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## **The Finnish Sugar Sector and Its Multiplier Effects**

**Ellen Huan-Niemi and Marja Knuuttila**



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# Suomen sokerisektori ja sen kerrannaisvaikutukset

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## Tiivistelmä

Taustatietoa eri toimialojen taloudellisesta merkityksestä tarvitaan poliittisessa päätöksenteossa etenkin silloin kun tuotantoon on sitoutunut julkista rahoitusta. Maakunnat ja kunnat ovat riippuvaisia alueen työllisyyttä ylläpitävästä tuotannosta, joka tuottaa alueiden elinvoimaisuutta ylläpitäviä verotuloja.

Tutkimuksessa selvitettiin panos-tuotos-mallilla (pt-malli) sokerialan ja talouden muiden tuotannonalojen välisiä kytkentöjä. Pt-malli vastaa kysymykseen kuinka paljon tuotantoa, arvonlisäystä ja työllisyyttä häviäisi, jos sokeriala Suomessa katoaisi kokonaan. Pt-mallilla saadaan sokerialan tuotannon välilliset talousvaikutukset, joita kutsutaan kerrannaisvaikutuksiksi.

Vaikka sokerijuurikkaan ja sokeritehtaan merkitys tuotannon kerrannaisvaikutukset mukaan lukien näyttää melko pieneltä maakuntien tasolla, todelliset vaikutukset tuntuvat kunnissa niiden työttömyyden kasvaessa ja verotulojen vähentyessä. Nämä vaikutukset toteutuvat, mikäli sokeriala Suomessa katoaa eikä alueille löydy korvaavia tuotantomuotoja.

Tilastotiedoin voidaan osoittaa, että Irlannissa, jossa ei ole omaa sokerituotantoa sokerin kuluttajahinta on muita EU-maita korkeampi. Tämä johtuu EU:n sokerimarkkinoiden puutteista ja toimimattomuudesta sokeripolitiikan vuoden 2006 uudistuksen jälkeen. Sokerin kuluttajahinta Irlannissa on Iso-Britanniaa, Suomea ja Saksaa korkeampi. Iso-Britannia ja Suomi eivät ole omavaraisia sokerin kotimaan markkinoilla, mutta Saksassa tuotanto on aina ylittänyt omavaraisuuden. Tästä syystä kuluttajat Saksassa maksavat alemmaa hintaa sokerista verrattuna Irlantiin, Suomeen ja Iso-Britanniaan. Suomessa ja Iso-Britanniassa sokerin hinta on Irlantia alhaisempi koska näissä on vielä säilynyt kotimaista sokerituotantoa.

## Avainsanat:

*sokeriala, sokeria käyttävä teollisuus, panos-tuotos-malli, Varsinais-Suomi, Satakunta, Suomi*

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# The Finnish Sugar Sector and Its Multiplier Effects

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## Abstract

Background information on the economic role of industries is crucial to policy and decision makers due to the involvement of public financing. At the provincial and municipal level, the economic role of industries is crucial for employment and tax revenues that sustain the livelihood of the provinces and municipalities in Finland.

This study employed an input-output model (IO model) to answer the question on the linkages between the sugar sector with the different industries in the economy and how much production, value-added and employment would be lost if the sugar sector in Finland would disappear totally. The IO-model would produce the direct, indirect and induced economic effects usually referred to as the multiplier effects of the sugar sector.

Even though the effects of primary sugar beet production and sugar factory production including multiplier effects seem rather small compared to the total effects at the NUTS3 regional level, the actual effects are felt at the municipalities level in the form of decreasing tax revenues and unemployment if the sugar sector in Finland disappears and is not substituted for by other forms of production and industry.

There is data to prove that without domestic production, the sugar price is higher for Ireland compared to the other EU member states due to imperfections in the EU sugar market after the reform of the EU sugar regime in 2006. The sugar price for consumers in Ireland is the highest compared to the United Kingdom (UK), Finland and Germany. The UK and Finland are not self-sufficient in producing sugar for the domestic market, but Germany has been always producing over its self-sufficiency limit. Therefore, the consumers in Germany enjoy the lowest price for sugar compared to Ireland, Finland and the UK. Due to the existing domestic sugar production in Finland and the UK, the price of sugar is lower in these countries compared to Ireland.

## Keywords:

*sugar sector, sugar utilizing industry, input-output model, Varsinais-Suomi, Satakunta, Finland*

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# 1 Introduction

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Sugar beet grown in Finland was only 11 500 hectares in 2012 compared to 15 years ago whereby the area cultivated was at its peak with almost 35 000 hectares. The number of sugar beet growers has plummeted to less than 800 compared to more than 30 000 in the early 1960s. The importance of the sugar beet sector in Finland has evolved through the decades, and the number of sugar beet processing factories has dwindled down to only one in Säkyli. The sugar industry in Finland started soon after the First World War due to the acute lack of sugar and high price for sugar. Hence, the sugar beet processing factory in Salo was established in 1919. However, this factory was finally closed down following the reform of the EU sugar regime in 2006. The extreme weather conditions in Finland make sugar beet cultivation challenging, hence Finland has one of the lowest yields for sugar and beets compared to other EU member states. The most competitive producing areas in the EU are France, Germany, the United Kingdom and Poland, where the climate is more suited to growing sugar beet. Nonetheless, domestic sugar production in Finland plays quite an important role in the regions of Varsinais-Suomi and Satakunta because of the direct and indirect effects of the sugar beet production and processing to the local economy. This study employed an input-output model (IO model) to answer the question on the linkages between the sugar sector with the different industries in the economy and how much production, value-added and employment would be lost if the sugar sector in Finland would disappear totally. The IO-model would produce the direct, indirect and induced economic effects usually referred to as the multiplier effects of the sugar sector.

