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**Conference Paper**

## Constructing Regional Supply and Use Tables in Finland

39th Congress of the European Regional Science Association: "Regional Cohesion and Competitiveness in 21st Century Europe", August 23 - 27, 1999, Dublin, Ireland

**Provided in Cooperation with:**

European Regional Science Association (ERSA)

*Suggested Citation:* Piispala, Juha (1999) : Constructing Regional Supply and Use Tables in Finland, 39th Congress of the European Regional Science Association: "Regional Cohesion and Competitiveness in 21st Century Europe", August 23 - 27, 1999, Dublin, Ireland, European Regional Science Association (ERSA), Louvain-la-Neuve

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# Constructing Regional Supply and Use Tables in Finland<sup>1</sup>

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Juha Piispala<sup>2</sup>

**Abstract.** *Regional input-output (IO) tables form a consistent and well-founded method for regional analysis. However, there is an increasing interest to construct regional IO tables using the so-called supply and use (S&U) framework. In constructing S&U tables less assumptions are needed than in 'traditional' IO tables. In this paper we present the current project to compile regional IO tables in Finland using S&U framework. The regionalisation is carried out using basically either top-down or bottom-up methods. Both of these are examined in the paper in the context of regional S&U tables. Also the methods to estimate regional trade-flows are discussed. In addition to these theoretical and methodological presentations, the paper also gives an overview of the actual work carried out in the regionalisation of S&U tables at Statistics Finland.*

**Keywords:** *regional supply and use tables, regional input-output, top-down vs. bottom-up methods, interregional trade-flows*

## 1. INTRODUCTION

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In summer 1997 a project to compile regional input-output (IO) tables was launched at Statistics Finland. A growing interest in modelling and analysing regional economies became topical when Finland in 1995 joined the European Union. At the same time Finland was recovering from her most severe recession since World War II which had resulted in extremely high unemployment and slump in economic activity. Especially certain regions in Finland were severely affected by the recession and the unemployment.

The EU membership together with the recession reformulated the contexts and objects of regional policies in Finland. Therefore it became necessary to have more detailed data of economic activity of different regions. Regional input-output, being a consistent and well-founded method, is considered to be a suitable method to analyse the impact of regional policies. This is why regional input-output project was launched.

The eventual goal of the project is to compile regional IO tables of 1995 for 20 Finnish provinces (NUTS-3 level). As the tables are compiled simultaneously for all the regions using similar procedures, the effects of different regional policies, for example, can be analysed simultaneously for each region.

Although the eventual aim is regional IO tables, these tables will be derived from regional supply and use tables (S&U tables) which will be compiled first. Supply and use tables are widely compiled in connection with national accounts in different countries in the EU and

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<sup>1</sup> Paper presented at the European Regional Science Association (ERSA) 39<sup>th</sup> European Congress in Dublin, Ireland, 23-27 August 1999.

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elsewhere. Thus, IO tables at the national level are in many cases based on S&U tables. At the regional level the approach is rather new but seems to receive an increasing attention.<sup>3</sup>

The aim of this paper is to describe the ongoing project to compile 20 regional S&U tables in Finland. We begin with defining the level of detail of compiling the tables by introducing the classifications used in regionalising Finnish S&U tables. In section 3 the supply and use tables are introduced at the national level. In section 4 we describe the methods typically used in the regionalisation process. Here the emphasis is, on the one hand, on regionalising national S&U tables by top-down and bottom-up methods and, on the other hand, on estimating regional trade flows. Section 5 gives an overview of the regionalisation of national S&U tables at Statistics Finland. Finally, section 6 concludes.

## 2. CLASSIFICATIONS

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S&U tables having industry by commodity dimension need classifications for both industries and commodities. In connection of regional tables a further dimension of regions is added whereby the nation should be grouped into necessary regions. These classifications determine the level of detail at which the S&U tables are compiled.

In constructing regional S&U tables, the economy is split into some 75 industries. This is our 'working level' and aggregations are inevitable for publication due to concealment rules, for example. Industry classification is mainly based on TOL95, which is the Finnish version of the European NACE, Rev.1 industry classification.<sup>4</sup> The industries were formed mainly at the TOL95 2-digit level, but in certain cases a more disaggregated level was chosen. All in all, in our project the division of industries is largely dependent on the industry classification used in the national accounts and S&U tables at the national level. Both of these statistics use TOL95 as a basis for classification.

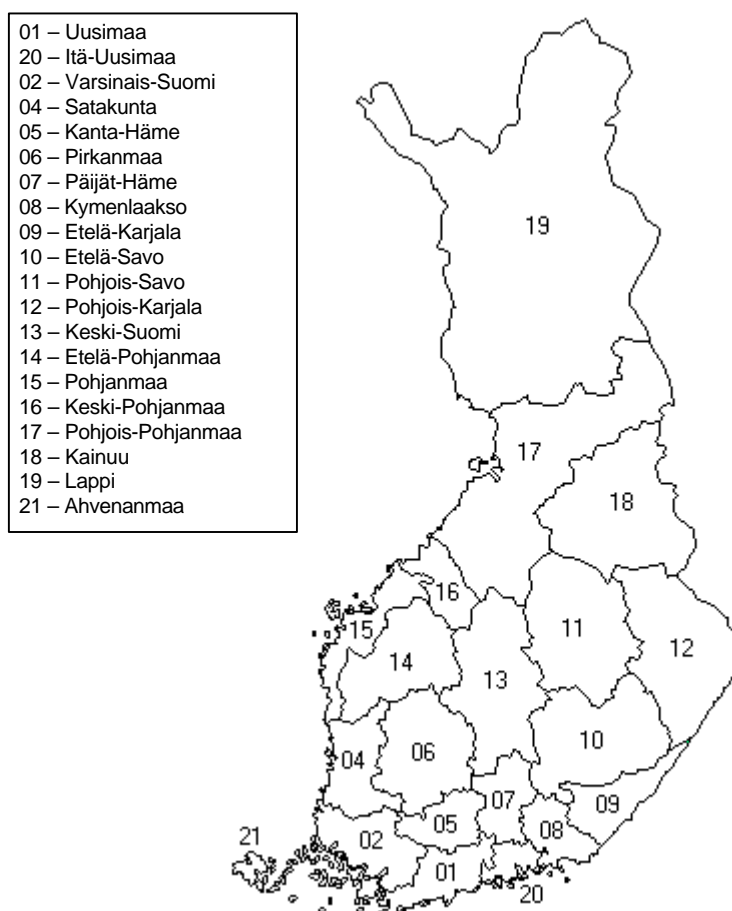
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<sup>3</sup> Other regional S&U tables have been, or will be, compiled at least in Canada (Siddiqi and Salem, 1995), the Netherlands (Eding *et al.*, 1998), the USA (Jackson, 1998) and Denmark (Madsen and Jensen-Butler, 1998).

