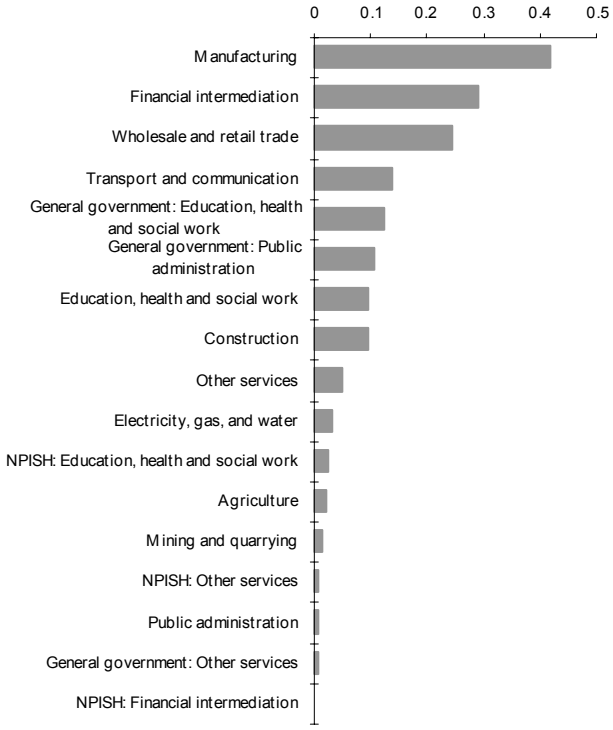
New Zealand



Norway



United Kingdom



4.6 Import content of exports, gross fixed capital formation and consumption[24]

GDP at market prices can be calculated as the sum of total use in purchasers' prices of final demand less total economy imports. Thus, all else equal, an increase in imports leads to a decline in GDP. To assess the import content of final demand output, the cumulated primary input coefficient for final demand categories can be used. The coefficient shows the contribution of primary inputs to consumption, exports, gross fixed capital formation and changes in inventories taking into account direct and indirect costs of primary inputs by all industries and the ultimate disposition of commodities produced.[25] The matrix of cumulated primary input coefficients for categories of final demand Y is calculated as follows

$$Y = MQ^w + S^w \qquad (18)$$

where $Q^w = [q_{ik}^w]$ with $q_{ik}^w = \frac{q_{ik}}{\sum_{i=1}^{N} q_{ik} + \sum_{l=1}^{L} s_{lk}}$ is industry i's weighted output absorbed by final demand category k, $S^w = [s_{lk}^w]$ with $s_{lk}^w = \frac{s_{lk}}{\sum_{i=1}^{N} q_{ik} + \sum_{l=1}^{L} s_{lk}}$ is the weighted primary input l absorbed by final demand category k, where L denotes the number of primary input categories.

Cumulated primary input coefficients for final demand categories across primary inputs sum to one. The coefficients hence show the contribution of primary inputs to the cost of producing final demand output. The cumulated primary input coefficients for exports, consumption and gross fixed capital formation are plotted in Figures 16 to 18. Primary inputs are divided into components of value added (i.e. compensation of employees, employers' social contributions, gross operating surplus and mixed income and other taxes less subsidies on production), imports and other primary inputs.

The cumulated primary input coefficient for exports, plotted in Figure 16, shows large differences in the import content of exports across countries. Belgium, which has the largest share of exports in total supply (25.5 percent, Figure 1), also has the highest import content in exports (58.3 percent). Australia's exports, whose share in total supply is smallest (10.3 percent), has the lowest import content (16 percent). A high import content in Belgium means that exports are contributing proportionally less to value added, 0.409 per unit of value added, compared to Australia, 0.8 per unit of value added. The export share in gross output in New Zealand is also relatively low (14.1 percent), but the contribution to value added is high (76.1 percent). The contribution of a unit of exports to value added in New Zealand is comparable to that in the United Kingdom.

[24] See Statistics New Zealand (1989) for more details on cumulated primary input coefficients for categories of final demand.