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## 2 Framework of the analysis

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The most common methods to study economic effects of industries are Computable General Equilibrium (CGE) and Input-Output (IO) models. Data requirements of the CGE models are demanding especially at local level as availability of demand and production elasticities and among other data requirements pose challenges. In favor of CGE models is that they compute a new supply-demand equilibrium following a supposed economic shock, thus providing an extensive picture of the after-the-shock-economy. Static input-output models do not take into account reactions of the economy on the production changes. This means that effects of a production change are studied *ceteris paribus* not taking into account adjustment of the rest of the economy into the new economic state. This means that the IO-estimates obtained tend to be overestimates of the reality as in due course economy readjusts and released factors of production find new uses either in the same sector (other cultivated crops) or in other lines of production.

IO-models are most suitable in ex post -analysis answering the question what are the linkages between different industries in the economy. They can answer the question how much production, value-added and employment would be lost in case an industry would disappear totally (e.g. Miller and Blair 2009, Vatanen 2010). Results of the IO-models are categorized as direct, indirect and induced effects and they are usually referred to as multiplier effects of the industry studied.

*Direct effects* refer to the industry itself i.e. output and value-added generated and persons employed in the industry studied. In case of the Finnish sugar sector direct economic effects would refer to the effects of sugar beet production, effects of sugar processing and refining factories, and effects of production of sugar utilizing products.

*Indirect* economic effects answer the question how much output, value-added and employment is needed in other industries of the economy in order to generate the output of that particular industry studied. As such indirect effects refer to inputs purchased from other industries of the economy. Multiplier effects are here used as a synonym for indirect economic effects.

In case of the Finnish sugar sector indirect effects include inputs purchased in sugar beet production and inputs acquired at sugar factories. Inputs purchased in sugar beet production basically include seed, fuel and motor oils, chemicals like fertilizers and plant protectants, agricultural equipments and their trade, transportation and haulage. Input purchases at sugar factories basically include wide variety of materials, equipment and services (electricity, water, sewage etc.) in addition to the main raw materials for the sugar beet farms. This kind of inputs usually consumed during one growing season or production period are in national accounting called intermediates.

*Induced* economic effects in IO-literature refer to multiplier effects (output, value-added and employment) generated by households in spending the income earned in production. In the case of the Finnish sugar sector, this would include household spending of sugar beet production, sugar factories as well as the production of all local input suppliers. Induced effects also include effects generated by the industry studied when purchasing investment goods. The latter one however is empirically rarely done.



<u>Direct effects</u>	<u>Direct effects</u>	<u>Direct effects</u>
<b>Sugar beet production +</b>	<b>Sugar factories +</b>	<b>Production of processed products +</b>
<u>Indirect effects:</u>	<u>Indirect effects:</u>	<u>Indirect effects:</u>
← <i>Inputs (intermediates) purchased</i>	← <i>Inputs purchased</i>	← <i>Inputs purchased</i>
← <i>Investment inputs purchased</i>	← <i>Investment inputs purchased</i>	← <i>Investment inputs purchased</i>
← <i>Household purchases</i>	← <i>Household purchases</i>	← <i>Household purchases</i>
<i>Note: This symbol “←” represents the demand for inputs/investment/household</i>		

**Figure 1.** Theoretical framework for the input-output model economic effects estimation of the Finnish sugar sector.

In this paper, the economic effects of the Finnish sugar sector are studied in a traditional input-output framework. This means that in addition to the direct effects of the sugar sector, the indirect effects on other industries are considered both at the national and regional level. It should be noted however, that even though we can construct an IO-model in a proper theoretical framework, data availability sets the limitations to the empirical estimation due to cost, time, accessibility etc. In this paper, the sugar sector direct effects including sugar beet production, sugar factories production and production of sugar utilizing processed products are derived from the national level. At the regional level, a case study on NUTS3<sup>1</sup> of Varsinais-Suomi includes indirect effects of primary sugar beet production and a case study on NUTS3 region of Satakunta also includes the indirect effects of the sugar factory production in Säkylä. Indirect effects include economic effects due to input purchases and household spending. Indirect effects due to investment purchases are left out.

<sup>1</sup> NUTS (Nomenclature des Unités Territoriales Statistiques) division is the regional classification system of the EU regions and Finland is divided into 21 NUTS3 regions (maakunta in Finnish).

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## 3 Data

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Statistic Finland (2013a) provides official industry by industry economic data in form of national accounting. Single industries are classified by the Standard Industrial Classification (SIC). In national accounting, the economic role of individual industries is expressed in terms of output (value of gross production), gross domestic product (GDP) generated by individual industries' value-added and employment. Whereas in bookkeeping data for example, the Farm Accountancy Data Network of MTT Agrifood Research Finland provides the profitability calculation for farms (Taloustohtori 2013).

National accounting classification gives the size (in the sense of output, value-added and employment) of industries in the economy. National accounting does not, however, take into account the production impact of an industry on the rest of the industries as industries are always linked with other industries in the economy via input demand.

