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Hannu Törmä and Thomas Rutherford *

INTEGRATING FINNISH AGRICULTURE INTO EC'S COMMON AGRICULTURAL POLICY

VALTION TALOUDELLINEN TUTKIMUSKESKUS
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TIIVISTELMÄ: Maatalouden integraatiovaihtoehtoja on tutkittu yleisen tasapainon laskentamallilla, joka on kehitetty suomalais-amerikkalaisena tutkimusyhteistyönä. Mallissa kuvataan yksityiskohtaisesti Suomen maatalouden tavoitehintojen määräytyminen. Tällä GEMFIN-mallilla on tutkittu Suomen GATT-ratkaisun ja EY-jäsenyyden vaikutuksia maatalouteen ja elintarviketeollisuuteen.

Maatalouden tuotanto supistuisi laskelman mukaan nykyvaluuttakurssilla noin kolmanneksella, jos Suomi liittyisi EY:n jäseneksi ja jos maatalouden tavoitehinnat alennettaisiin Euroopan tasolle. Viljaa ei kannattaisi viljellä pitkällä tähtäimellä ollenkaan ja sian- ja naudanlihaa voitaisiin tuottaa 30-45 % vähemmän kuin nykyisin. Maidon tuotanto supistuisi lähes 30 % ja siipikarjatuotteiden tuotannon määrä laskisi hieman alle puoleen nykytasosta. Parhaiten pärjäisivät muut kuin viljakasvit, joiden tuotanto ei juurikaan kärsisi. Jos Suomen nykyinen GATT-sopimuslinja tulisi hyväksytyksi, niin maatalouden tuotanto supistuisi noin 10 %:lla.

ASIASANAT: GATT-sopimus, EY-jäsenyysneuvottelut, maataloustuki, rajasuoja, yleisen tasapainon mallinnus

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ABSTRACT: Integration scenarios of Finnish agriculture have been studied by means of an applied general equilibrium model which has been developed as a Finnish-American co-research project. The determination of the target prices of Finnish agricultural products are modeled in a detailed manner. The authors have studied by means of this GEMFIN model the effects of the GATT aggreement and the effects of Finnish EC membership for agriculture and for food processing industries.

The produce of agriculture would decrease by one third with current exchange rate if Finland would become a member in EC and if the producer prices of agricultural products would be reduced to European levels. It would be unprofitable to grow grains in the long run and 30 to 45 % less of pork and beef could be produced compared to the present situation. Milk production would decrease by almost 30 % and the production of poultry and eggs would be nearly halved. The best resistance would be in other plants, their production would hardly suffer at all. If the present Finnish view for the GATT aggreement would be accepted then the produce of agriculture would decrease by about 10 %.

KEY WORDS: GATT aggreement, EC membership negotiations, subsidies of agriculture, general equilibrium modeling

ESIPUHE

Valtion taloudellisen tutkimuskeskuksen eräänä painopistealueena on kansantalouden pitkän aikavälin rakennekehityksen tutkiminen. Euroopan integraatio on epäilemättä yksi keskeisistä kansantalouden tulevaan rakennekehitykseen vaikuttavista tekijöistä. VATT osallistuukin integraatiokehityksen selvittelyihin paitsi laatimalla tutkimuksia aiheesta myös asiantuntijana integraationeuvottelujen valmisteluryhmissä.

Maatalouden sopeutumista on pidetty Suomen kannalta eräänä ongelmallisimpana asiana Suomen EY-jäsenyyden kannalta. Ennen jäsenhakemuksen jättämistä VATTissa selviteltiin EY:n maatalouspoliittista järjestelmää ja sen mahdollisia budjettivaikutuksia Suomen kannalta (Suomi Euroopan yhteisön jäseneksi? Taloudelliset vaikutukset, VATT, julkaisuja 5, 1992). Samalla pyrittiin arvioimaan maatalouden sopeutumisen kansantaloudellisia vaikutuksia kokonaistaloudellisen mallilaskelman avulla.

Oheisessa tutkimuksessa maatalouden sopeutumisproblematiikkaa on tarkasteltu metodologisesti uudesta näkökulmasta. Tutkimus perustuu yleiseen tasapainomalliin, johon on pyritty sisällyttämään maatalouden sopeutumisen kannalta kaikki keskeiset tekijät. Tutkimuksessa on uutta ennen kaikkea se, että tarkastelukehikossa sekä kotimaiset maatalouden hinnat että tuotantomäärät sopeutuvat tuoteryhmittäin optimaalisella tavalla käytetyn mallikehikon puitteissa. Malli on kehitetty suomalais-amerikkalaisena yhteistyönä ja sen taustalla on oletus taloudellisista tulostaan optimoivasta maatilasta.

Vaikka malli tavallaan pyrkiikin jäljittelemään viljelijöiden optimaalisia reaktioita muuttuneisiin olosuhteisiin, on mallilaskelmiin aina suhtauduttava tietyin varauksin. Todellisuus voi olla aina monimutkaisempi ja yllätyksellisempi kuin mitä malleissa pystytään kartoittamaan. Tämän ohella virallisissa neuvotteluissa saatetaan pyrkiä tuloksiin, jotka poikkeavat mallin perustana olevista lähtökohdista. Näistä varauksista huolimatta tutkimus antaa nähdäksemme aineksia pohdiskella aiempaa monipuolisemmin maatalouden sopeutumiseen vaikuttavia tekijöitä ja siksi valtion taloudellinen tutkimuskeskus on halunnut saattaa tutkimuksen myös laajemman lukijakunnan käyttöön.

Reino Hjerppe
ylijohtaja

ALKUSANAT

Tämä tutkimus on tehty yhteistyössä prof. Thomas Rutherfordin (University of Colorado, Boulder, USA) kanssa. Allekirjoittanut on vastannut tutkimuksen suunnittelusta, aineiston hankinnasta ja tutkimuksen käytännön toteutuksesta. Prof. Rutherford on toiminut ohjelmointikonsulttina ja lisäksi osallistunut mallin täsmentämiseen ja kuvaukseen.

Lausun parhaimmat kiitokseni kaikille niille henkilöille, jotka ovat kommenteillaan vaikuttaneet tutkimuksen etenemiseen. Valtion taloudellista tutkimuskeskusta kiitän tutkimusprojektin rahoituksesta ja julkaisemisesta. Yrjö Jahnssonin Säätiölle esitän lämpimät kiitokset projektin tukemisesta stipendivaroin.

Hannu Törmä

CONTENTS:

1. INTRODUCTION AND ASSESSMENT OF EARLIER RESEARCH

Finnish economy is strongly tied to European economies. Finland is a small open economy so her welfare rests heavily upon foreign trade. Through her now 75 year old independence she has tried to establish profitable trade agreements. Finland has liberalized her foreign trade together with other EFTA countries but the trade agreements have always excluded agriculture. This has been motivated by needs of self-sufficiency in food economy and by regional policy considerations. The planned new agreement for European Economic Area does not change this chain of agricultural protectionism in Finland.