<sup>4</sup> European classification of economic activities, NACE, is an acronym for *Nomenclature Générale des Activités Economiques dans les Communautés Européennes*. TOL95, on the other hand, is an acronym for *Toimialaluokitus 1995*.

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**Figure 1.** NUTS-3 Regions in Finland.



Because we are constructing regional tables, it would be natural to use the same aggregation level of industries as are used in regional accounts. This is not what we do, however. The main reason is that the current regional accounts in Finland use different classification from the Finnish national accounts. Regional accounts will, however, in the near future skip to the same classification as in other systems of national accounts. Therefore, using the current classification of regional accounts in regional S&U tables would not have made much sense.

Our commodity classification follows closely CPA.<sup>5</sup> It is uniform with NACE, and thus with TOL95, up to 4-digit level. The commodity groups in our regional IO project are formed typically at the 3-digit level of CPA, but some exceptions have been made due to the industry classification used. In our work we use some 200 product-groups as a working level. This means that, on average, three commodities are characteristic to each industry. However, at least one commodity is characteristic to each industry. Of course, not necessarily all commodities are produced domestically, but some are only imported to Finland.

In our case, the regional S&U tables are constructed at the level of 20 Finnish provinces (see Figure 1). These form the NUTS-3 level in Finland. The distinctive geographical feature of Finland is that the southern part of the country consists of small (in size) provinces while the largest provinces lie in the northern and eastern Finland (see Table 1). However, most of Finland's population is situated in south and south-west, and especially in the province of Uusimaa (01).

What comes to the economic structures among the provinces, they are also very different from each other. For example, the small archipelago province of Ahvenanmaa (21) and Uusimaa (01) both have a relatively high service sector while agriculture and forestry and manufacturing industries form only about 20 per cent of GDP (see table 1). Other regions' economies are more dependent on primary industries and manufacturing. Agriculture and forestry are especially important in the eastern and western provinces of Finland. These differences in economic structures between regions are also translated into the GDP per person figures as shown in table 1 column (8).

**Table 1.** Land Area and Population (31.12.1997) and GDPR<sup>6</sup> (1995) of Provinces in Finland.

	Land area, Population		GDPR by Industry							
			(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	km <sup>2</sup>									
Uusimaa – 01	6 366	1 257 702	0,7 %	19,0 %	5,0 %	25,8 %	33,4 %	16,2 %	100 %	125 528
Itä-Uusimaa – 20	2 747	87 287	6,3 %	46,3 %	5,1 %	13,8 %	17,6 %	10,9 %	100 %	101 381
Varsinais-Suomi – 02	10 624	439 973	6,3 %	33,3 %	5,9 %	15,9 %	20,5 %	18,2 %	100 %	96 087
Satakunta – 04	8 290	242 021	7,1 %	39,5 %	5,9 %	13,8 %	17,7 %	16,0 %	100 %	86 692
Kanta-Häme – 05	5 204	165 026	8,5 %	31,5 %	5,0 %	14,1 %	19,8 %	21,1 %	100 %	82 505
Pirkanmaa – 06	12 605	442 053	4,9 %	33,9 %	5,6 %	16,5 %	21,6 %	17,5 %	100 %	89 658
Päijät-Häme – 07	5 133	197 710	6,0 %	35,9 %	4,0 %	15,6 %	23,1 %	15,4 %	100 %	85 078
Kymenlaakso – 08	5 106	190 570	5,5 %	40,2 %	5,7 %	17,5 %	15,3 %	15,8 %	100 %	99 669
Etelä-Karjala – 09	5 674	138 852	5,6 %	44,8 %	5,1 %	13,3 %	15,8 %	15,4 %	100 %	101 342
Etelä-Savo – 10	14 436	171 827	18,6 %	19,2 %	6,4 %	14,8 %	18,2 %	22,7 %	100 %	69 653
Pohjois-Savo – 11	16 510	256 760	10,8 %	26,3 %	5,9 %	16,3 %	18,1 %	22,6 %	100 %	79 008
Pohjois-Karjala – 12	17 782	175 137	12,1 %	26,4 %	6,7 %	13,8 %	17,4 %	23,6 %	100 %	75 493
Keski-Suomi – 13	16 248	259 839	8,4 %	34,9 %	5,8 %	12,6 %	18,0 %	20,3 %	100 %	85 586
Etelä-Pohjanmaa – 14	13 458	198 641	15,5 %	22,1 %	7,8 %	17,9 %	17,5 %	19,2 %	100 %	72 965
Pohjanmaa – 15	7 675	174 230	10,8 %	36,9 %	5,3 %	14,3 %	15,3 %	17,4 %	100 %	97 004
Keski-Pohjanmaa – 16	5 286	72 336	14,3 %	26,4 %	5,6 %	18,4 %	16,4 %	19,0 %	100 %	75 581
Pohjois-Pohjanmaa – 17	35 291	359 724	7,8 %	32,4 %	6,9 %	15,8 %	16,1 %	20,9 %	100 %	85 205
Kainuu – 18	21 567	93 218	12,3 %	26,1 %	6,0 %	13,8 %	16,8 %	25,2 %	100 %	70 497
Lappi – 19	93 003	199 051	7,7 %	33,1 %	6,6 %	13,8 %	15,3 %	23,5 %	100 %	93 693
Ahvenanmaa – 21	1 527	25 392	9,6 %	10,2 %	4,2 %	38,6 %	17,6 %	19,8 %	100 %	120 175
FINLAND	304 532	5 147 349	6,0 %	28,7 %	5,6 %	18,7 %	23,0 %	18,1 %	100 %	96 199

<sup>5</sup> CPA stands for *Statistical Classification of Products by Activity in the European Community*.