Although the industry by industry direct effects are systemically available from Statistic Finland national accounting, in practice however data is published at the aggregated level (SIC classification). This means that in national accounting direct effects are available neither for sugar beet production (*SIC01134 Growing of sugar beet*) nor for sugar factories (*SIC1081 Manufacture of sugar*). The lack of the latter one is easily explained by non-disclosure agreements as there are only two factories in Finland, one for processing sugar beets and another one for refining raw sugar. This means that the estimates for direct output, value-added and employment of both sugar beet production and the sugar factories have to be estimated from alternative data sources. Data from ready-made input-output tables for sugar beet production or the sugar factories is neither available for estimating the indirect effects at regional level.

Statistic Finland (2013) provides regional input-output data and national input-output tables. The regional data is published irregularly with the latest statistical year dating back in year 2002 and the national data is published annually, whereby the latest statistical year is 2010. Both ready-made input-output tables provided by Statistic Finland are based on SIC (Standard Industrial Classification) classification. This means that sugar beet production is included in primary production aggregate *SIC01 Crop and animal production* (aggregate agricultural production), and sugar factories production in aggregate *SIC10\_12 Manufacture of food products etc.* (aggregate food industry).

In constructing the sugar sector industry specific input-output tables especially at the regional level, we are faced with constraints due to the lack of time and money resources and eventually data availability. In sugar beet production, the problem is the dispersion of production on farms with other crops and animal husbandry complicating the sugar beet specific cost structure building. Machinery, buildings and equipment can be utilized for other crops on the farm as well. In case of sugar factories, interviews with individual firm would be indispensable in order to trace the precise cost and income structures. The construction of the specific sugar sector's input-output tables including sugar beet primary production and sugar factories at regional level would thus be the time-consuming and expensive alternative, and would not necessarily lead to a more accurate outcome.

In this paper, figures for the indirect economic effects of the sugar sector are derived from public sources. The estimated regional indirect economic effects of the sugar sector for NUTS3 Varsinais-Suomi and NUTS3 Satakunta are based on Statistic Finland (2006) regional input-output tables and IO-models based on Knuutila and Vatanen (2008).

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## 4 Sugar sector in Finland

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The sugar sector in Finland comprises of primary production of sugar beet, sugar factories production (Säkylä and Kantvik) and production of processed products utilizing sugar (Figure 1).

The size of the sugar sector in Finland is defined in terms of output, value-added and employment. In addition to absolute figures (in euro), the relative size of the sugar sector industries are stated both at the industry aggregate level (SIC classification) and regional economy level. This is to figure out the relative size of the sugar sector compared to the aggregate industry level. This means that sugar beet production is compared to the aggregate agricultural production (*SIC01 Crop and animal production*) and production from the sugar factories is compared to the aggregate food industry (*SIC10\_12 Manufacture of food products etc.*).

### 4.1 Sugar beet production

Primary production consists of sugar beet production on farms. In Finland there are no farms focused entirely on sugar beet production, but sugar beet farms produce also other farm crops and/or have domestic animals. This is why the number of persons employed annually full-time in sugar beet production is difficult to estimate. It could only be done by obtaining the annual working hours in sugar beet production and converting hours into annual full time jobs. This is why we use the number of farms producing sugar beet as an indicator of persons employed in primary sugar beet production. This is also the practice in Statistic Finland national accounting system. Persons recorded as employees in an industry are not necessary working full time. In 2013 growing season sugar beet will be grown on less than 800 farms, which means that there are roughly about 800 farmers engaged in sugar beet production.

These 800 sugar beet farms is about 1.3 percent of the 60 000 active farms in Finland and 800 farmers engaged in sugar beet production is about 0.8 percent of the aggregate agricultural production employment of 95 000 persons in national accounting.

Market value of sugar beet production can be figured out using the average sugar beet producer price. The Information Centre of the Ministry of Agriculture and Forestry (Tike), which in Finland is responsible for the official agricultural price monitoring and data collection, does not collect data on sugar beet producer price. Also gross value of sugar beet production (i.e. output) including subsidies on production is difficult to estimate. This is because subsidies for production (farm, environment, Least Favoured Area/LFA, national etc.) in Finland are paid according to farm hectares, but there are also other crops grown and livestock raised on farms. This leads to the problem on how to allocate per farm paid subsidies between different lines of production.

Due to lack of official data, the gross value of sugar beet production is based on sugar beet farm models produced by ProAgria<sup>2</sup>. The sugar beet gross output including both market returns and subsidies on production in 2011 was € 2 323/per hectare (B area) (Liesivaara et. al 2011). Area under sugar beet production in 2011 was 14 100 hectares (Tike 2013). By exploiting the figures on cultivated area and per hectare gross output for sugar beet production in the sugar beet farm models, the gross output of sugar beet production is approximated at about €33million. The sugar beet production output of €33 million is 0.5 percent of the aggregate agricultural production output of €6 218 million (Table 1).

Similarly, no official data is available on the value-added for sugar beet production. In approximating the value-added for sugar beet production, we utilize the aggregate level agricultural production output. According to national accounting, the share of value-added of the aggregate agricultural output was 52.1 percent in 2011 (Statistic Finland 2013b). Derived from the 52.1 percent share of the €33 million sugar beet production output the sugar beet production value-added is estimated at €17.2 million. This is 0.5 percent of the national aggregate agricultural production value-added €3 439 million. (Table 1)

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<sup>2</sup> ProAgria is an advisor organization producing services for farmers including for example farm model based profitability calculations for different crops (ProAgria 2013).

**Table 1.** The direct effects of sugar beet production on output, value-added and employment in the national economy (€ million, persons) and the share of the national aggregate agricultural production (SIC01 Crop and animal production).