[25] The exact categories of primary inputs for each country are listed in Table A3 in the appendix.

Figure 16: Cumulated primary input coefficient for exports

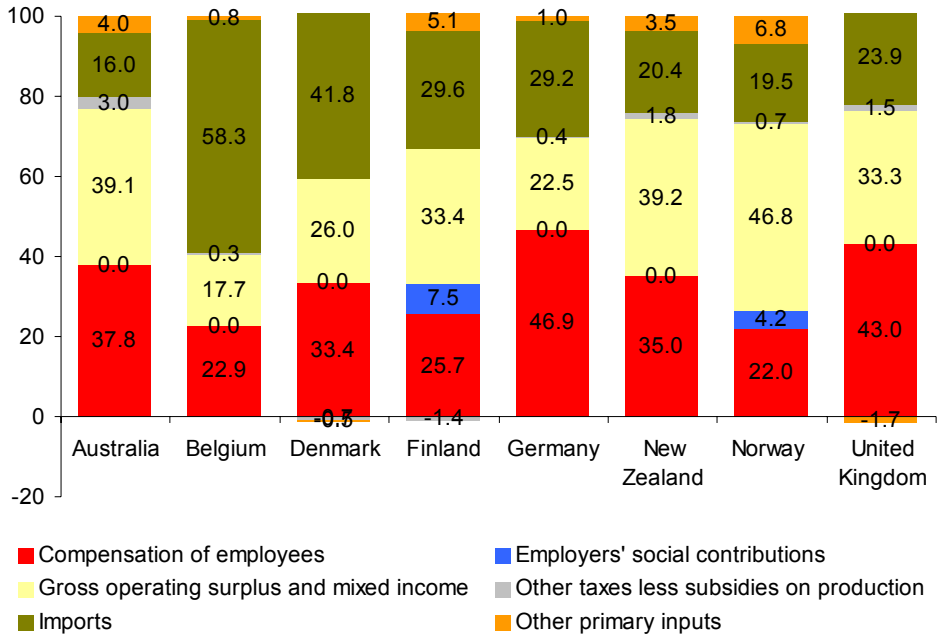
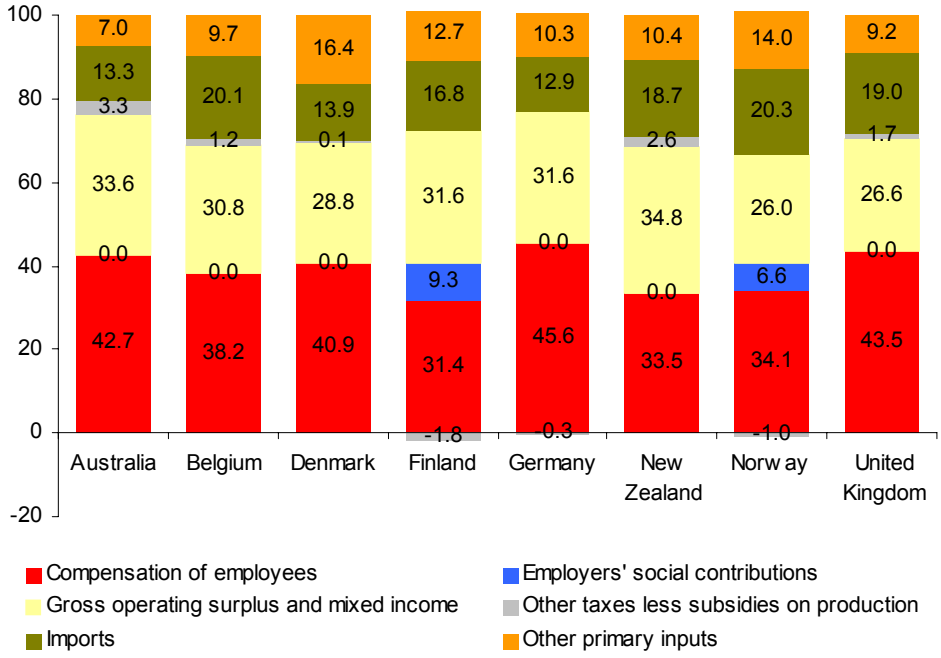