<sup>6</sup> GDPR is an acronym for regional gross domestic product. It is valued at factor prices.

Key: (1) Agriculture and forestry, (2) Mining; manufacturing; electricity and water supply, (3) Construction, (4) Trade and transport, (5) Other Services, (6) Government activities, (7) Total, (8) GDP per person, FIM  
Source: Statistics Finland

### 3. SUPPLY AND USE TABLES AT THE NATIONAL LEVEL

#### 3.1. Overview

Following ESA 1995<sup>7</sup> and using standard notation, supply table (see table 2) consists of two parts: **V** describes the production of commodities  $c$  ( $c = 1, \dots, k$ ) by *domestic* industries  $j$  ( $j = 1, \dots, m$ ). Vector **M** on the right of the domestic production matrix denotes the foreign imports of the commodities  $c$ . Total supply of the commodities  $c$  in the economy, **q**, is equal to supply from domestic producers plus imports from abroad. From the supply table we can derive that total output by industries equals **g'**.

**Table 2.** *Simplified Supply Table.*

	Industries	Abroad	Total
Commodities	<b>V</b>	<b>M</b>	<b>q</b>
Total	<b>g'</b>		

The use table consists of the following parts (see table 3). Matrix **U** describes the use of commodities  $c$  by domestic industries  $j$ , matrix **E** the use of commodities by final demand categories  $f$  ( $f = 1, \dots, t$ ) and vector **X** exports of commodities from abroad. Total demand by commodities equals **q**. Matrix **Y** describes the use of primary inputs  $h$  ( $h = 1, \dots, p$ ) by industries. Total use of inputs (intermediary and primary) is given by vector **g'**.

**Table 3.** *Simplified Use Table.*

	Industries	Final Demand	Abroad	Total
Commodities	<b>U</b>	<b>E</b>	<b>X</b>	<b>q</b>
Primary Inputs	<b>Y</b>			
Total	<b>g'</b>			

There are two identities that hold between the supply and use tables. First, the industry identity states that total output by industries equals total use of inputs by industries, or

$$(1) \quad \mathbf{V}_j = \mathbf{U}_j + \mathbf{Y}_j.$$

Or, written differently:

$$(2) \quad \sum_{c=1}^k v_{cj} = \sum_{c=1}^k u_{cj} + \sum_{h=1}^p y_{hj} \quad \text{for all } j = 1, \dots, m.$$

<sup>7</sup> ESA stands for European System of Accounts which sets the guidelines for compiling national accounts and S&U tables in member countries (see Eurostat 1996).

The second identity is the commodity identity. According to it total supply by commodities equals total use by commodities<sup>8</sup>, or

$$(3) \quad \mathbf{V}_c + \mathbf{M}_c = \mathbf{U}_c + \mathbf{E}_c + \mathbf{X}_c.$$

This is can be written also as:

$$(4) \quad \sum_{j=1}^m v_{cj} + m_c = \sum_{j=1}^m u_{cj} + \sum_{f=1}^t e_{cf} + x_c \text{ for all } c = 1, \dots, k.$$

These two identities guarantee that the whole system is balanced and consistent.

### 3.2. The National S&U Tables of 1995

In Finland the core system of national accounts has to date consisted of separately compiled sector accounts and input-output tables, the control total of the latter one being determined by sector accounts. Thus, the system has not been totally integrated so that there has not been feedback from one system to the other. After joining the EU, the system of national accounts in Finland is now facing renovations. Though the feedback link to sector accounts is not yet fully realised, the national S&U tables incorporating many features of ESA have now been constructed in Finland for the year 1995.

The national S&U system is compiled at the level of 190 industries and over 1300 commodities. After both supply and use tables at the basic prices were compiled at this level of detail, a 'manual' balancing was carried out using expert judgements to reach the final balanced S&U system. The Finnish S&U system includes supply table in basic prices including the transformation to purchasers' prices, use table in both basic and purchasers prices, and industry by industry IO tables, among others.

National S&U tables form the control totals for regional S&U tables. That is, regional tables should, when summed together, equal national tables. Thus, after the working level of the regionalisation has been determined (i.e. classifications), the next task in regionalising national S&U tables is to decide what methods should be followed. In the next section some of the possible methods are reviewed.

## 4. METHODS OF REGIONALISING SUPPLY AND USE TABLES

### 4.1. Top-down versus Bottom-up Methods

When constructing regional S&U tables (or any other regional statistics) the estimation of regional figure from its national counterpart should be done at the level of company's establishments<sup>9</sup>. Thus, a multi-establishment company may have producing activities in two or more regions or industries. In this case these differences should be noticed in compilation process.

Regionalisation of national economic statistics such as national accounts can be done basically by using either top-down or bottom-up methods. These same methods can be applied to the regionalisation of S&U tables as well. The bottom-up method involves collecting data at the establishment level, and using this data a regional aggregate can be

<sup>8</sup> The commodity identity to hold, both the LHS (left-hand-side) and the RHS (right-hand-side) should have the same valuation, for example valued in basic prices. If the use table is valued in purchasers' prices, then a matrix of trade and transportation margins and commodity taxes and subsidies by commodities must be added to the LHS or deduced from the RHS to have similar valuation and to have the commodity identity to hold. In what follows we assume the same valuation for both tables.

<sup>9</sup> ESA uses the term local KAU (kind-activity-unit) instead of establishment. Here we use the term establishment.

estimated. In the top-down method a national figure is distributed among regions using an indicator that is as close as possible to the variable to be estimated (Eurostat 1995, 14).

The bottom-up method is to be preferred. However, it is not always applicable due to data constraints, for instance. In fact, the choice of the method is usually determined by the availability of data. Also, it should be mentioned that where the bottom-up method can be applied, it can seldom be used in its purest form. Rather, some adjustments to national figures are almost always necessary. Therefore, one usually has to use some kind of mixed method, a mixture of the above two.