	Output € million	Value-added € million	Employment persons
Sugar beet production	33	17.2	800
% of aggregate agricultural production (SIC01 Crop and animal production)	0.5%	0.5%	0.8

## 4.2 Sugar factories (Säkylä & Kantvik)

There is only one sugar beet processing factory in Finland. This factory is located in the Säkylä municipality and NUTS3 region of Satakunta, nearby the main sugar beet cultivation areas in south-west Finland. In addition to the Säkylä sugar factory, there is a sugar refining mill in Porkkala, south coast of Finland (NUTS3 region of Uusimaa). The Porkkala factory is engaged in trading, importing and also refining imported raw cane and beet sugar.

Based on the balance sheet of Sucros Oy, the turnover of the Finnish Sucros group was €165.7 million for the accounting period of 1.3.2011-28.2.2012 (Sucros 2012). This €165.7 million turnover of the Finnish Sucros Group is used as an approximation for the output of the sugar factories (processing & refining) in Finland. This output represents 1.5 percent of the aggregate food industry output of €11 271 million in 2011 (Table 2).

In approximating the value-added for the sugar factories' production, we utilize the aggregate level of food industry output. According to national accounting, the share of value-added for the aggregate food industry output was 23.9 percent in 2011 (Statistic Finland 2013b). Derived from the 23.9 percent share of the €165.7 million sugar factory output the sugar factory value-added is estimated at €39.6 million. This stands for 1.5 percent of the national aggregate food production value added €2 698 million (Table 2).

The Sucros group together with the Säkylä factory and Porkkala refining mill employs around 245 persons in Finland (Sucros 2012). The Säkylä sugar factory employs around 40 additional seasonal workers during the autumn. The Sucros group total employment of 285 persons stands for 0.7 percent of the national aggregate food industry employment of 38 300 persons in 2011.

**Table 2.** The direct effects of production from sugar factories on output, value-added and employment in the national economy (€ million, persons) and the share from the national food production aggregate (SIC10\_12 Manufacture of food products etc.).

	Output € million	Value-added € million	Employment persons
Sugar factories (Säkylä, Kantvik)	165.7	39.6	285
% of the aggregate food industry output (SIC10_12 Manufacture of food products etc.)	1.5%	1.5%	0.7%

### 4.3 Sugar utilizing food and beverage industry

Sugar utilising food and beverage industry include a wide range of industries from fruit and dairy products to bakery, confectionery and beverages. In approximating the size of the sugar utilising industry, we use official statistical sources. By summing the national aggregate for “*SIC103 Processing and preserving of fruit and vegetables*”, “*SIC105 Manufacture of dairy products*”, “*SIC107 Manufacture of bakery and farinaceous products*”, “*SIC1082 Manufacture of sugar confectionery*”, and “*SIC110 Manufacture of beverages*” in the food and beverage industry that utilise sugar as an input in their production, the total output is €5 914 million (table 3). This is more than half (53 percent) of the food industry aggregate output of €10 323 million. The sugar utilizing industry’s value-added output of €1 535 million makes 61 percent of the food industry’s value-added aggregate of €2 534 million. The sugar utilizing food industry’s employment of 19 709 persons constitutes 59 percent of the food industry’s employment of 38 000 persons (Table 3). Therefore, potential changes in the sugar market would be relevant to a major part of the Finnish food and beverages industry.

The sugar utilizing industry output of €5 914 million makes up 5.5 percent of the manufacturing industries’ aggregate output (*SIC\_C Manufacturing*) of €106 702 million, which includes other industrial production. The sugar utilizing industry’s value added output of €1 535 million constitutes 5.7 percent of the manufacturing industry’s value-added output of €27 137 million. Finally, the sugar utilizing industry’s employment of 19 709 person comprises 5.2 percent of the total manufacturing industry’s employment of 382 000 persons (Table 3). However, Statistic Finland SIC industry classification unavoidably includes also production not operating in the sugar utilizing industry, thus there may be an overestimation of the employment figures.

The sugar utilizing industry’s output of €5 914 million accounts for 1.7 percent of the national production aggregate (*SIC\_0 Industries total*) output of €350 523 million, which includes also primary production and services. The sugar utilizing industry’s value-added output of €1 535 million represents 1.0 percent of the aggregate national production’s value-added output of €155 632 million. Lastly, the sugar utilizing industry’s employment of 19 709 persons corresponds to 0.8 percent of the total national employment of 2 482 000 persons (Table 3).

**Table 3.** The direct effects of production from sugar utilising industries on output, value-added and employment in the national economy (€ million, persons) and the share from the national food industry aggregate (*SIC10\_12 Manufacture of food products etc*), manufacturing production aggregate (*SIC\_C Manufacturing*), and national production aggregate (*SIC\_0 Industries total*) (%) in 2010<sup>3</sup> (Statistic Finland 2013c).

SIC-industry	Output, € million	Value-added, € million	Employment, persons
<i>SIC103 Processing and preserving of fruit and vegetables</i>	472	135	1 733
<i>SIC105 Manufacture of dairy products</i>	2 693	429	4 692
<i>SIC107 Manufacture of bakery and farinaceous products</i>	1 095	473	8 423
<i>SIC108-2 Manufacture of sugar confectionery</i>	431	131	1 576
<i>SIC110 Manufacture of beverages</i>	1 222	368	3 286
<b>Total</b>	<b>5 914</b>	<b>1 535</b>	<b>19 709</b>
% of food industry aggregate ( <i>SIC10_12 Manufacture of food products and beverages</i> )	53%	61%	59%
% of manufacturing production aggregate ( <i>SIC_C Manufacturing</i> )	5.5%	5.7%	5.2%
% of national production aggregate ( <i>SIC_0 Industries total</i> )	1.7%	1.0%	0.8%

Although the majority of the food industry establishments are situated in southern, south-western and western parts of Finland (NUTS3 regions: Uusimaa, Etelä-Pohjanmaa, Varsinais-Suomi and Satakunta), there are dairy, bakery, sugar confectionary and fruit preserving production on all sides of Finland. This suggests that changes in the EU sugar market would have an effect on production in all parts of Finland along with sugar beet production and sugar factories clustered distinctively in south and south-west of Finland.