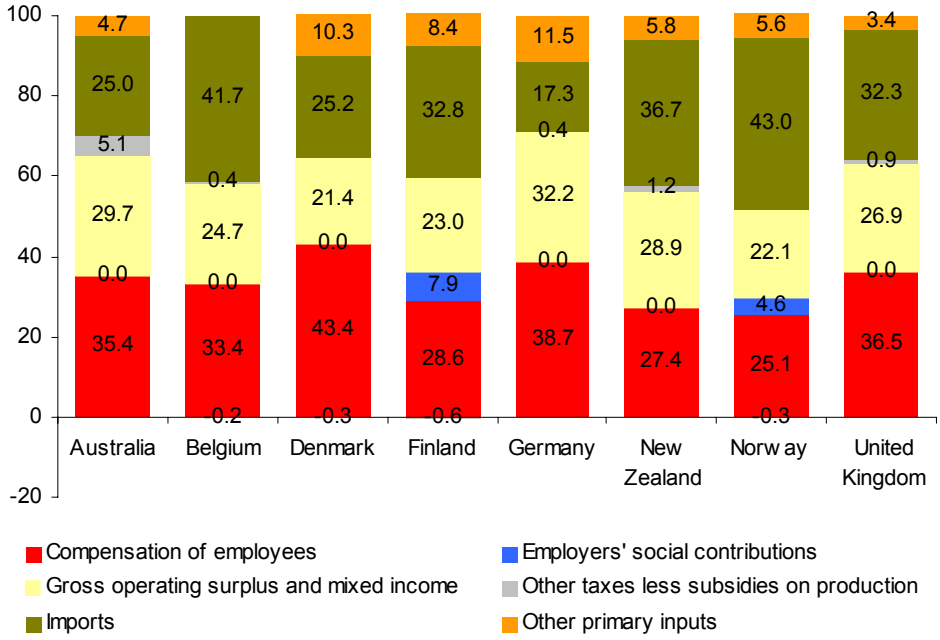
Figure 17: Cumulated primary input coefficients for consumption



The contribution of a unit of consumption of goods and services to value added in New Zealand is comparable to that in Belgium, Denmark, Finland and the United Kingdom, around 70-72 percent (Figure 17). The import content, at 18.7 percent, is similar to that in the United Kingdom (19 percent).

The import content of gross fixed capital formation, plotted in Figure 18, is highest in Norway, at 43 percent, followed by Belgium (41.7 percent) and New Zealand (36.7 percent). A large import content of gross fixed capital formation is suggestive of a high degree of acquisition and diffusion of foreign technology in these countries.

Figure 18: Cumulated primary input coefficients for gross fixed capital formation



5 Summary and conclusions

This paper has examined New Zealand's industrial structure relative to that in other OECD countries using input output analysis. Comparator countries included Australia, Belgium, Denmark, Finland, Germany, Norway and the United Kingdom. Backward and forward linkages, indices of industry interconnectedness, a value added index, a value added production multiplier, a cumulated primary input coefficient for compensation of employees and a measure of import content of final demand output were calculated.

The analysis suggests that New Zealand's industrial structure is broadly similar to that in other OECD countries. Some differences arise as certain industries are more important in some countries. For example, the contribution to value added from exports is large for mining in Australia and Norway, for wood, paper products, printing in Finland and machinery and equipment; and chemical, petrol, rubber etc in Germany. New Zealand's (and Belgium's) exports appear to be more diversified.

The share of exports in total supply is lower in Australia, New Zealand and the United Kingdom, but the value added of these countries' exports is higher than in economies with a relatively large share of exports in total supply. The main reason for this larger contribution to value added in Australia, New Zealand and the United Kingdom is a lower import content of exports. This suggests that looking at exports as a share of total supply or as a share of GDP only to assess the importance of exports for economic growth can be misleading.