Times change and so do economic thinking. One part of Finns seems to think today that protectionistic agricultural policy is the cause of the too high food prices and overproduction of most agricultural products. The old system is shaking since there are strong pressures for cheaper goods in Finland.

The final expression of this new thinking was the Finnish application for membership in the European Communities. While this is written it seems that Finnish application will be accepted. The result of negotiations is very uncertain because it is probable that there will be a popular election in Finland on this matter.

The question of agricultural integration raises strong emotions. There is a lot of information on economic effects of alternative integration schemes for agriculture. Most of them are, however, of partial nature or based on aggregated data. The purpose of this study is to provide a general equilibrium calculation on these matters. The general equilibrium framework is suitable for evaluating wide range effects such as changes of terms of trade.

1.1 Domestic studies on agricultural reform

Kuhmonen (1991 a, b), Leppä (1992) and Vaittinen (1992) have recently estimated the economic effects of Finnish agricultural liberalization. The studies differ both in simulation assumptions and in types of models used in calculations. Their common objective is, however, to estimate how deeply Finnish food economy will change as a result of Finnish membership in EC. In the following pages there is a short summary of these studies.

The study of Kuhmonen (1991)

Kuhmonen (1991 a) presents a summary of national studies of agricultural integration conducted in Sweden, Norway, Austria and Switzerland. He also presents a preliminary evaluation of the EC membership effects for Finnish farms using margin-return calculations.

The research approach of Kuhmonen (1991 a) can be characterized as static short run analysis, where long run adjustment effects are ignored. The results aim at revealing the situation of farming after the direct effects of Finnish EC membership have been materialized. The calculations are based on the differences of producer prices in Germany and in Finland in 1988.

The key assumption in all of his calculations is the obvious fact that producer prices of agriculture will reduce by about 50 % as a consequence of the membership. This happens because as a member of EC Finland would be part of EC's price system and use EC's target prices for agricultural products. According to Kuhmonen (1991 a) producer prices of plant products would reduce by about 60 %, in gardening products the decrease would be about 40-55 % and the producer prices of farm animal products would decrease by about 50 %.

The main result of Kuhmonen (1991 a) is that while producer prices and thus farm gross incomes would reduce by about 50 % the corresponding cost savings (mainly in feedingstuffs) would be only about 20 %. The profitability of agricultural production would decline dramatically. The margin return would decrease by about 60-80 % for plant products and by about 70-80 % for most farm animal (meat production) products. The most profitable of the main plant products would be feed grains and oil plants. The profitability of production would reduce least in milk production where margin returns would decrease by about 25-40 %. Kuhmonen (1991 a) concludes that profitability would decrease most for farms specialized in plant and farm animal products and least in farms specialized in milk production.

Kuhmonen (1991 a) calculates that without adjustments farm income could even become negative in the short run. Average net cash flow of farms would be reduced by about 80 %. Kuhmonen concludes that structural change needed in agricultural production must be financed largely by sources outside agriculture. The financing problem must be solved domestically since according to Kuhmonen Finland would give net finance to the agricultural budget of EC.

Kuhmonen also reminds that Finnish food industry is strongly dependent on domestic raw materials. Kuhmonen concludes that the decrease in domestic agricultural production would raise unit costs and threaten the profitability of the food industry.

Kuhmonen (1991 b) has also calculated the effects on GDP. Calculation is a static one where gross income of agriculture would decrease by about 50 %. All adjustments and feedbacks are ignored. Kuhmonen presents his results on a regional level. The direct effect of Finnish EC membership would reduce GDP dramatically in most provinces. Vaasa province would lose most, about 7 % of regional GDP would be wasted. Other middle Finland provinces would lose 1-4 % of their regional GDP. Northern part of Finland would lose less than 2 % and the most southern Uudenmaa province would lose least, less than 1 % of its regional GDP.

Kuhmonen (1991 a, b) emphasizes the huge size of adjustment needed in connection with Finnish EC membership. Kuhmonen's analysis was the first research based discussion

of EC membership effects of agriculture in Finland. Its task was to shaken the audience and to raise further discussion of EC strategy for Finnish agriculture. When interpreting his results we have to bear in mind, however, his short run static approach. Direct effects are not usually the final ones. Indirect and feedback effects might be equally important. General equilibrium analysis can reveal the importance of these second stage effects.

The study of Leppä (1992)

Leppä (1992) compares macroeconomic effects of the EES and EC membership agreements for Finland. He applies the econometric KESSU IV macromodel in his simulations. Leppä simulates the path of Finnish economy under EC agreement and compares the performance of macro variables to the reference path which follows the economic situation under the EES agreement.

Leppä assumes for computational purposes that Finland will be a full member in EC in the beginning of the year 1995 and all results refer to the average of period 1999-2002. Leppä's research approach could thus be characterized as long run analysis.

Leppä (1992) divides the total effect of Finnish EC membership into four parts. The first macromodel simulation deals only with the change of agricultural policy. For our purposes this simulation is the most interesting one. It is assumed that producer prices of agriculture will be reduced by 50 %. The state abolishes agricultural subsidies, worth of FIM 9 billion and they will be replaced by direct support to farmers worth of FIM 5 billion.

It is further assumed that agricultural production will decrease by 30 % as a consequence of these actions. The producer prices of food industries will decline by 30 % because of the cost savings in raw materials. In these calculations the wage level reduces according to reduction in costs of living. In an alternative simulation wages were sticky.

The first simulation of Leppä (1992) shows that the agricultural integration reform supports economic growth. GDP would increase by 0.6 % with adjusting wages and by 1 % if wages are assumed sticky. Prices of consumer goods would decrease by 4 to 7 % correspondingly. The social price of the reform would be a loss of 23 000 jobs in agriculture. This estimate is based on the assumed decrease of 30 % in the produce of agriculture. Farmers would be the greatest losers in the reform. Producer prices would be halved while input prices of agriculture would reduce by only 18 %. Further, the reform would worsen the balance of payments problem of Finland. Due to increased imports and slightly decreased exports the balance of payments deficit would increase by FIM 7 billion. The government budget balance will strengthen, however, since the government saves in subsidies of agriculture.

The second simulation of Leppä (1992) adds the assumption that increased competition after the EC agreement will reduce producer prices also in other sheltered sectors.

Producer price decreases are assumed to be 3-20 %. In the third simulation it is further assumed that after Finland joins the European Monetary System the rate of interest will come down by two percentage points. Finally, the fourth simulation adds to this the effects of harmonization of indirect taxation.