<sup>3</sup> For regional and industrial statistics on manufacturing (Statistics Finland 2013c) statistic year 2010 is used instead of the 2011.

**Table 4.** Estimated direct and indirect effects on total output, value-added and employment of sugar beet production, sugar factories production and sugar utilizing industry production (€ million, persons) according to the share of national production aggregate in 2011 (%).

	Output € million			Value-added € million			Employment persons		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Sugar beet production	33	44.6	77.6	18.2	13.6	31.8	800	296	1 096
Sugar factories (Säkylä, Kantvik)	165.7	236.7	402.6	40.6	77.1	117.7	245	485	730
Sugar utilizing industry	5 914	8 457.0	14 371.0	1 535	2 916.5	4 451.5	19 709	39 024	58 733
Total	6 112.7	8 258.3	14 371.0	1 593.8	2 857.7	4 451.5	20 754	37 979	58 733
% of the national production aggregate	1.6%	2.2%	3.8%	1.0%	1.7%	2.7%	0.8%	1.5%	2.3%

The output effects of the sugar chain production including sugar beet production, sugar factories and sugar utilizing industries totals €14 371.0 million when indirect multiplier effects €8 258.3 million in addition to direct effects €6 112.7 million are taken into account. This accounts for 3.8 percent of the national aggregate output of €375 777 million in 2011. The value-added effects of the sugar chain production totals €4 451.5 million when indirect value-added effects €2 857.7 million in addition to direct value-added effects €1 593.8 are taken into account. This totals 2.7 percent of the national aggregate €163 424 million value-added. The employment effects of the sugar chain production totals 58 732 persons as the indirect employment effects 37 979 persons in addition to direct effects 20 754 persons are taken into account. This accounts for 2.3 percent of the national aggregate employment of 2 509 500 persons. As far as employment effects are concerned, the number of employees does not refer to full-time employees, but included also all those who are involved at any stages of the sugar chain production. The indirect effects include multiplier effects due to both household spending and intermediate input purchases.

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## 5 Regional economic effects

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### 5.1 The case of NUTS3 region of Varsinais-Suomi

Varsinais-Suomi NUTS3 region accounts for almost half of the area under sugar beet production in Finland. This is about 6 700 hectares, which is 48 percent of the total sugar beet area of 14 100 hectares in 2011 (Tike 2013). By using the figures on cultivated area and per hectare gross output for sugar beet production (€2 323 ) in the sugar beet farm models, the gross output of sugar beet production in the region of Varsinais-Suomi is approximated to be €15.6 million.

The output of €15.6 million for sugar beet production is called the direct output effect in the the region of Varsinais-Suomi. The multiplier effects of sugar beet production in Varsinais-Suomi can be estimated by using Knuuttila and Vatanen (2008) IO-models for the NUTS3 regions. The multipliers for the aggregate level of agricultural production are applied as no specific multipliers for sugar beet production are available. The output multiplier for the region of Varsinais-Suomi was 1.27. This multiplier includes only intermediate inputs of production. The multiplier would be 2.01 if multiplier effects due to household spending are included in the extended input-output model. The extended input-output model's multipliers indicate that household purchases intensify the significance of regional economic effects for primary production substantially. The total output effect of sugar beet production in this region is €31.4 million (Table 5).

The value-added of sugar beet production in the region of Varsinais-Suomi is approximated to be €8.0 million. The share of value-added for agricultural production in the region of Varsinais-Suomi is approximated by utilizing in the share of value-added for sugar beet production at the aggregate level. The direct value-added effect of sugar beet production in the region of Varsinais-Suomi is €8 million and the indirect value-added multiplier effect for sugar beet production in Varsinais-Suomi is estimated to be €4.1 million. This estimation is based on Knuuttila and Vatanen (2008) IO-models by using the value-added multiplier of 1.51 for the aggregate agricultural production of Varsinais-Suomi. Hence, the total value-added effects of sugar beet production in the region of Varsinais-Suomi are € 12.1 million (Table 5).

The employment of sugar beet production in the region of Varsinais-Suomi is approximated to be 380 persons. This approximation is based on the total sugar farm employment of about 800 persons and the area share of sugar beet production for Varsinais-Suomi (48 percent). One sugar beet farm is assumed to correspond to employment of one person. The direct employment effect of sugar beet production in the region of Varsinais-Suomi is 380 persons. The indirect employment effect of sugar beet production can be estimated by utilizing the employment's multiplier of 1.37 from the aggregate level of agricultural production in Varsinais-Suomi (Knuuttila and Vatanen 2008). The indirect employment of sugar beet production would be 140 persons, thus the total employment effect of sugar beet production in Varsinais-Suomi is 520 persons (Table 5).