Finally, the share of gross operating surplus in value added is high in New Zealand and the proportion of compensation employees is low, indicating a high rate of return to capital relative to labour. This probably warrants further investigation.

References

Black, M, M Guy and N McLellan (2003) "Productivity in New Zealand 1988 to 2002." *New Zealand Treasury Working Paper* 03/06.

Chatterjee, S (1989) "Policy conflicts in economic restructuring: A New Zealand case study in input-output framework." *Massey Economic Papers*.

Claus, I (2003) "Changes in New Zealand's production structure: An input output analysis." *New Zealand Treasury Working Paper* 03/01.

Dixon, R (1996) "Inter-industry transactions and input-output analysis." *Australian Economic Review* 115(3rd quarter): 327-336.

Hirschman, A O (1958) *The strategy of economic development*: Yale University Press.

Morimoto, Y (1970) "On aggregation problems in input-output analysis." *Review of Economic Studies* 37: 119-126.

Rasmussen, P N (1956) *Studies in inter-sectoral relations*: North-Holland.

Soofi, A (1992) "Industry linkages, indices of variation and structure of production: An international comparison." *Economic Systems Research* 4(4): 349-375.

Statistics New Zealand (1989) *Inter-industry study of the New Zealand Economy 1981-82*: Statistics New Zealand.

Statistics New Zealand (2003) "Regional input-output study: Methodological review." http://www.stats.govt.nz/domino/external/web/Aboutsnz.nsf/htmldocs/Regional+Input-Output+Methodology+Study.

Theil, H (1971) *Principles of econometrics*: John Wiley & Sons, Inc.

United Nations (1993) "Supply and use tables and input-output." *System of National Accounts 1993*.

Appendix

Table A1: Categories of final demand

Australia	Belgium	Denmark	Finland	Germany	Netherlands	New Zealand	Norway	United Kingdom
	Financial intermediation services indirectly measured	Financial intermediation services indirectly measured	Financial intermediation services indirectly measured				Financial intermediation services indirectly measured	Financial intermediation services indirectly measured
Final consumption expenditure	Final consumption expenditure	Final consumption expenditure	Final consumption expenditure	Final consumption expenditure	Final consumption expenditure	Final consumption expenditure	Final consumption expenditure	Final consumption expenditure
Households	Households	Private consumption	Households	Households	Households	Households	Households	Households
	Non-profit institutions serving households	Individual non-market government consumption	Non-profit institutions	Non-profit institutions	Non-profit institutions serving households	Private non-profit institutions serving households		Private non-profit institutions serving households
					Resident households in the rest of the world			
Government	Government	Collective government consumption	Government	Government	Government	Central Government	Government	General government
						Local Government		

Belgium	Denmark	Finland	Germany	Netherlands	New Zealand	Norway	United Kingdom
Gross capital formation	Gross capital formation	Gross capital formation	Gross capital formation	Gross capital formation	Gross capital formation	Gross capital formation	Gross capital formation
Gross fixed capital formation	Gross fixed capital formation	Gross fixed capital formation	Gross fixed capital formation	Gross fixed capital formation	Gross fixed capital formation	Gross fixed capital formation	Gross fixed capital formation
			Buildings				Valuables
Changes in inventories	Changes in stocks	Changes in inventories	Change in inventories	Changes in inventories	Change in inventories	Change in inventories	Changes in inventories
Exports	Exports	Exports	Exports	Exports	Exports	Exports	Exports
				Trade and transport margins			
				Paid minus imputed value added tax and consumption of imputed bank services			

Table A2: Categories of value added

Australia	Belgium	Denmark	Finland	Germany	Netherlands	New Zealand	Norway	United Kingdom
Compensation of employees	Wages and salaries	Compensation of employees (empty at constant prices)	Wages and salaries	Compensation of employees	Wages and salaries	Compensation of employees	Wages and salaries	Compensation of employees
			Employers' social contributions		Employers' social contributions		Employers' social contribution	
Gross operating surplus and mixed income	Net operating surplus	Gross operating surplus and mixed income	Operating surplus/mixed income	Gross operating surplus	Gross operating surplus	Operating surplus	Gross operating surplus	Gross operating surplus
	Consumption of fixed capital		Consumption of fixed capital			Consumption of fixed capital		
Other taxes less subsidies on production	Other taxes less other subsidies	Other production taxes net (empty at constant prices)	Other taxes on production less subsidies	Other taxes on production less subsidies	Other taxes on production	Other taxes on production	Other taxes on production, net	Taxes less subsidies on production