**Table 5.** Regional Supply Table.

Region $r$	Industries	Abroad	Other regions	Total
Commodities	$\mathbf{V}^r$	$\mathbf{M}^r$	$\mathbf{T}^r$	$\mathbf{q}^r$
Total	$(\mathbf{g}')^r$			

In table 4 a regionalised supply table is shown. Similar tables should be compiled for each of the regions involved in regionalisation. The regionalised table has an additional element, namely  $\mathbf{T}^r$  that is either a matrix or a column showing imports of commodities from other regions in a country to the region. In case of a column vector this item shows the imports from the rest of the country despite the origin. However, if enough information is available this column can be disaggregated into matrix showing the imports of commodities from every other region separately. Thus, in this matrix each column depicts the imports from a particular region.

Similar item to  $\mathbf{T}^r$  is separated in regional use table as shown in table 5. Now  $\mathbf{T}^r$  depicts the exports from the region to other regions, either shown as aggregate (column) or separated by each region (matrix).

**Table 6.** Regional Use Table.

Region $r$	Industries	Final Demand	Abroad	Other regions	Total
Commodities	$\mathbf{U}^r$	$\mathbf{E}^r$	$\mathbf{X}^r$	$\mathbf{T}^r$	$\mathbf{q}^r$
Primary Inputs	$\mathbf{Y}^r$				
Total	$(\mathbf{g}')^r$				

As mentioned in Eding *et al.* (1998) the regionalisation of national S&U tables can be done along either industry dimension or commodity dimension, or both. Usually the data available favours the regionalisation along the industry dimension since most of the regional data relate directly to industries (establishments or companies), not commodities. If data on both establishments and commodities are available they should be used in which case both dimensions can be regionalised simultaneously. In that case, one applies the bottom-up method.

To illustrate the top-down and bottom-up methods, let each element of industrial supply  $\mathbf{V}$ ,  $v_{cj}$ , denote the production of commodity  $c$  by industry  $j$  in national table. Then, total output of industry  $j$  is equal to:

$$(5) \quad v_{1j} + v_{2j} + \dots + v_{kj} = \sum_{c=1}^k v_{cj} = g_j.$$

The top-down method along the industry dimension means that we first estimate the industry output  $g_j^r$  for each region  $r$ . This can be done, if data permits, directly from establishment level output figures. If output for establishments is not available some other indicator, like

turnover or employment, could be used.<sup>10</sup> After industry output is regionalised, the regionalised industrial supply of commodity  $c$  can be calculated as

$$(6) \quad v_{cj}^r = \frac{v_{cj}}{g_j} \times g_j^r.$$

An unfortunate feature of the top-down method is that commodity structure of a particular industry will be similar in each region. This is seldom the case in reality, but if no other data is available this will be the outcome.

In ideal case, we would have data of industry output by commodities for each region,  $v_{cj}^r$ . In that case the bottom-up method in its purest form could be applied, i.e. regional industrial supply could be compiled by summing each  $v_{cj}^r$  over  $c$  for all  $j$ . This, however, is hardly ever the case in reality. Instead, some adjustments to national figures are usually needed as mentioned earlier.

A typical situation is where one has commodity data only for some companies or establishments within an industry. Thus, the commodity information is only partial. The commodity information available is also usually for the largest establishments while for the smaller ones this information does not exist.<sup>11</sup> If we let  $v_{cj=i}^r$  be the output of commodity  $c$  in region  $r$  produced by those large establishments of industry  $j$  that we have commodity data of, and let  $v_{cj \neq i}^r$  be the corresponding figure for small establishments (i.e. those on which no commodity data is available), the problem in calculating regional  $v_{cj}^r$

$$(7) \quad v_{cj}^r = v_{cj=i}^r + v_{cj \neq i}^r$$

is how the last term should be estimated. One possibility is to assume an 'average' commodity structure for the whole industry  $j$  in region  $r$ , i.e. first calculate the commodity structure for the largest units and then apply the same structure for smaller units, as well. In this case

$$(8) \quad \frac{v_{cj \neq i}^r}{g_{j \neq i}^r} = \frac{v_{cj=i}^r}{g_{j=i}^r}$$

or

$$(9) \quad v_{cj \neq i}^r = \frac{v_{cj=i}^r}{g_{j=i}^r} \times g_{j \neq i}^r.$$

Then (7) becomes

$$(10) \quad v_{cj}^r = v_{cj=i}^r + \frac{v_{cj=i}^r}{g_{j=i}^r} \times g_{j \neq i}^r$$

or after rearranging the terms in the RHS (right-hand-side)

$$(11) \quad v_{cj}^r = \frac{v_{cj=i}^r}{g_{j=i}^r} (g_{j=i}^r + g_{j \neq i}^r) = \frac{v_{cj=i}^r}{g_{j=i}^r} \times g_j^r.$$

<sup>10</sup> Jackson (1998) gives a nice example of the top-down method in regionalising supply and use tables. There, regional output for each industry is estimated from the region's share of national industry employment,  $\varepsilon_j$ , as  $g_j^r = \varepsilon_j g_j$ .

<sup>11</sup> This, at least in Finland, is the case for certain industries.

Thus, the commodity structure of the industry in each region is determined by the commodity structure of the largest establishments.

Applying this assumption is likely to have two major drawbacks in relation to reality, however. First, it is improbable that the small units within an industry produce commodities in similar proportion to the large ones. Second, and perhaps more importantly, assuming an average commodity structure to small establishments actually implies that all small establishments produce the whole variety of commodities produced by all large establishments. This cannot be true of course, since even among the large units the commodity structures differ. Thus, because the commodity structures of large units are different, and typically none of them produces every commodity that is produced by all the large units within the industry and region, how could all small units then produce the whole commodity mix.<sup>12</sup>

These two reasons lead us to propose another assumption to be used. We consider it to be more realistic to assume that small establishments produce only a couple of commodities. How many and which commodities should one assign to small establishments then? This is a question that is left to each researcher regionalising S&U tables to decide. However, we did as follows. We assumed that each small establishment produces only one commodity that is characteristic to its industry. This kind of commodity we call a *characteristic commodity*. As mentioned above (see section 2), our industries are formed from NACE (TOL95) typically at the 2-digit level. On the other hand, the commodity groups are formed from CPA usually at the 3-digit level. This leads us to the classification where 1 to 7 commodities are characteristic to each industry (an average is around 3 commodities characteristic per industry). In our data each establishment is given a NACE 5-digit industry code. NACE and CPA, on the other hand, are typically congruent at the 4-digit level. Assuming that each small establishment produces only a commodity characteristic to its industry, the above means that an establishment's 4-digit NACE code reveals what that commodity is at CPA 4-digit level. Thus, for each small establishment we are able to assign a commodity it produces as shown in an example in table 6 below.