The combined effect of the whole EC reform package would be very positive. GDP would be 7.7 % higher in the long run compared to the situation under the EES agreement. Prices of consumer goods would be even 19 % cheaper if Finland would be a member of EC. Total employment would be 103 000 jobs better, balance of payments would be FIM 13 billion stronger and there would be a surplus of FIM 12 billion in the public budget. Leppä concludes that Finland has potentially much to gain from membership in EC provided that the adjustment will succeed.

The main uncertainty in Leppä's estimations seems to be in the assumptions about producer prices. In Leppä (1992) most producer prices change exogenously. In reality their adjustment is endogenous. In a general equilibrium model all price adjustments are based on the interplay of demand and supply. In our analysis we assume as little as possible and let the endogenous adjustments of demand and supply determine after reform prices.

The study of Vaittinen (1992)

Vaittinen (1992) presents three simulations based on econometric sector models. His models are all partial equilibrium models. Agriculture is analyzed in a disaggregated manner but linkages to other sectors are not modelled. He uses flexible functional forms and duality theory in deriving supply and demand functions of agricultural products. From these he calculates elasticities of supply and demand to predict by how much agricultural production suffers when producer prices become lower.

The use of flexible functions implies that there are no a priori restrictions on elasticity values. Vaittinen uses estimation results to prepare welfare calculations of Harbergerian style. He wants to estimate the welfare gain the consumers receive when agricultural policy is altered.

Vaittinen studies the effects of three integration scenarios for agriculture: full liberalization (word market prices) of agricultural trade, harmonization of price structure with EC countries (EC prices) and lowering of price subsidy level of agricultural products by 30 % (the GATT alternative). Finally, he tries to estimate the efficiency loss of present agricultural policy compared to these three alternatives. Vaittinen presents his results both for the short and the long run. The short run is defined to be a time period during which only variable factors of production (raw materials + labor) adjust. In the long run also fixed factors (land and capital) adjust.

Vaittinen's (1992) first model is a supply model for three agricultural sectors: farm animal production, plant production and milk production. Vaittinen prepares his model for a case of perfectly competitive profit maximizing firm. Supply functions are derived

from a translog profit function. Vaittinen estimates the model using Finnish data from the years 1960-89. Vaittinen uses the assumption of partial adjustment in his empirical model.

The short run elasticities range from 0.6 to 1.1 and the long run elasticities vary between 1.2 and 1.7. The supply of agricultural products would be inelastic or unitary elastic in the short run with respect to producer prices and clearly elastic in the long run. Cross supply elasticities are all positive and usually a little bit lower than the own price elasticities.

The first end result of Vaittinen (1992) is the calculation where these elasticities are used to predict the changes of agricultural production for each of the three scenarios. Vaittinen concludes that even the GATT agreement would drop the profits of agriculture by more than half in the long run. In the EC and full liberalization cases profits would almost vanish in the long run.

According to Vaittinen (1992) agricultural production would decrease by about 30 % in the short run due to the GATT agreement. The short run cut in production would be about 65 % for the EC agreement and about 80 % in the full liberalization case. The long run figures are even more dramatic: -50 %, -85 % and -95 %, correspondingly. The conclusion of Vaittinen (1992) is gloomy. EC membership would almost put an end to farming in Finland in the long run.

The second model of Vaittinen (1992) is a demand model for three agricultural goods: grain products, animal products and other foodstuffs. The fourth good is an aggregate of all other consumer goods. The model type used was an econometric AIDS-expenditure system. The derivation of demand functions is based on an aggregated expenditure function of consumers. Demand elasticities are derived from this formulation.

Own price demand elasticity values range from -0.1 to -0.4. The consumer demand for food products seems to be quite insensitive to real price changes. Income elasticities range from zero to 0.7. Five cross-price elasticities out of all six are negative indicating a weak complementarily relation between the foodstuff products.

The following stage in Vaittinen's (1992) analysis is to calculate by how much the consumer prices of the three agricultural goods decline as a consequence of the three agricultural reforms. Vaittinen uses an input-output-model in this calculation.

His result is that the consumer prices of food products would reduce on average by 7.6 % in the GATT agreement, by 12.9 % in the EC agreement and by 19.4 % in the full liberalization case. Vaittinen concludes that food prices will not reduce dramatically.

Using information on demand elasticities and estimates of consumer price changes Vaittinen (1992) predicts the changes of demand for the three agricultural products.

Vaittinen converts these estimates into Harbergerian style welfare measures to show by how much consumers would gain from these price reductions. Vaittinen concludes that consumers would gain about FIM 3.6 billion due to the GATT agreement, consumer gain would be about FIM 6 billion if Finland becomes a member in EC and full liberalization of agricultural trade would benefit the consumers by about FIM 9 billion. The share of benefits in total expenditures of consumers varies from 1.6 % to 4.1 %. The corresponding share in food expenditures is 10 to 26 %. Vaittinen concludes that Finnish consumers could gain pretty much from agricultural integration.

Vaittinen (1992) combines the information from his supply and demand calculations and presents an estimate of the social welfare costs of present Finnish subsidy policy of agriculture. This is the sum of profits of producers under present producer prices, the loss of consumers due to too high consumer prices of food products and the loss of tax payers that finance the subsidy system. Vaittinen concludes that compared to the GATT agreement the present agricultural policy creates an efficiency loss of 0.4 % of GDP. The loss is higher for the two other alternatives: 1.4 % of GDP in the EC membership case and 2.2 % of GDP in the full trade liberalization case.

The third model of Vaittinen (1992) is a macro application. Vaittinen assumes perfect competition and profit maximazion as a starting point. The econometric model describes the demand for imports. It further describes the supply of domestic production, agricultural exports and the supply of other exports. Equations for these variables are derived from a translog profit function. Elasticities of supply and demand are derived from this formulation. The model was estimated using Finnish data from the years 1960-89.

The estimated elasticity of supply for agricultural exports is 4.1. The supply elasticities of other exports and domestic production are 0.6 and 0.5, respectively. These ela sticities were used to predict the performance of macro variables in case of the three agricultural reforms.

Domestic production would increase by 0.7 % as a consequence of the GATT agreement. In the EC membership case domestic production would grow by 1.9 % and the corresponding figure is an increase of 2.4 % in the full liberalization case. The demand for other exports would grow by 1.7 %, 4.9 % and by 6.3 % in these scenarios. In agricultural exports the present oversupply would change into huge deficit. The real wage would raise in all of these scenarios.

The research approach of Vaittinen (1992) is based on modern econometric methods. The important contribution of Vaittinen's (1992) analysis is the use of disaggregated data for agricultural sectors. Vaittinen also provides new estimates for the supply and demand elasticities of agricultural products.