Table A3: Industry categories

No.	Categories	Australia	Belgium	Denmark	Finland	Germany	New Zealand	Norway	United Kingdom
1	Agriculture, forestry, fishing	Agriculture, hunting and trapping Forestry and fishing	Farming and livestock Forest products Fishing	Agriculture Horticulture, orchards etc. Agricultural services, landscape gardeners etc. Forestry Fishing	Agriculture, hunting and fishing Forestry, logging and related service activities	Agriculture and hunting Forestry products and related services Fishing	Horticulture and fruit growing Livestock and cropping farming Dairy cattle farming Other farming Services to agriculture, hunting and trapping Forestry and logging Fishing	Agriculture, forestry, fishing	Agriculture

No.	Categories	Australia	Belgium	Denmark	Finland	Germany	New Zealand	Norway	United Kingdom
2	Mining	Mining	Coal, lignite and peat Natural hydrocarbons Uranium ores Metal ores Other mining products	Extraction of crude petroleum, natural gas etc. Extraction of gravel, clay, stone and salt etc.	Mining and quarrying	Coal and peat Oil, gas and related services Uranium and thorium Metal ores Other mining and quarrying	Mining and quarrying Oil and gas exploration and extraction	Mining, quarrying, oil and gas extraction	Mining and quarrying
3	Food, beverages, tobacco	Meat and dairy products Other food products Beverages and tobacco products	Food products Tobacco manufacturing	Manufacture of food, beverages and tobacco	Manufacture of food products Manufacture of beverages and tobacco products	Food and feed products, beverages Tobacco products	Meat and meat product manufacturing Dairy product manufacturing Other food manufacturing Beverage, malt and tobacco manufacturing	Food products and beverages Tobacco	Manufacturing

No.	Categories	Australia	Belgium	Denmark	Finland	Germany	New Zealand	Norway	United Kingdom
4	Textile, apparel, leather	Textiles	Manufacture of textiles	Manufacture of textiles, wearing apparal, leather	Manufacture of textiles, wearing apparel and leather	Textile	Textile and apparel manufacturing	Textiles, wearing apparel, leather	
		Clothing and footwear	Manufacture of wearing apparel			Apparel			
			Leather, luggage, footware			Leather and leather products			
5	Wood and paper products, printing	Wood and wood products	Wood products	Manufacture of wood and wood products	Manufacture of wood and wood products	Wood, wood, cork and wicker-work products (excluding furniture)	Wood product manufacturing	Wood, paper and paper products	
		Paper, printing and publishing	Paper and cardboard	Manufacture of paper products, printing and publication	Manufacture of pulp, paper and paper products	Paper, cardboard and paper and cardboard products	Paper and paper product manufacturing		
			Publishing, printing or reproduction products		Publishing and printing	Printing, publishing and recorded media	Printing, publishing and recorded media	Publishing, printing, reproduction	