The output for the sugar utilizing food industry in Varsinais-Suomi is €499.3 million by assuming that the sugar utilizing industry's 53 percent share (see table 3) of the aggregate food industry's output at the national level is also valid for Varsinais-Suomi. This figure is 53 percent of Varsinais-Suomi's food industry aggregate output of €942 million. The total output effects of the sugar utilizing industry in this region are €1 048.5 million by using the output multiplier of 2.10 (Knuuttila and Vatanen 2008) for the aggregate food industry in Varsinais-Suomi (Table 5).

The direct value-added effect for the sugar utilizing food industry in Varsinais-Suomi is estimated at € 154 million by assuming the sugar utilizing industry's 61 percent value-added share (see table 3) of the aggregate food industry's output for Varsinais-Suomi. The total value-added effects of the sugar utilizing industry in this region are 380.4 million by using the value-added multiplier of 2.47 (Knuuttila and Vatanen 2008) for the aggregate food industry in Varsinais-Suomi (Table 5).

In estimating the direct employment effect of the sugar utilizing industry in Varsinais-Suomi, we assume that the share of sugar utilizing industry's employment in this region corresponds to the share at the



national level (59 percent, see table 3). Hence, the direct employment effect of the sugar utilizing industry in Varsinais-Suomi is 1 933 persons (out of the aggregate food industry's employment of 3 277 persons in Varsinais-Suomi). The total employment effects of the sugar utilizing industry in this region are 5 122 persons by using the employment multiplier of 2.65 (Knuutila and Vatanen 2008) for the aggregate food industry in Varsinais-Suomi (Table 5).

The total output effects of the sugar chain in Varsinais-Suomi are €1 048.5 million. This figure is the sum of the output from sugar beet production and sugar utilizing industry and their indirect multiplier effects in this region including both intermediates in production and household spending. This figure accounts for 3.7 percent of Varsinais-Suomi's total output of €28 159 million (Table 5).

The total value-added effects of the sugar chain in Varsinais-Suomi are €392.5 million. This figure is the sum of the value-added from sugar beet production and sugar utilizing industry and their indirect multiplier effects in this region including both intermediates in production and household spending. This figure accounts for 3.3 percent of Varsinais-Suomi's total value-added of €11 849 million (Table 5).

The total employment effects of the sugar chain in Varsinais-Suomi are 5 122 persons. This figure is the sum of the employment from sugar beet production and sugar utilizing industry and their indirect multiplier effects in this region including both intermediates in production and household spending. This figure accounts for 2.5 percent of Varsinais-Suomi's total employment of 207 849 persons (Table 5).

Among the Finnish NUTS3 regions, the indirect multipliers for Varsinais-Suomi are ranked high. The size of the multiplier indicates how much of the intermediate inputs needed in production and household purchases originate from the region. The size of the multiplier is affected by the diversity of production in the region – the more diverse the industrial and service sectors in the region, the bigger the multiplier effects tend to be. The indirect effects of agricultural production are biggest in agricultural trade. This is natural as most of the production inputs are supplied by agricultural trade. Indirect multiplier effects include also manufacturing industries, for example energy and refined petroleum products, rubber and plastic products and chemicals etc.

**Table 5.** The estimated direct and indirect effects (€ million, persons) of the sugar chain plus the percentage share of the sugar chain's total output, value-added and employment in the NUTS3 region of Varsinais-Suomi.

	Output			Value-added			Employment		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Sugar beet production	15.6	15.7	31.4	8.0	4.1	12.1	380	140	520
Sugar utilizing industry	499.3	549.2	1 048.5	154	226.4	380.4	1 933	3 189	5 122
<b>Sugar beet production and sugar utilizing industry</b>	<b>514.9</b>	<b>533.6</b>	<b>1 048.5</b>	<b>162</b>	<b>230.5</b>	<b>392.5</b>	<b>2 313</b>	<b>2 809</b>	<b>5 122</b>
<i>% of total output/value-added/employment of NUTS3 region of Varsinais-Suomi</i>			<b>3.7%</b>			<b>3.3%</b>			<b>2.5%</b>

## 5.2 The case of NUTS3 region of Satakunta

The only sugar beet processing factory in Säkyly is located in the NUTS3 region of Satakunta. The factory in Säkyly accounts for €58.6 million out of the Sucros group total turnover of €165.7 million (accounting period of 1.3.2011-29.2.2012). This €58.6 million is the direct output effect of the sugar factory production in Satakunta. The indirect effects of the sugar factory in Satakunta can be estimated by using the aggregate food production multipliers introduced in Knuutila and Vatanen (2008) IO-models for the NUTS3 regions. The output multiplier of the food industry in the region of Satakunta was 2.01, thus the total output effect of the sugar factory is €117.8 million by implying an indirect output effect of €59.2 million (Table 6).

The value-added from the sugar factory production is approximated at €15.8 million (the share of value-added from the food industry's aggregate output for the region of Satakunta). This is called the direct value-added effect of the sugar factory production in Satakunta. The indirect value-added effect of the sugar factory production can be estimated by utilizing the food industry's multiplier of 2.04 based on Knuutila and Vatanen (2008) IO-model for the NUTS3 region. This gives the total value-added effect of €32.2 million for the sugar factory production with the indirect value-added effect of €16.4 million in the region of Satakunta (Table 6).