The answers he provides are, however, produced through partial equilibrium reasoning. Supply is analyzed separate from demand and agriculture is analyzed as if it were torn apart from the rest of the economy. Vaittinen's third model may be too aggregated to capture all significant macro linkages.

1.2 Foreign studies on trade liberalization

There is an extensive foreign literature of studies on trade liberalization. Excellent summary for applications of general equilibrium models are presented by Shoven and Whalley (1984). Another recent summary is Richardson (1989) which focus especially on trade research with imperfect competition. For purposes of this study there is no need to describe all existing AGE-modeling. We will, however, present a selection of models that have similarities to GEMFIN. We have presented in table 1 main features and results of selected foreign studies.

AGE-models presented in table 1 have been developed either for the world economy or for a particular country. All six models differ in structure. All but two of them are static in nature. Most models listed take account for tariffs and non-tariff barriers of trade and assumptions of imperfectly competitive markets. Also other deviations from a pure Walrasian model such as unemployment, foreign trade quotas and international capital mobility are specified. All referred models seem to be rather special-purpose than general-purpose models. They have been tailored for a particular research question.

Simulation results summarized in table 1 are found to be very sensitive to the specification of the model. In most cases bilateral or multilateral abolition of trade barriers are studied. Freer trade produces positive welfare gains in these simulations but the magnitude of these gains is strongly dependent on the model variant.

Foreign experience seems to imply that structural sensitivity analysis is really needed. This fact revealed itself also in table 2 where we have presented the progress of the AGE model for the Philippines. In four years this model has developed in detail and the results of trade liberalization have sharpened.

GEMFIN model has similarities to most of the models in table 1. We employ the Armington assumption for all sectors in imports. Finnish goods are thus assumed to be qualitatively different from the corresponding import goods. In exports we specify imperfect substitutability between domestic and foreign goods. In agriculture, however, domestic and exported goods are perfect substitutes.

We have concentrated our modeling efforts in describing Finnish agricultural policy. The target price system and quotas for production, exports and for imports of agricultural products are well represented. Our model resembles most the model of Clarete and Roumasset (1990). Their results (see table 2) show that the welfare implications of a trade reform are strongly dependent on the way the institutional structure of the economy is modelled.

Our sectoral coverage is richer than in most of the models referred. We have specified 29 producing sectors, 15 consumer goods and three primary factors. The land factor was included because we feel that the capitalization effect of a trade reform should also be studied.

Table 1. Features and results of selected foreign AGE studies on trade liberalization

Name, country, size, model type	Special features	Main results
Hamilton, Whalley (1985), EEC, USA, Japan, Canada, other developed c., newly indust. c., less develop. c., 1977, 6 sectors, 2 factors, one representative consumer in each region, factors regionally immobile, static.	Armington assumption, international investments, dividends and foreign aid modeled, non-tariff barriers modeled as tariff equivalents.	Several bilateral and multilateral cases studied. If EEC and USA formed a bilateral free trade area USA´s welfare would rise by 5.1 %, EEC would gain only 0.7 % while other areas would lose welfare. Multilateral free trade areas would improve USA´s welfare by even more.
Wigle (1988), 8 world regions as in Hamilton, Whalley (1985) plus OPEC, other features same too, static.	Collusive or monopolistically competitive pricing, non-tariff barriers expressed as tariff equivalents.	If Canada would abolish tariffs on imports from USA, Canada´s welfare would drop by 0.3 %. If Canada and USA would abolish tariffs bilaterally, USA would benefit 0.1 % in welfare while Canada would lose as much in welfare. If all regions would abolish all protection from Canadian trade the welfare of Canada would increase by 2.5 %. This is much less than previous estimates.
Shantayanan, Rodrik (1989), Cameroon, 11 sectors, 3 types of labor, capital, factors mobile across industries but number of firms constant, static.	6 sectors assumed oligopolistic, increasing returns to scale experimented.	If tariffs were abolished, the structure of production would change dramatically. Manufacturing sectors would gain and losses would be imposed on cash crops and on production of consumer goods. With scale economies welfare would rise by 2 %. With constant returns welfare increases by 1.1 %.

Table 1. Features and results of selected foreign AGE studies on trade liberalization (... continued)

Name, country, size, model type	Special features	Main results
Harrison, Rutherford, Wooton (1989), 8 EC countries, USA, Japan, rest of the world, 1985, 6 sectors, 3 factors (land included), one representative consumer in each country, static.	Armington assumption for traded goods, tariff and non-tariff trade barriers included, EC´s Common Agricultural Policy (CAP) modelled.	If CAP would be eliminated the significant losers would be Denmark and Ireland who´s welfare would drop by 0.2-0.3 %. CAP is not significantly detrimental to the more industrially biased economies. The unilateral exit of the EC members would produce welfare losses ranging from 0.5 % (W-Germany) to 7.9 % (Ireland). Membership is thus more important in welfare terms than CAP.
Capros, Karadeloglou, Mentzas (1991), Greece 1965-85, 1 sector, 3 markets (goods, labor, foreign exchange), 2 factors, 3 consumers, dynamic sequence for 6 years.	Small open economy. 12 model variants to study the importance of market imperfections. Price vs. production cost clearing in goods market, wage clearing vs. Phillips curve in labor market, flexible, fixed or purchasing power parity evaluation of the exchange rate.	If the rate of technical progress increases by 1 % and both the import tariff rates and export subsidies reduce by 1 % point for Greece in the EC´s common market integration then GDP of Greece would change in the interval (-0.6, 5.6) %. Results are strongly dependent on the model variant.
Goulder, Eichengreen (1992), USA 1983, USA and rest of the world, 10 sectors, 2 factors, labor intersectorally mobile but capital sector-specific, representative domestic and foreign consumer and government, dynamic, simulated for 30 years.	Import quotas, intertemporal decision making, adjustment dynamics, international capital mobility.	If tariffs would be unilaterally eliminated welfare would drop by 0.4 %. Elimination of quotas increase welfare by 1.1 %. International cross-ownership of capital associated with internationally mobile capital significantly influences the distribution of capital gains and losses from trade liberalization.

One feature yet worth mentioning is that the data bases of the AGE models in tables 1 and 2 are quite old. We don't suffer from this defect. Our benchmark data is from the year 1990.

1.3 Summary of earlier research

The main postulates and conclusions of the three earlier Finnish studies on agricultural integration can be summarized as:

1. **Agricultural reforms** which reduce subsidies and lower producer prices **produce** efficiency and thus **welfare gains in net terms.** These reforms are worth implementing because the society would be better off after the reform. Increased social welfare will materialize through better allocation of resources and lead to faster economic growth.