No.	Categories	Australia	Belgium	Denmark	Finland	Germany	New Zealand	Norway	United Kingdom
6	Chemical, petrol, rubber etc.	Petroleum and coal products	Energy products	Manufacture of refined petroleum products etc.	Manufacture of refined petroleum products, coke	Coke and mineral oil products	Petroleum and industrial chemical manufacturing	Refined petroleum, chemical and mineral products	
		Chemicals	Chemical products	Manufacture of chemicals and man-made fibres etc.	Manufacture of chemicals and chemical products	Chemical products			
		Rubber and plastic products	Rubber and plastic products	Manufacture of rubber and plastic products	Manufacture of rubber and plastic products	Rubber and plastic products	Rubber, plastic and other chemical product manufacturing		
		Non-metallic mineral products	Other non-metallic mineral products	Manufacture of other non-metallic mineral products	Manufacture of other non-metallic mineral products	Glass, ceramic and non-metallic mineral products	Non-metallic mineral product manufacturing		
		Basic metals and products	Metallurgical products	Manufacture and processing of basic metals	Manufacture of basic metals	Metals and semi-finished metal products	Basic metal manufacturing	Basic metals	
		Fabricated metal products	Manufacture of fabricated metal product		Manufacture of fabricated metal product	Metal products	Structural, sheet and fabricated metal product manufacturing		

No.	Categories	Australia	Belgium	Denmark	Finland	Germany	New Zealand	Norway	United Kingdom
7	Machinery and equipment	Transport equipment	Machinery and equipment	Manufacture of machinery and equipment n.e.c.	Manufacture of machinery and equipment n.e.c.	Machinery	Transport equipment manufacturing	Machinery and equipment n.e.c	
		Other machinery and equipment	Office and data processing machinery	Manufacture of electrical and optical equipment	Manufacture of electrical and optical equipment	Office machinery, data processing machinery and equipment	Machinery and equipment manufacturing	Building of ships and oil platforms, other manufacturing	
		Miscellaneous manufacturing	Electronic machinery and appliances	Manufacture of transport equipment	Manufacture of transport equipment	Electricity generation and transmission equipment, etc.	Furniture and other manufacturing		
			Radio, television and communication equipment	Manufacture of furniture, manufacturing n.e.c.	Manufacturing n.e.c. and recycling	Communication and radio equipment, televisions, electronic components			
			Medicinal, measuring, control and optical instruments, clocks and watches			Manufacture of medicinal, measuring, control and optical products, clocks and watches			
			Motor vehicles and parts			Motor vehicles and parts			
			Other transport materials			Other vehicles (water transport, rail, aviation etc.)			

No.	Categories	Australia	Belgium	Denmark	Finland	Germany	New Zealand	Norway	United Kingdom
			Furniture and other industries' products			Furniture, jewellery, musical instruments, sports equipment, toys, etc.			
			Salvage services			Secondary raw materials			
8	Electricity, gas and water	Electricity, gas and water	Electricity, gas and heat	Electricity, gas and water supply	Electricity, gas and water supply	Energy (electricity, gas) and energy supply services	Electricity generation and supply	Electricity, gas and water supply	Electricity, gas and water supply
			Water distribution			Water and water supply services	Gas supply		
							Water supply		
9	Construction	Construction	Construction	Construction	Construction	Construction	Construction	Construction	Construction

No.	Categories	Australia	Belgium	Denmark	Finland	Germany	New Zealand	Norway	United Kingdom
10	Trade, restaurants, hotels	Wholesale trade Retail trade Repairs	Automobile sales and repairs Wholesale trade and related services Retail sales and repairs of consumer goods	Sale and repair of motor vehicles etc. Wholesale and commission trade excluding motor vehicles Retail trade of food etc. Department stores Retail sale of pharmaceutical goods, cosmetic, art etc. Retail sale of clothing, footwear etc. Other retail sale, repair work	Wholesale and retail trade	Motor vehicles sales, services and repairs, petrol Wholesale trade Retail sales and repairs of consumer goods	Wholesale trade Retail trade	Wholesale and retail trade, hotels and restaurants	Wholesale and retail trade
		Accommoda-tion, cafes and restaurants	Hotel and restaurant services	Hotels and restaurants	Hotels and restaurants	Bars, clubs, cafes and restaurants, accomodation	Accommoda-tion, restaurants and bars		