**Table 7.** Characteristic commodities for NACE 5-digit industries. Example: RSU industry 310.

RSU Industry <sup>1</sup>	NACE (TOL95) <sup>2</sup>	RSU Commodity <sup>3</sup>
310	31100	31100
310	31200	31200
310	31300	31300
310	31400	31400
310	31500	31500
310	31610, 31620	31600
<sup>1</sup> ) Regional S&U industry code. 310 = Manufacture of electrical machinery and apparatus n.e.c. <sup>2</sup> ) NACE/TOL95 industry code. <sup>3</sup> ) Regional S&U commodity code.		

In this case  $\sqrt{c_j^i}$  in (7) is calculated as

$$(12) \quad v_{cj \neq i}^r = \sum_{c=1}^d g_{j \neq i, c}^r$$

where the term in RHS is the total output produced by small establishments summed over all commodities characteristic to the industry,  $d$ . The total commodity structure of the industry  $j$  in region  $r$  is then

<sup>12</sup> It should be noted that if the commodity data relates to a sample of both large and small units then one can estimate the commodity structure of industry  $j$  in region  $r$  using (11). However, if the commodity data relates only to the largest establishments, which may be the case also in many other countries, using (11) would give a biased estimate of the commodity structure.

$$(13) \quad v_{cj}^r = v_{cj=i}^r + \sum_{c=1}^d g_{j \neq i, c}^r.$$

Thus, for those establishments we have commodity data we apply the data straightforwardly, whereas other establishments produce only one commodity, the characteristic commodity. This method is, to our opinion more realistic than the one proposed by (11).<sup>13</sup>

All in all, the best method is dependent on the data available for a researcher. Top-down method is often the only possible, while pure bottom-up method can seldom be applied. However, if the data permits, the use of the (near) bottom-up method should be favoured since the regional structures are then more accurately estimated. Also, if the commodity data relates only to the largest units, we recommend using the method represented in equation (13) in the regionalisation of industrial supply since the smallest units are then more realistically treated.

## 4.2. Estimation of Regional Trade-flows

Equations (1) and (3) describe the industry identity and the commodity identity, respectively, for the national S&U table. In case of regionalised S&U tables, the regional industry identity is again:

$$(14) \quad \mathbf{V}_j^r = \mathbf{U}_j^r + \mathbf{Y}_j^r.$$

However, the regional commodity identity contains the additional elements represented in tables 4 and 5 and is written as:

$$(15) \quad \mathbf{V}_c^r + \mathbf{M}_c^r + \mathbf{T}_c^r = \mathbf{U}_c^r + \mathbf{E}_c^r + \mathbf{X}_c^r + \mathbf{T}_c^r.$$

For the sake of simplifying presentation let us drop the sub-index  $c$  and rewrite the equation as

$$(16) \quad \mathbf{V}^r - (\mathbf{U}^r + \mathbf{E}^r) = (\mathbf{X}^r + \mathbf{T}^r) - (\mathbf{M}^r + \mathbf{T}^r).$$

The first term in RHS of (16) is the 'cross-border' exports of region  $r$  while the latter term is the 'cross-border' imports. Thus, the RHS is the trade balance, or net exports, of the region. It could be either positive or negative. This result is quite easy to yield as long as we can estimate the LHS, i.e. the terms  $\mathbf{V}^r$ ,  $\mathbf{U}^r$  and  $\mathbf{E}^r$ .

The trade balance of region  $r$  is equal to supply of commodities by establishments in region  $r$  minus demand (intermediate and final) of commodities by economic units (establishments, households, government agencies etc.) in region  $r$ , as given by the LHS of (16).

Often, for example because of the sake of an analysis, we need to separate between foreign trade and trade within the country's borders. This is shown by rearranging the RHS of (16) as

$$(17) \quad \mathbf{V}^r - (\mathbf{U}^r + \mathbf{E}^r) = (\mathbf{X}^r - \mathbf{M}^r) + (\mathbf{T}^r - \mathbf{T}^r).$$

The first term in RHS represents the net foreign exports of region  $r$  and the latter term represents the net exports in relation to the rest of the country. Both of these terms could be either larger than or smaller than zero.

<sup>13</sup> It should be mentioned that the method in (13) cannot be pursued in regionalising the use table ( $\mathbf{U}$ ). This is because the NACE industry code relates only to the production whereas it reveals nothing about the input use of the establishment. In regionalising the use table there are certain industries we have data only on commodity structure of inputs for large establishments. In this case, we have to assume that the small establishments have an 'average' input structure of the industry in the region.

The data on regional trade flows is typically very scarce, at least at the commodity level. Though foreign trade statistics record exports and imports typically at the commodity level its regionalisation directly from these statistics is not possible, since these exports and imports are recorded at nation's borders. The origin of exports and the final destination of imports are not necessarily available. Thus, the data available on regional exports and imports usually relates to companies or establishments and, therefore, to industries. Furthermore, this data relates only to foreign trade, not intra-country trade. It is also common that the import information is not available at the industry level. Thus, the reality is that there might be just enough data available to estimate the regional foreign exports, while three other items in the RHS of (16) and (17) cannot be estimated directly from the data available. If it suffices to estimate only the foreign exports then the residual term can be interpreted as net imports, and defined as

$$(18) \quad \mathbf{N}^r = (\mathbf{M}^r + \mathbf{T}^{\bullet r}) - \mathbf{T}^r = (\mathbf{U}^r + \mathbf{E}^r + \mathbf{X}^r) - \mathbf{V}^r.$$

Thus, net imports are the difference between demand and supply in the region. It can be either positive or negative.

It is naturally up to the researcher and depends on the needs of the analysis at which level of detail regional trade flows should be modelled. Usually a more detailed estimation of regional trade flows is needed than just the estimation of exports and net imports. There are basically two options: non-survey or survey methods.