The sugar factory employment is 80 persons and also 40 additional seasonal workers during the autumn (Sucros 2013). This is the direct employment effect (120 persons) of the sugar factory production. The aggregate food industry's employment multiplier for the NUTS3 region of Satakunta is 2.21, which would give the sugar factory production's total employment effect of 177-265 persons with the indirect effect of 97-145 persons. By definition, the IO-model includes also sugar beet production employment effects because sugar beet is the main raw material input for the sugar factory. However, farm employment alone is about 306 persons based on the cultivated sugar beet area in the region of Satakunta. The sugar beet cultivation area in the region of Satakunta is 5400 hectares i.e. 38 percent of the total sugar beet area of 14 100 hectares in Finland. This means that the aggregate food industry's multiplier of 2.21, although high, clearly underestimates the input based multiplier effects of employment from the sugar factory with a highly centered production in the region. Therefore, the total employment for both the sugar beet production and sugar factory production would be about 483 to 571 persons in the region of Satakunta (Table 6).

The output for the sugar utilizing food industry in Satakunta is €274.3 million by assuming that the sugar utilizing industry's 53 percent share (see table 3) of the aggregate food industry's output at the national

level is also valid for Satakunta. This figure is 53 percent of Satakunta's food industry aggregate output of €517.6 million. The total output effects of the sugar utilizing industry in this region are €551.3 million by using the output multiplier of 2.01 (Knuuttila and Vatanen 2008) for the aggregate food industry in Satakunta (Table 6).

The direct value-added effect for the sugar utilizing food industry in Satakunta is estimated at €86.3 million by assuming the sugar utilizing industry's 61 percent value-added share (see table 3) of the aggregate food industry's output for Satakunta. The total value-added effects of the sugar utilizing industry in this region are 176.1 million by using the value-added multiplier of 2.04 (Knuuttila and Vatanen 2008) for the aggregate food industry in Satakunta (Table 6).

In estimating the direct employment effect of the sugar utilizing industry in Satakunta, we assume that the share of sugar utilizing industry's employment in this region corresponds to the share at the national level (59 percent, see table 3). Therefore, the direct employment effect of the sugar utilizing industry in Satakunta is 1 315 persons (out of the aggregate food industry's employment of 2 229 persons in Satakunta). The total employment effects of the sugar utilizing industry in this region are 2 906 persons by using the employment multiplier of 2.21 (Knuuttila and Vatanen 2008) for the aggregate food industry in Satakunta (Table 6).

The total output effects of the sugar chain in Satakunta are €551.3 million. This figure is the sum of the output from sugar factory production and sugar utilizing industry and their indirect multiplier effects in this region including both intermediates in production and household spending. This figure accounts for 3.5 percent of Satakunta's total output of €15 716 million (Table 6).

The total value-added effects of the sugar chain in Satakunta are €208.3 million. This figure is the sum of the value-added from sugar factory production and sugar utilizing industry and their indirect multiplier effects in this region including both intermediates in production and household spending. This figure accounts for 3.5 percent of Satakunta's total value-added of €5 953.4 million (Table 6).

The total employment effects of the sugar chain in Satakunta are 3 477 persons. This figure is the sum of the employment from sugar factory production and sugar utilizing industry and their indirect multiplier effects in this region including both intermediates in production and household spending. This figure accounts for 3.4 percent of Satakunta's total employment of 102 223 persons (Table 6).

**Table 6.** The estimated direct and indirect effects (€million, persons) of the sugar chain plus the percentage share of the sugar chain's total output, value-added and employment in the NUTS3 region of Satakunta.

	Output			Value-added			Employment		
	Direct	Indirect	Total	Direct	Indirect	Total	Direct	Indirect	Total
Sugar factory production (sugar beet production effects are included in indirect effects)	58.6	59.2	117.8	15.8	16.4	32.2	426	ca. 145	ca.571
Sugar utilizing industry	274.3	277.0	551.3	86.3	89.8	176.1	1 315	1 591	2 906
<b>Sugar factory production and sugar utilizing industry</b>	<b>332.9</b>	<b>218.4</b>	<b>551.3</b>	<b>102.1</b>	<b>106.2</b>	<b>208.3</b>	<b>1 741</b>	<b>1 736</b>	<b>3477</b>
<b>% of total output/value-added/employment of NUTS3 region of Satakunta</b>			<b>3.5%</b>			<b>3.5%</b>			<b>3.4%</b>

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## 6 Discussion and final remarks

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Information on the role of industries in the regional and national economy is important for the industries themselves in building up their public image and justifying their role in the economy. Background information on the economic role of industries is crucial to policy and decision makers due to the involvement of public financing. At the provincial and municipal level, the economic role of industries is crucial for employment and tax revenues that sustain the livelihood of the provinces and municipalities in Finland.

Even though the effects of primary sugar beet production and sugar factory production including multiplier effects seem rather small compared to the total effects at the NUTS3 regional level, the actual effects are felt at the municipalities<sup>4</sup> level in the form of decreasing tax revenues and unemployment if the sugar sector in Finland disappears and is not substituted for by other forms of production and industry.

Domestic sugar production is important because of the constant supply of raw materials for the sugar utilizing industries and shield from the volatile world market prices. One good case study is from Ireland. In 2006, following the EU sugar policy reforms, Ireland's last sugar plant in Mallow was controversially closed down with a direct loss of 320 jobs (The Irish Times 2012). However, in 2010, a report by the European Court of Auditors found that the closure of the factory was needless because the business was profitable at the time. Since the reform of the EU sugar regime in 2006, the price of sugar eventually doubled in Ireland over the past years from about €450 to €900 per ton (Irish Examiner 2013). The drastic increase in price for sugar and difficulty in sourcing sugar would have a profound impact on the sugar utilizing industry in Ireland<sup>5</sup>. As a consequence, the Irish government is attempting to revive the Irish sugar beet industry in 2015, if it can agree an arrangement on sugar production quotas with the European Commission (The Irish Times 2012).