2. **The reforms would lead to considerable structural change in production.** The produce of agriculture would drop considerably. Resources such as labor and capital are now, however, available to be used in other sectors. The other sectors would benefit and produce more in aggregate terms as a consequence of the agricultural policy change.

3. **Farmers are the greatest losers in these reforms.** In a situation where production costs decrease less than producer prices profits fall dramatically. Income transfers are needed to sustain the living standard of Finnish farmers.

These results seem reasonable. What could a general equilibrium calculation add to this discussion? At least it can serve as a check of the previous studies. General equilibrium framework can also reveal some wide-range effects which are hard to capture by more partial or aggregated analysis.

In chapter two we describe the simulation model, GEMFIN 4.0. The General Equilibrium Model of the FINnish Economy is tailored to be used in trade applications. It was originally developed for tax applications (version 3.0, see Törmä and Rutherford, 1992) but has now been supplemented with special features such as administrative prices and quantity restrictions in agricultural production and trade. The technicalities of these modifications are discussed in the second chapter together with the collection of the Base Case 1990 data. The key equations of the model are presented in the end of this report.

The third chapter defines the agricultural reforms considered in this study and describes their parametrization. General equilibrium effects and desirability of the reforms are then discussed. The final chapter sums up the conclusions and policy recommendations.

Table 2. The progress of the AGE model of the Philippines

Name, country, size, model type	Special features	Main results
Clarete, Roumasset (1987), Philippines 1978, 7 sectors, 2 variable factors, 1 aggregate consumer, static.	Small open economy, imports and domestic goods perfect substitutes, sector specific factors to avoid complete-specialization, no savings or investments, only tariffs and export taxes included, Cobb-Douglas preferences and technology.	If tariffs and trade taxes were abolished, resources would shift from exportables to importables. Agricultural food industries would lose 3.9 % of its labor and 0.5 % of its capital and economic rents would reduce by 9.2 %. The economic losses of tariffs and export taxes are 3.4 % of free-trade income. The loss estimate is large compared to earlier estimates.
Clarete, Roumasset (1990), as in Clarete, Roumasset (1987).	As in Clarete, Roumasset (1987) plus government-imposed price distortions: price ceilings and floors together with import restrictions.	If industrial tariffs and import quotas were removed welfare would increase by 4.9 %. Removing of agricultural policies (export and production taxes, parastatals) would improve welfare by only 0.9 %. The welfare cost of industrial policies dominates agricultural price distortions.
Clarete, Whalley (1991), as in Clarete, Roumasset (1987).	As in Clarete, Roumasset (1987) plus a fixed exchange rate, an exogenous domestic money supply, a foreign exchange premium and import quotas.	If sector-specific tariffs were removed the welfare would increase from 0.9 % (quotas not modelled) to 1.9 % (quotas are modelled). If foreign exchange premia is removed from the model the welfare increase would be 3.3 %. Tariff reforms have smaller liberalizing effects in models where foreign exchange is rationed.

2. GEMFIN MODEL AS A TRADE SIMULATION ENVIRONMENT

2.1 Trade barriers of Finnish agriculture[1]

The main objective of Finnish agricultural policy has been the 100 % self-sufficiency in foodstuffs. The second goal has been to secure that the income of farmers progresses parallel to that of the overall population. The implementation of these objectives aims to support rural employment and to secure the settling of the country side.
The key means of Finnish agricultural policy have been the target price system, price and export subsidies, import tariffs and quotas for production, imports and for exports of agricultural products.

Target prices are set for milk, pork, beef, mutton, eggs, rye, wheat, feed barley and for feed oats. The target price is not a quaranteed minimum price but a policy objective that will be pursued by regulating the foreign trade of agricultural products. When the price seems to settle to a lower level than the target the government increases export quotas. The domestic supply of agricultural products decreases and the price is strengthened toward the target level. On the other hand, when the price seems to rise in excess of the target the government increases import quotas to increase the supply and to lower the price toward the targeted level. The system quarantees in practice the attainment of the target prices.

Price subsidies have served as an alternative to the raising of the target prices. These have been allocated according to the size of the farm, on regional and on some special grounds.

Export subsidies are paid for unrefined agricultural products such as grain, pork, beef and eggs. They are further paid for such refined agricultural products as butter, cheese, milk powder and eggmass. Export subsidies cover for farmers the difference between the domestic and the world market price. The farm income law specifies a production ceiling for milk and export ceilings for meat, eggs and for grain.

The government finances export subsidies up to these ceilings. Farmers have to participate in the marketing costs of the quantities exceeding these ceilings. Farmer's share of marketing costs must be less than 13 % of farm net income. For the year 1990 farmer's share is estimated to be about 10 %.

All target price products face import tariffs and duties. The duty payment is determined as a difference between the domestic and the world market price. Also products processed from target price products are due to these tariffs. Main group of products facing tariffs are fruits, vegetables, sugar and coffee. The sum of duty payments has been modest because of the import quotas.

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[1] *The description of Finnish agricultural policy is based on Kettunen (1991).*

Finland has relied on family farming. The measures taken to regulate domestic production have tried to prevent the development of large scale manufacturing-like production activities. Agricultural production have been regulated by both mandatory and by voluntary measures. Mandatory measures consist of the dual price system of milk and eggs, the system of establishment permits of farms and the limitations of arable land clearing.

In the dual price system of milk each farm faces a production quota which is 40 000 liters per year. These quotas cannot be sold or bought. If the farm produces in excess of this quota it only receives the world market price. Since 1988 quotas have been specified also for dairies. The quota system thus consists of three stages. In the upper level there is the national ceiling for milk production. In the middle there is the quota for the dairies. On the bottom is the quota for the farm level. In practice the production quotas have not been exceeded. Milk production is thus totally regulated by the government.

In egg production the dual price system is based also on production quotas. The quota has been specified to be the maximum of the production quantities the farm has produced in 1982, 1983 or 1984. The price received by the farmer is dependent on the production quantity. The target price is paid for the producer and a supplementary price is paid according to the amount of the quota. The total price decreases with production volumes. In 1990 the egg production quotas have been exceeded by about 36 %.

Voluntary measures are the reduction agreements of farm, milk or egg production, agreements of leaving fields lying fallow and the support for planting forest into the fields. All these measures constitute the production quota system of Finnish agriculture.

All agricultural goods produced in Finland face import quotas. Also some other foodstuffs face the quotas. Import licenses are granted only when the corresponding domestic product is not available. Products demanding import licenses have constituted 20-30 % of the value of total foodstuff imports. The largest group is made of the seeds of oil plants, raw sugar, vegetables, fruits and goods manufactured from vegetables and fruits.

Export licenses (quotas) are granted to stabilize the domestic supply in situations where the prices seems to exceed the targeted levels.