No.	Categories	Australia	Belgium	Denmark	Finland	Germany	New Zealand	Norway	United Kingdom
11	Transport and storage	Transport and storage	Land transport Water transport Air transport Services to transport	Land transport, transport via pipelines Water transport Air transport Support transport activities, travel agencies	Transport and storage	Land freight and passenger transport Water transport Air transport Services to transport	Road transport Water and rail transport Air transport, services to transport and storage	Transport, post, telecommunication, financial intermediation	Transport and communication
12	Communication services	Communication services	Post and telecommunication services	Post and telecommunications	Post and telecommunications	Communication services	Communication services		
13	Finance	Finance and insurance	Financial intermediation Insurance Services to finance and insurance	Financial intermediation Insurance and pension funding Activities auxiliary to financial intermediation	Financial intermediation and insurance	Financial institutions Insurance (excluding social insurance) Services to financial institutions and insurance	Finance Insurance Services to finance and insurance		Financial intermediation Non-profit institutions serving households: Financial intermediation

No.	Categories	Australia	Belgium	Denmark	Finland	Germany	New Zealand	Norway	United Kingdom
14	Dwellings, property and business services	Ownership of dwellings	Real estate	Real estate activities	Letting and operation of dwellings	Real estate and rental	Real estate	Own final use	
		Property and business services	Ownership of owner-occupied dwellings	Renting of machinery and equipment etc.	Other real estate activities	Other rental	Ownership of owner-occupied dwellings	Real estate, renting and business activities	
			Computer services	Computer and related activities	Business activities	Computer services	Equipment hire and investors in other property		
			Research and development Business administrative and management services	Research and development Consultancy etc. and cleaning activities		Research and development Business administrative and management services	Business services		
15	Public administration	Government administration	Public administration services	Public administration etc.	Administration, compulsory social security	Public administration, defence, social insurance	Central government administration, defence, public order and safety services	Central government	Public administration
							Local government administration services and civil defence	Local government	General government: Public administration
									General government: Education, health and social work

No.	Categories	Australia	Belgium	Denmark	Finland	Germany	New Zealand	Norway	United Kingdom
16	Education, health, social services etc.	Education	Education	Education	Education	Education	Education	Education	Education, health and social work
		Health and community services	Health and social work Services by community organisations	Health care activities Social institutions etc. for children Social institutions etc. for adults	Health and social work Other community, social and personal services	Health, veterinary and social services	Health and community services	Other private and personal services	Non-profit institutions serving households: Education, health and social work
		Cultural and recreational services	Recreational, cultural, sporting activities	Recreational, cultural, sporting activities		Cultural, recreational and entertainment services	Cultural and recreational services		Other services
		Personal and other services	Cleaning, waste collection and management Personal services	Sewage and refuse disposal and similar activities Activities of membership organisation n.e.c.		Waste disposal, sewerage and drainage services etc. Interest groups, churches etc.	Personal and other community services		General government: Other services Non-profit institutions serving households: Other services
			Extra territorial services Domestic services	Other service activities		Other services Household services		Non-profit institutions serving households Trade and transport margins	

Table A4: Categories of primary inputs

Australia	Belgium	Denmark	Finland	Germany	Netherlands	New Zealand	Norway	United Kingdom
Value added	Value added	Value added	Value added	Value added	Value added	Value added	Value added	Value added
Complementary imports	Imports	Imports	Imports	Imports	Imports	Imports	Imports	Imports
Competing imports			Consumption expenditure of non-resident households		Final consumption by resident households in the rest of the world		Direct purchases by non-residents	
					Net exports of goods			
					Taxes on imports (excluding value added tax)			
					Import subsidies			
					Non-deductible value added tax			

Australia	Belgium	Denmark	Finland	Germany	Netherlands	New Zealand	Norway	United Kingdom
	Value added taxes	Value added tax	Value added tax		Trade and transport margins			
Taxes less subsidies on products	Taxes less subsidies on products		Product taxes	Taxes on products less subsidies	Taxes on domestic production (excluding value added tax)	Taxes on products	Taxes on products	Taxes less subsidies on products
			Product subsidies		Subsidies on domestic products			
					Sales of existing fixed assets		Used fixed capital	
							Corrections	
					Adjustment related to wages and salaries in kind			Financial intermediation services indirectly measured adjustment