There are several *non-survey methods* to estimate regional trade-flows, e.g. supply-demand pool and location quotients methods. Instead of presenting these in detail we only refer to literature (see e.g. Miller and Blair, 1985 ch. 9) on these. The common outcome of any of these non-survey methods is that no cross hauling is possible. This means that the region is either an exporter or an importer of a commodity, but cannot be both simultaneously. Thus, these methods are considered to lead to underestimates of trade (Harris and Liu 1998, Susiluoto 1996, 78-79).

As an example of a non-survey method, Jackson (1998) uses a supply-demand pool method to estimate regional trade flows. In his study, foreign regional exports ( $\mathbf{X}^r$ ) are first calculated and (18) is formed to estimate net imports. If  $\mathbf{N}^r$  is negative, this negative value is assigned to  $\mathbf{T}^r$  and reversed in sign. Thus, the rationale behind this is that if the region has negative net imports of a commodity, then it must be an exporter of that commodity. But while the foreign exports are already determined, the remaining exports (i.e. negative net imports) must be exported to other regions in the country. Still, the method fails to differentiate between foreign and rest-of-nation imports. Furthermore, no cross hauling takes place.

*Survey methods* are considered to be both time and money (resources) consuming. However, survey methods make it possible to have a more precise and realistic view of regional trade flows. In a survey method data relating to regional trade flows is used. However, there typically is no data available, so it must be first collected, i.e. surveyed. The process of collecting survey data is not discussed in detail here. Instead we refer to a paper by Kauppila (1999) where this process is reviewed in connection of the Finnish regional IO project. The review of the Dutch experiences can be found in Eding and Nijmeijer (1998).

In practise a trade-flow survey means a postal questionnaire for a sample of establishments in which establishments are asked to reveal their foreign and domestic trade-flows regionally. There are basically three options available. In the first, establishments are asked about the destination of their sales. In the second, the origin of their purchases is questioned. The third possibility includes the both. In addition to these, there is a choice between asking the trade flows either at the commodity level or at the total sales/purchases level, in which case no commodity information is directly obtained.

In estimating the regional trade flows for the Finnish regional S&U tables we resorted to a survey where we asked the regional destination of establishments' total sales, not separated by commodities. However, with the information of this survey and other data available it is possible to estimate the trade flows destined abroad and to all the 20 regions within Finland by commodities. Thus, in the first phase, we estimate  $\mathbf{X}^r$  and  $\mathbf{T}^{rs}$  for all regions using the information of the survey and other data. Here  $\mathbf{T}^{rs}$  for all  $r$  and  $s$  ( $r \neq s$ ) is the exports of commodities from  $r$  to  $s$ . Thus, an important aspect of our survey is that instead of estimating  $\mathbf{T}^r$  as a column,  $\mathbf{T}^{r\cdot}$ , (i.e. rest-of-nation exports) we estimate it as a matrix by regions,  $\mathbf{T}^{rs}$ , showing every region receiving exports from  $r$ . But, exports from  $r$  to  $s$  are imports of  $s$  from  $r$ . Thus, by knowing every origin-destination pair of domestic exports we actually know domestic imports, as well. If the regional domestic exports are estimated as a column only, the estimation of the region's domestic imports by origin becomes difficult. This leads to the situation where it is again difficult to separate between foreign and domestic imports, unless foreign imports can be estimated using other data.

Since we now know  $\mathbf{X}^r$ ,  $\mathbf{T}^r$  and  $\mathbf{T}^{\cdot r}$  we have only  $\mathbf{M}^r$  unknown in (17), so it can be estimated as a residual of

$$(19) \quad \mathbf{M}^r = (\mathbf{U}^r + \mathbf{E}^r + \mathbf{X}^r) - \mathbf{V}^r + (\mathbf{T}^r - \mathbf{T}^{\cdot r}).$$

The advantages of our survey approach are as follows. First, we are able to estimate all four items of regional trade-flows separately. Second, a survey approach does not ignore cross hauling, but the region may simultaneously export and import any commodity. Third, by estimating all domestic origin-destination pairs, we are able to form multiregional S&U tables. All these increase the modelling and analysis possibilities of regional economies, as well as are likely to give a more accurate and realistic view of the regional interdependencies.

## 5. REGIONALISING SUPPLY AND USE TABLES: SOME EXPERIENCES

The natural order of regionalising the national supply and use tables is first to regionalise industrial supply and use of commodities and value added by industries.<sup>14</sup> After these final demand of commodities by different categories is regionalised. Finally, regional trade flows, both foreign and domestic, are estimated.

In this section we give some ideas about the regionalising process and data used in the Finnish project. The presentation gives a short overview of the most important issues and data used in regionalisation.<sup>15</sup> The regionalisation of supply and use tables is carried out using primary data as much as possible while the use of substitute indicators is avoided whenever possible. However, this is not always conceivable. Most of the data is available at Statistics Finland, but in certain instances we needed to make contacts to other institutions for having suitable data. Especially, in transportation industries, other than Statistics Finland data are used.

A very important 'missing' piece of information concerns regional trade flows. To have reliable data on that issue, we needed to collect the data by ourselves by carrying out a separate survey.

### 5.1. Regional Industrial Supply and Use of Commodities

Since the data in supply and use tables relate both to industries and commodities, one basically needs information on both dimensions. This sort of information is presented in

<sup>14</sup> In what follows we do not discuss the problem of regionalising value added. Rather, here our main interest is the commodity dimension which does not include value added (cf. the commodity identity in (3) or (15)). For regionalising value added, see Eurostat (1995).

<sup>15</sup> An interested reader may refer to Piispala (1998) for an example of a more detailed presentation of regionalising industrial supply of manufacturing industries in the Finnish project.

national S&U tables which collect this information from various sources. In regionalising the national S&U tables we used the same data as is used in national tables wherever possible. However, in certain instances such commodity-related data was not available at the regional level. Therefore, in these cases the top-down method is employed and the regional structures are determined by the national structures of S&U tables.

### ***Agriculture, hunting and forestry; Fishing (NACE A-B)***

This industry contains six sub-industries in our project. Of these agriculture and forestry make a bulk of the value of output. For both of these, regional data on the produced commodities is available. In addition, for agriculture there is also data on the purchases of inputs. For the rest of the industries the national commodity structures are applied quite directly and the levels of output and intermediate consumption are regionalised using top-down method.