Finnish agricultural policy is very protectionistic. It has been successful, however, in maintaining the policy objectives. Self-sufficiency is about 155 % for grain products and about 126 % for animal products. Agriculture produces even 95 % of all sugar demanded in Finland.

Trade barriers have social costs. Finnish agricultural policy has sustained high prices and thus large overproduction. Producer prices for grain are about three times the European level and the producer prices of farm animal products are nearly two times dearer than in Europe. The government spends in the year 1990 about FIM 9 billion in net terms to agricultural subsidies. This is 5 % of the budget of the state government and 1.7 % of GDP.

2.2 Assumptions and tailored features of the model

The GEMFIN 4.0 model follows the research tradition of applied general equilibrium (AGE) models. The basic structure of our model is similar to the widely applied model of Ballard, Fullerton, Shoven and Whalley (1985). GEMFIN is distinctively Finnish first because it uses parameters derived from Finnish data, and second because of the special attention paid to the tax and agricultural policy instituted in Finland in the late 1980's.

GEMFIN 4.0 has grown out of an earlier tax model version 3.0 (Törmä and Rutherford, 1992). Both versions are static general equilibrium models. The earlier version 3.0 was designed to be used especially in tax analysis. In the new version 4.0 we have included the target price system of Finnish agriculture. The model simulates short- and long-term general equilibrium effects of changes in agricultural policy. The short-run results are produced by holding the sectoral capital and land allocations fixed and permitting labor to adjust. Capital and land are thus sector specific in the short run. These equilibria produce differential rates of return across sectors which would not be maintained when capital and land are freely mobile within the domestic economy. In our long run equilibrium both capital, land and labor are free for adjustment.

Basic model structure[2]

The sectors of our model are presented in Appendix 1. The model contains 29 sectors. These have been aggregated from Finnish input-output table which contains altogether 64 sectors. The extension to a higher degree of disaggregation is computationally feasible. We have, however, decided to use only 29 sectors because they compare to the two- and three-digit industrial classification. Agriculture has been disaggregated into six subsectors according to the line of production. Milk and beef production have been aggregated in our analysis. The aggregate is called cow production. The joint production nature of this industry should be modeled in a more detailed manner in the future. There are seven food processing industries. We have specified altogether 15 final consumption goods. Private consumption of foodstuffs have been divided into eight parts (see Appendix 3). Chemicals are divided between production of fertilizers and besticides and production of other chemical products.

A schematic presentation of the production structure is shown in Appendix 2. Each cost minimizing industry is assumed to create sector specific domestic output in a joint production process with a corresponding export good. The mathematical form used is the constant elasticity of transformation (CET) function. Domestic and export goods are assumed to be imperfect substitutes. If the price ratio changes in favor of exports then production is shifted toward exported goods, but this technology accommodates changes

[2] *Key equations of the model are presented in the algebraic summary at the end of this report.*

in relative prices without complete specialization. In agriculture we assume, however, that domestic and exported agricultural goods are perfect substitutes.

Inputs to the production process consist of intermediate inputs and primary factors. The value-added component is made up of labor and aggregate capital (capital + land) factors under constant returns to scale and constant elasticity of substitution (CES) technology. Grain and other plant production and forestry have land as third primary factor. Land and capital are assumed to be imperfect substitutes in CES structure. Intermediate inputs are modeled through an input-output-structure with constant coefficients.

In foreign trade we adopt the Armington assumption under which domestic and foreign goods of the same industry are distinct. We use this assumption to account for cross hauling. Imports are in this scheme a factor that enters intermediate and final demand as an imperfect substitute for the domestic goods.

The output of each industry is used in private and public consumption, as an intermediate good, as an export product and in investment. To convert from 29 industrial products to 15 consumption goods we use a fixed coefficient transformation matrix.

Investments are regarded in this model as savings for future consumption. Private and public investment goods are aggregated through a transformation matrix from the 29 sectoral goods.

Consumer goods are listed in Appendix 3 together with a schematic representation of the structure of utility. There are altogether six "consumer agents" in the model. The first five are households grouped by socio economic status (employees, farmers, other entrepreneurs, pensioners and other consumers). These consumers own all labor, capital and land endowments of the economy. Their demand functions arise from maximization of a homothetic, three-level constant elasticity of substitution utility function which depends on inputs of 15 consumption commodities, leisure and savings (=investment). Households differ in terms of both the composition of factor ownership and preferences.

The sixth "consumer" is the aggregate of state and local governments. They do not participate in production, but exist as separate agents collecting taxes which finance public expenditures, investment expenses and the subsidies. Government investments are treated as exogenous in the model.

GEMFIN 4.0 model takes into account the factor, commodity and personal income taxation prevailing in Finland. Sectoral tax rates employed in our Base Case are presented in Appendix 4. The social security payments are interpreted as a labor tax. The new Avoir Fiscal system affects the treatment of corporate income taxation. Before the tax code change the model treated corporate income taxes as capital input taxes. In the present model version corporation income taxes are treated as prepayments of the personal income taxation.

The effects of agricultural reforms flow in the model through simultaneous factor and commodity substitution. When parametrizing the model, one has to specify values for several elasticities. In the production side these include the sectoral substitution elasticities of capital and labor factors, the substitution elasticities between land and capital in grain and other plant production and in forestry, the transformation elasticities of domestic and exported goods and the Armington elasticities between domestic and imported goods. For consumption one must specify the substitution elasticity among the 15 consumer goods, the substitution elasticity of present consumption and leisure, and the one between present and future consumption.

Given a limited research budget, we have not been able to econometrically estimate all substitution elasticities for the present study. Until careful econometric estimates of the remaining elasticities are conducted, our results should be considered as illustrative rather than concrete estimates.

The Armington elasticity between imported and domestic goods is essential for our application. We do not unfortunately have good Finnish estimates of this elasticity for agriculture. For this reason we have used reasonable "quessimates". The main idea in choosing the values has been an assumption that agricultural products are quite well substitutable by corresponding imported goods. The other assumption is that this substitutability is much weaker in production of milk compared to other agricultural activities.

GEMFIN 4.0 model is, in its present form, a pure (tax and target price-distorted) Walrasian general equilibrium model. The equilibrium conditions of the model require that the unknown prices of the economy adjust until the demand of all factors and products are equal to their supply. There are no pure profits, and the public budget and foreign trade are both in balance.

The model assumes perfectly competitive markets. There are no externalities or quantity restrictions in the model, nor are there other restrictions narrowing the allocation of resources. There is no unemployment in a Keynesian sense. Agriculture represents an exception to this rule. Agricultural target prices are administrative and foreign trade of agricultural products is restricted.

Tailored features for agriculture

Agricultural protection system of Finland is very complex. When implementing the system in model equivalent form we have to decide which elements are most crucial for our purposes of analysis. We have decided to emphasize the importance of the target price system.