There is data to prove that without domestic production, the sugar price is higher for Ireland compared to the other EU member states due to imperfections in the EU sugar market after the reform of the EU sugar regime in 2006. Appendix 1 shows that the retail prices for sugar in Ireland, the UK, Finland and Germany were quite close to each other before the reform of the EU sugar regime in 2006, but the sugar prices started to diverge after 2010 with Ireland achieving the peak price without domestic sugar production and Germany maintaining the lowest price with sugar production above the self-sufficiency rate. The sugar price for consumers in Ireland is the highest compared to the United Kingdom (UK), Finland and Germany. The UK and Finland are not self-sufficient in producing sugar for the domestic market, but Germany has been always producing over its self-sufficiency limit. Therefore, the consumers in Germany enjoy the lowest price for sugar compared to Ireland, Finland and the UK. Due to the existing domestic sugar production in Finland and the UK, the price of sugar is lower in these countries compared to Ireland.

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<sup>4</sup> The municipal of Säskylä would definitely be affected. For example, the municipal of Salo is badly affected by the lost of tax revenues and employment after the sugar factory and electronics factory were closed down. Salo had to lay off some teachers in its municipality due to its deficit budget.

<sup>5</sup> The Irish Examiner (2013) reported that big sweet and soft drinks manufacturers said that "their biggest problem is being sure they can source sugar and they only talk about price after that".

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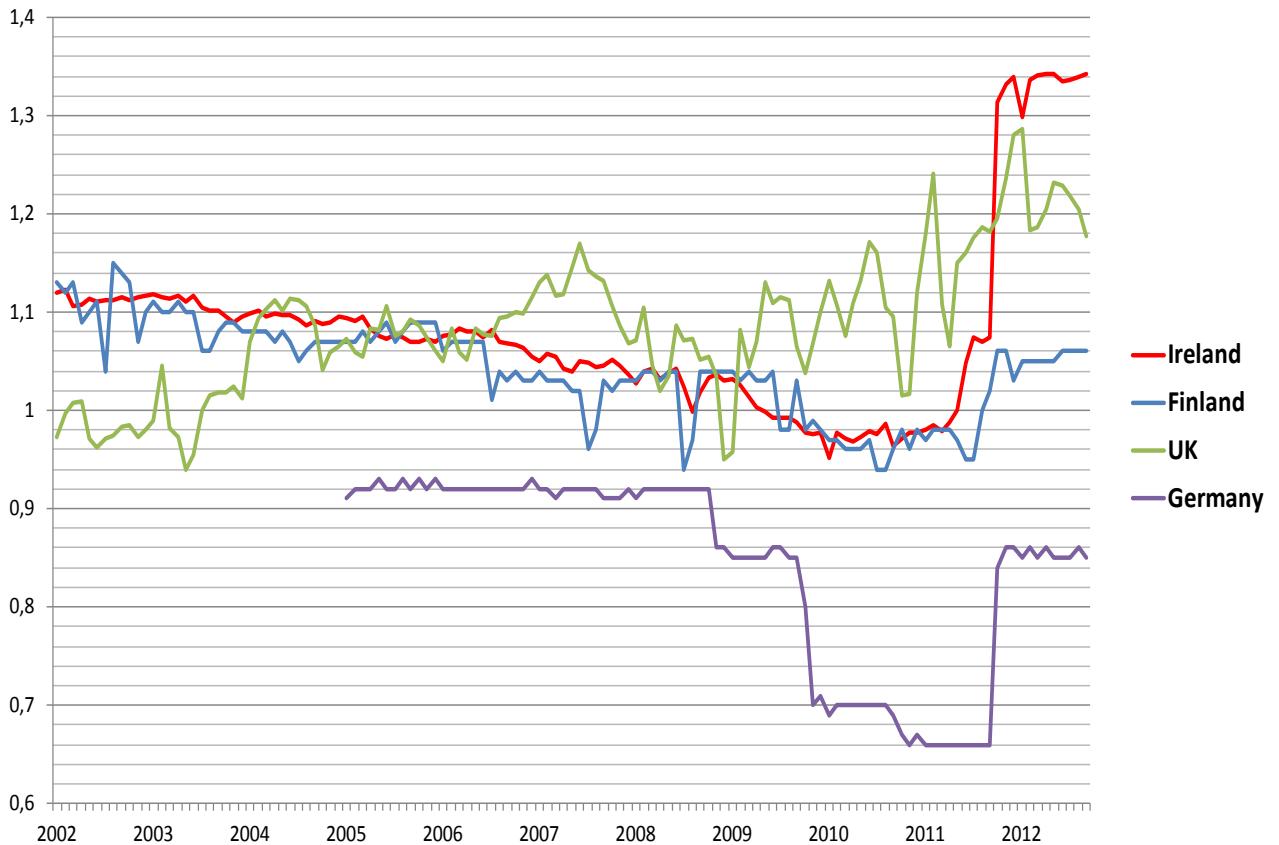
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# Appendix

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## Appendix 1

The retail price in euro for 1 kg of granulated white sugar in Ireland, Finland, the United Kingdom<sup>6</sup> (UK), and Germany from 2002 to 2012



Source: The Statistics Office of Ireland, Finland, UK, and Johann Heinrich von Thünen Institute

<sup>6</sup> The retail price in the UK is converted from pound to euro. Thus, the UK price is also influenced by currency fluctuation between the pound and euro.

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