As is shown in table 1 (see page 3) certain regions in Finland are more dependent on primary production. Furthermore, some sub-industries are concentrated in certain regions. For example, the reindeer farming is almost exclusively situated in the province of Lappi (Lapland), the most northern region of Finland. On the other hand, most of the fur farming industry is situated in the provinces of the western coast.

### ***Mining and quarrying; Manufacturing; Electricity, gas and water supply (NACE C-E)***

Most of the industries in the project belong to these industries. Altogether, there are 41 industries in this category. The main source of our data for regional industrial supply and use of commodities comes from the manufacturing statistics. This data is, to a large extent, based on a postal survey of manufacturing companies and it contains detailed data on deliveries of goods produced by commodity (HS classification) as well as use of raw materials, packaging materials and energy inputs.

A thing that is very good from the point of view of regional S&U tables is that the manufacturing statistics is available not only at the company level, but also at the level of companies' establishments. Therefore, the problem of multiregional companies is not a serious problem in this case.<sup>16</sup>

The disaggregation of the manufacturing industries' outputs and intermediate consumption is highly reliable in our case since we have good and wide data available on the production of goods and the use of inputs by local units in manufacturing. Actually, we resorted to two manufacturing data registers. One describes the profit and loss accounts of all the manufacturing establishments in great detail (called manufacturing structure register, MSR). Another records the value and volume of produced and purchased commodities of the largest manufacturing establishments (called manufacturing commodity register, MCR). In 1995 almost all establishments of manufacturing firms having 10 or more employees were surveyed for both these registers. For MSR those outlets not directly surveyed, data is imputed from other registers and/or estimated so that, in principle, it contains information on all establishments of manufacturing industries. For MCR, on the contrary, no imputation is done, so it does not contain data of all outlets. The total size of MSR is over 34,000 establishments. Since both MSR and MCR are at the establishment level, this data is easily regionalised using the information of the location of the establishments.

Since the commodity data is only a sample of the largest establishments, the commodity structure of the industry output in any region was calculated using (13) (see section 4.1.). However, as pointed out in footnote 13, for the use table (11) was applied. In fact, using (11) also in regionalising the supply table would have lead to another problem. Namely, some commodities in Finland are produced in small companies and establishments only. A typical

<sup>16</sup> For a discussion of the problems of multi-regional units in the regional context, see e.g. de Vet *et al.* (1999).

example is musical instruments. Because of the small size of these establishments, they are not a part of the MCR sample. Thus, no production of these commodities is recorded in MCR. Therefore, we think that applying (13) and introducing the concept *characteristic commodity* (see section 4.1 and table 6) leads to a more realistic view of the structure of the output.<sup>17</sup>

All in all, the regionalisation of NACE industries C-E in our case is close to pure bottom-up method. Only some adjustments to national figures (i.e. total output and intermediate consumption levels) are needed.

### ***Transport, storage and communications (NACE I)***

This industry is very disaggregated in our project. Altogether 17 sub-industries are formed. The reason stems mainly from the fact that this industry is very problematic from the point of view of regionalisation (see Eurostat 1995). In regionalising these sub-industries we have also resorted to many other institutions and their data to have a detailed and accurate information on the regional division of these sub-industries.

Still, the main method applicable in this industry is top-down. Thus, most of the commodity structures are taken from national tables, and these are applied to regions by first regionalising output and intermediate consumption levels. However, using national structures in these industries may not lead to a very biased picture of the reality.

Transportation industry is very important to certain regions in Finland. For example, in the archipelago province of Ahvenanmaa more than one quarter of RGDP consisted of sea transportation in 1995. On the other hand, air transportation is mainly concentrated in Uusimaa. The main reason is that most of the international flights arrive and depart at the Helsinki-Vantaa international airport, where also a bulk of domestic arrivals and departures occur. Because of these and other peculiarities of the transport industry in Finland, it has been vital to resort to first-hand data handed over to us by various companies and institutions.

### ***Other industries (NACE F-H, J-Q)***

For most of the other industries not discussed so far there typically is very little data on commodity structures of both output and inputs at the regional level. In these cases, then, national structures are applied as these industries are regionalised mainly using the top-down method.

The so-called register of enterprises/establishments at Statistics Finland contains information on turnover, salaries and number of employees of all business establishments in Finland. Thus, the regionalisation of all these other business industries can, in principle, be done by using this data register and any of the variables mentioned above as an indicator. For most of the 20 industries in this category this data is used if no better data is available.

**Table 8.** Part of the Regionalised Supply Table<sup>18</sup> (Note: preliminary figures).

REGION:01						
	Industry					
Commodity	151	152	153	154	155	Total
A01	0	0	0	0	4 708	8 177
A151	850 776	0	0	0	0	875 861
A152	8 441	21 621	0	0	0	31 929

<sup>17</sup> In the context of musical instruments the characteristic commodity works as follows. NACE (TOL95) code 36300 is manufacture of musical instruments. Thus, if an establishment belongs to that NACE industry, then its output is assumed to consist of only musical instruments which is one of the commodities in our regional S&U project. This way we are able to have also domestic supply for musical instruments in addition to import supply.

<sup>18</sup> The figures are only preliminary. Sum of the column elements equals total output of an industry. Row sum equals total (domestic) supply of a commodity. Most of the industries and commodities are not shown. Also, commodities are disaggregated commodity-groups.



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A153	15 981	0	55 134	0	95 277	181 284
A154	0	0	0	674 760	0	676 147
A155	0	0	0	0	1 315 866	1 319 643
A158	22 099	0	0	0	19 110	3 892 945
A159	0	0	0	0	36 889	1 703 936
A40	0	0	0	672	900	6 145 592
A52	5 476	0	0	89 208	252	2 183 042
A60	24	0	0	0	25 530	138 829
A63	18	0	0	0	18 870	102 612
A70	0	0	0	979	12 099	33 199
A71	0	0	0	2 241	23 249	512 499
A72	0	0	0	0	3 645	31 986
A73	0	0	0	1 312	8 121	928 659
A74	96	41	1 883	6 157	17 199	4 725 436
A80	0	0	0	11	2 567	12 527
Total	902 913	21 662	57 018	775 340	1 584 283	

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When all the regional supply and use tables are compiled the outcome looks as shown in table 7. Here an example of one particular region is given. In the table only five industries and their output by commodities are shown. Also the total domestic supply of the commodities are given for those commodities that are produced by the five industries given. All the other elements are deleted for the sake of simplicity.