The leading idea is that the government restricts imports of certain agricultural products in order to maintain a high domestic producer price as incentive for domestic production. The government thus sets politically desired target prices for agricultural products. In the model, the government employs three different policy instruments, all

of which support the producer price of agricultural products: import quotas, export subsidies and production quotas.

We treat import quotas and production quotas as exogenous, and we let the export subsidy rate be endogenous. It will be set at a level that will fix the producer price at the target level. The model allows for only one adjustment variable. We could have chosen production or import quotas for this task. We feel, however, that using export subsidies is the best choice because it emphasizes the constant overproduction situation of Finnish agriculture.

Those who export agricultural products receive the target price for these goods and the government absorbs the loss through export subsidies when the goods are sold on the international market. Agricultural imports are sold at the domestic price and the difference between the lower international price and the sale prices is taken by the government as import quota rent.

In addition to foreign trade restriction, domestic output of agriculture is managed. The government sets politically desired production quotas for agriculture. This will reduce production volumes and we assume that as a consequence of this farmers will receive a premium in the target prices. Farmers thus earn a production quota rent.

Production quotas cannot be traded in Finland. If production quotas would be tradable then we could observe their market price. The premium in target prices would be the amount a farmer would be willing to pay for a unit of production quota. Because we don't have this information we have to estimate the premium using an indirect method.

We have estimated for each agricultural good the production volume that would have prevailed without the production quota system. Econometric time series trend models from the period 1960-81 were used to predict the production volume for 1990. The premium was then calculated by dividing the difference between actual and predicted production volume by the supply elasticity taken from Vaittinen (1992). This procedure corresponds to asking "By how much would the target price reduce if the production quota system would be abolished?"

There is still one new element in the model. We have added the land input to analyze the possible capitalization effect of Finnish EC membership. If the price of land is altered in the new situation then EC membership would have effects even on property values. We feel that there is a strong possibility of underestimation if these capitalization effects were ignored.

One has to be aware of the approximate nature of computable equilibrium models. These models, as models in general, can only approximate reality. The GEMFIN 4.0 model should, thus, be seen as a learning tool. It makes us think systematically and with an appreciation for general equilibrium effects. The model gives the first answer, and one can compare its result to one's own mental arithmetic.

When used critically, the model can give us new insights into difficult questions regarding differential tax and agricultural policy reform. We feel that at the present time, for practical policy questions, there are few alternatives to general equilibrium modeling.

2.3 1990 benchmark data and elasticity estimates

We have used three primary data sources. These are the Input-Output Study for the year 1989, the Consumer Survey for the year 1985 and National Accounts of Finland. The data was adapted to the 1990 level by using sectoral correction coefficients. The Input-Output Study 1989 has served as an essential source of data in our research.

From the Input-Output Study we have gathered data on sectoral use of labor and capital as well as the data on intermediate resource use. The input-output table also gives information on social security payments, import duties, export subsidies and commodity taxes. Import tax was calculated by summing custom duties and the equalizing tax on imports.

Commodity taxes were obtained by summing sales taxes, other commodity taxes, commodity subsidies and other indirect taxes and subsidies.

Total amounts of labor and capital endowments were obtained from the Input-Output Study. Endowments were divided between the five consumers according to their wage and capital income earnings. The structure of private consumption is obtained from Consumer Survey. We thank Aino Salomäki for providing us with this data. She also provided the data for the average and marginal income tax rates. Her calculations are based on the TUJA-model.

Leisure is treated as consumer demand for labor. The quantity of leisure was calculated by assuming that the total amount of time is 4800 hours per man per year. The number of leisure hours was calculated by subtracting actual working hours from the total hours available. The net of tax wage rate was used as the price of leisure.

There are no reliable statistics available about the land rent. We know, however, that the contribution of land is included in capital income. We have decided to use estimates of capital stocks to separate land rent from capital earnings.

The Central Statistical Office of Finland has completed a special study (1991) that presents estimates for the value of land in agriculture and in forestry. Net capital stocks for structures, buildings and equipment are also available. Using these data we calculated that the share of land rent in capital earnings is 51.7 % in agriculture and 89.3 % in forestry.

Our disaggregation of state and local governments is based on the Input-Output Study. Local government consists of municipalities and federations of municipalities. State government is the sum of the state and the social security funds. Income tax and subsidy

data has been collected from National Accounts and from special studies conducted by the Central Statistical Office of Finland. Whenever possible, we have used National Account figures to check the validity of our data.

We use MPS/GE micro program (Rutherford, 1992) to solve the model. This program calibrates the second order preference and technology parameters conditional on the elasticities of substitution specified by the modeler. The numerical values of elasticities determine largely the simulation results. For this reason we have to be careful when specifying these values.

There are seven sets of elasticities in the GEMFIN 4.0 model. All but three of these elasticity sets were estimated from Finnish data. Exceptions are the Armington elasticity of domestic and imported goods, the transformation elasticity of domestic and exported goods and the substitution elasticity between capital and the land input. Since we lack Finnish estimates for these elasticities we have to use reasonable "guessimates". Estimation of other elasticities is reported in Törmä (1989) and in Ruokolainen (1989). Our Base Case elasticity values are presented in appendices 5-9. Elasticity values chosen here correspond to choices made in foreign studies.

Substitution elasticities of aggregate capital and labor in value-added differ somewhat from unity. These range from 0.3 to 1.1. We use a reasonable quessimate of 0.5 for the substitution elasticity of capital and land in agriculture. In forestry this elasticity is unity. Armington elasticities range from 1.0 to 8.0. The latter high value is used for agricultural production. The Armington elasticity of milk production is lover, 4.0, emphazing the requirement of freshness and the huge fixed costs of this line of production. For transformation elasticities we have specified two values: 2 for forestry and industrial production and 1.5 for services. In agriculture where perfect substitutability has been assumed these elasticities equal plus infinity.

All five consumers have same elasticity values. We use a value 1 for the elasticity of present and future consumption, 0.5 for the elasticity of aggregate consumption and leisure, and an intra-commodity elasticity of the 15 consumption goods equal to 0.3. The elasticity between aggregate consumption and leisure correspond to the supply elasticity of labor. Our initial estimate in Ruokolainen (1989) was 1.0 but it has been criticized to be too large. The specification 0.5 for this elasticity corresponds to labor supply elasticity that is 0.3.

2.4 Model implementation

GEMFIN 4.0 is implemented by a complementary application of two microcomputer programs: GAMS and MPS/GE. GAMS (Brooke et al., 1988) is a high level language for formulating models with concise algebraic statements that are easily read by modelers and computers alike, easily modified, and easily moved from one computer environment to another. In this application, we use GAMS solely for data manipulation and report writing. The computation of equilibrium prices is preformed by MPS/GE, a

specialized language for policy-distorted Arrow-Debreu economies. MPS/GE uses the SLCP algorithm (Mathiesen, 1985) to find a set of equilibrium prices.