The situation in table 7 is very typical. Namely, the common feature of any industry in any region is that most of the output consists of the production of a commodity that is characteristic to the industry. In addition to this commodity however, most industries produce by-products, i.e. commodities that are characteristic to some other industry.

## **5.2. Regional Final Demand**

The share of household consumption accounted for 38 per cent in 1995 of the total final demand (in purchasers' prices) in Finland. Thus, household consumption is an important item whose regionalisation should be given an appropriate effort. In our case Household Expenditure Survey (HES) is the most comprehensive data where regional figures can be estimated. HES is a yearly survey to some 2300 households and contains data on expenditures of some 700 commodity groups. Due to rather small sample size, a very detailed disaggregation of this data causes the problem of reliability. This means that the disaggregation of this data into 20 regions poses serious problems. To have more reliable database and estimates regionally, we decided to use a combined data of three consecutive years from 1994 to 1996. This increases the sample size to over 6700. However, the average sample size per region is still not very large, only some 335 households. Therefore we should not resort only to this data in estimating household consumption regionally, but use other statistics as well. For example data on disposable income of household by NUTS-3 regions is available which gives regional control totals for household consumption.

For consumption of state government there is quite detailed data on government spending by commodities available. About 80 spending groups are recorded most of which are spendings on different goods and services. Thus, most work with this item causes the regionalisation of these figures. However, State Expenditure by Region 1996 publication presents figures of state government spending regionally by account groups, by expenditure groupings and by function. This is a very good source when regionalising central government consumption by commodities. Also the spending of local governments (municipalities) is registered in statistics. Though not as accurate in commodity grouping as state government, this statistics is easily compiled by regions.

Unfortunately there is not much data on regional gross fixed capital formation (GFCF) in Finland yet. In an unpublished paper of Alanen (1998) some methods and figures of regional fixed capital formation are presented. However, there is currently a more detailed project to regionalise GFCF at NUTS-3 level whose results should be available to our project in autumn 1999.

## **5.3. Regional Foreign and Domestic Trade Flows**

As was discussed in section 4.2, there are basically a number of possibilities to estimate regional trade-flows. For our project's needs, it was considered to be important to have empirical data on the trade-flows between different regions, including foreign trade. Therefore a postal survey was designed and carried out (see Kauppila 1999 and Piispala 1998 for more details).

In our survey we applied the so-called export approach which means that the establishments were asked about the regional destination of their sales. Similar approach has been applied, for example, in the Netherlands in a recent survey (see Eding and Nijmeijer 1998, and Eding *et al.* 1998). The main argument for this approach is that the firms know the regional destination of their sales better than the regional origin of their purchases.

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We also used the so-called industry approach. This means that the establishments were asked only about the regional distribution of their total sales. This is in contrast to commodity approach where an establishment is asked about the regional division of its sales *by every commodity* it produces. Both export and industry approaches were selected in order to have as high a respondent rate and as reliable results as possible. To our opinion, that is exactly what we achieved.<sup>19</sup>

Using this survey data and other data<sup>20</sup> at our disposal, we are able to estimate every region's exports by commodities both abroad and to *all* other domestic regions. However, since the domestic exports can be estimated to all origin-destination pairs, we are in effect able to estimate domestic imports at the same time. In this case foreign exports to all the regions can also be estimated as a residual, see equation (19). Thus, in fact we have data which enables us to form multi-regional S&U and IO tables for 20 Finnish NUTS-3 regions.

## 6. CONCLUSIONS

In this paper we have presented the current Finnish project to compile 20 multi-regional supply and use tables. The main focus of the paper was in describing and discussing various possible methods of regionalising supply and use tables as well as regional foreign and domestic trade flows. Finally, a short overview of the practical work and data was presented.

Though not presented here, the final goal of our project is to derive institutional (i.e. industry by industry) IO tables at the regional level. While S&U tables are typically considered to be suitable for describing the economy's structures in a consistent way, still most of the regional IO analysis is carried out using 'traditional' IO tables. However, as argued elsewhere (see e.g. Madsen and Jensen-Butler, 1998) there are several arguments for a use of commodity by industry based modelling.

The compilation of regional S&U tables gives more varied possibilities for regional IO analysis. This is because both industry-by-industry and commodity-by-commodity IO tables can be constructed from S&U tables. Thus, if there is a need for both of these, a researcher may compile them from S&U tables quite easily.

The construction of regional S&U tables is rather new approach worldwide. To our knowledge, in only a few countries such tables have been or are being compiled. Our project has received very much interest in Finland also. Thus, it seems that there is rather large potential demand for such tables. It seems that many regional organisations, government ministries, research institutions and universities, as well as individual researchers find regional S&U tables and IO tables together with regional trade-flow data of use to them. Thus, impacts of regional policies and regional development are important issues in Finland where regional disparities are large and many regions are trying to find new ideas to improve their economic situation.

Since the tables are constructed for all 20 provinces simultaneously using similar methods, the analysis of regional policies is in a very consistent foundation. Therefore, various regions can be analysed simultaneously and the regional discrepancies can be compared.

However, there are also other potential benefits of compiling regional S&U and IO tables in terms of improved regional statistics. Especially, as is evident from the Dutch analyses (see Nijmeijer *et al.*, 1999 and Eding and de Vet, 1999), regional accounts – a counterpart of

<sup>19</sup> The respondent rate was close to 45 per cent. Although the sample contained only 5.4 per cent of all establishments, still the responses cover over 41 per cent of the turnover of the establishments in the population.

<sup>20</sup> This other data includes, among others, regional transportation flows (in tons) for different modes of transportation and commodity groups. For wood (commodity of forestry) at our disposal are origin-destination matrices of wood-flows (in Finnish markka values) for different types of wood.

national accounts – may be improved and developed using regional S&U tables and IO tables as a point of reference.

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