The specification of (i) consumers, commodities and production activities, (ii) production and utility functions and (iii) specific details of policy distortions and the operation of government are all used to characterize a general equilibrium model for MPS/GE. The modeler communicates with the program by means of a MPS/GE-command file which gives the parametrization of production and consumption.

The MPS/GE program uses utility and production functions of the Leontief, Cobb-Douglas or CES type which can be nested to two or more levels. Large models can be built with this program without the need for separate programming. It greatly reduces the tedium of model implementation. Using MPS/GE, numeric demand and supply equations are automatically generated by the program from the sparse set of input parameters.

To construct a utility function and associated uncompensated demand equations, for example, it is sufficient to specify expenditure shares at a representative set of prices together with associated substitution parameters.

In this study we have combined the best features of these two programs. GAMS is used to read in the social accounting matrix and all sets of elasticities in tabular format. GAMS is further used in checking the validity of the benchmark data, in debugging the data and in making necessary adjustments. Finally GAMS-commands are utilized to generate the MPS/GE-command deck. After this MPS/GE takes over and finds the model solution. At the end, GAMS is used again to read the MPS/GE solution and calculate functions of the equilibrium for summary reports.

Implementation of the target price system of agriculture

Domestic producer prices are set exogenously in the model. They are supported by endogenous export subsidy rent (XSR) which adjust to maintain a target output price. The model is calibrated using a parameter PQR, the producer quota rental rate which represents the premium received by agricultural producers with quota rights. Each four agricultural goods have PQR of their own. The premium is 9.2% for milk and beef, 12.4% for pork, 19.3% for poultry and eggs, 4.9% for grains and for other plants and 10% for other agricultural products.

The ownership of production quota rights is determined by a vector QSHARE(h) which represents what share of all agricultural quota rights is held by consumer h. QSHARE is based on consumer shares of farm ownership. Kettunen (1991) reports that 61.2 % of all farms are owned by farmers and 19.1 % by pensioners. The rest 19.7 % was allocated to other entrepreneurs.

Import quota restrictions are exogenous for agriculture, with quota rents collected by the government. The benchmark is calibrated to a specified quota rent called MQR. If the

international price of a good is P_w, the domestic price is: $P_d = P_w (1 + MQR + t)$ where t is the import tariff rate. MQR is 0.49 for milk and beef, 0.77 for pork, 0.59 for poultry and eggs, 1.42 for grains, 0.21 for other plants and 0.70 for other agricultural products. These numbers correspond to the external value of Finnish markka at the middle of March 1993 (ECU = FIM 7.0). The devaluation (November 1991) and depreciation of markka (floating since September 1992) has thus been accounted for.

Total amount of export subsidies is reported in the Input-Output Study. The benchmark has been calibrated by specifying adjusted export subsidies for agricultural products. This is based on actual differences between the international and domestic producer prices. The government is financing all export subsidies in the model.

The total effect of an agricultural policy change, such as the EC membership, will depend on several factors:

- **the degree of protection on imports** (MQR), the higher the value of MQR, the larger the resulting surge in agricultural imports

- **the substitution elasticity between domestic and imported agricultural products,** when this elasticity approaches plus infinity (perfect substitutability), we will have the largest trade respond

- **the extent to which domestic quota allocations restrict domestic output** (summarized by PQR), if PQR is large relative to MQR (or substitution elasticity between domestic goods and imports is small), elimination of the production quotas may, in fact, lead to reduction in agricultural imports

- **the supply response of domestic producers**, in particular the factor structure is quite important, the land input has been included into the model in order to capture the possible long run supply response

GEMFIN 4.0 model has been calibrated to highlight the producer price difference existing between Finland and EC. We have wanted to emphasize the possibility of Finland being integrated into EC's Common Agricultural Policy. In this case high Finnish producer prices in agriculture would be harmonized to European levels. There are not too many technical difficulties in constructing other cases such as comparing Finnish producer prices to even lower world market prices.

Once the model has been implemented, every stage in the simulation process is automated. Furthermore, it is relatively easy to modify the structural and elasticity assumptions of the model. Comparative simulations of differing agricultural reforms are created in a moment.

3. ECONOMIC EFFECTS OF THREE TRADE LIBERALIZATION SCHEMES

3.1 Three alternatives for agricultural integration

Finland is participating at the moment in two negotiations concerning agriculture. These are the Uruguay round of GATT and the EC membership negotiations. The end result of the talks are yet unknown. For this reason, we have based our scenarios on the views held by Finnish negotiators.[3] The integration scenarios specified for agriculture consist of one GATT alternative (**GATT**) and two EC membership alternatives (**EC1** and **EC2**).

We will simulate with a single country model in which the producer price differences between Finland and EC are exogenous. When calibrating the model we have noticed two important facts that have materialized after the year 1990. These are the devaluation and floating of Finnish markka and the CAP reform of EC for the years 1993-96. Depreciation of markka will reduce the price gap. In our simulations we have used an exchange rate FIM 7.0/ECU. This represents improvement of Finnish price competitiveness by over 30% since 1990.

On the other hand, EC´s CAP reform will increase the price gap because the ambition of the reform is to reduce producer prices considerably. The Base Case producer price gap has been calculated by taking notice of the following producer price reductions in EC: grains: -29 %, milk: -10 %, and beef: -15 %. After these adjustments and ignoring tariffs the percentage of EC's producer prices of the Finnish producer prices are the following: 67% for cowproducts, 56% for pork, 63% for poultry and eggs, 41% for grains, 83% for other plants and 59 % for other agricultural production.

The GATT scenario

In the GATT alternative we assume that the present view of Finland for GATT negotiations is largely accepted. The key elements in the GATT scenario are the reduction of export subsidies by 36 %, the reduction of domestic subsidies, excluding the so called "green" subsidies by 20 % and the replacement of the import quota system of agricultural products by tariff equivalents.

The tariff level, which represents the producer price difference between Finland and the world market price will be reduced by 20 % in the simulation. In this scenario all six agricultural products face the same rate of reduction in subsidies.

These changes correspond roughly to the original suggestion of Arthur Dunkel. The only deviation is in the change of the tariff level which reduces less than was suggested. Dunkel´s original target was an average reduction of 36 %. The minimum requirement was a reduction of 15 %.

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[3] *We thank Paavo Mäkinen and Pekka Huhtaniemi for their help in formulation of the scenarios.*

EC will have to reduce its agricultural support in the GATT process, too. If we could predict the changes of producer prices due to EC´s cuts in agricultural support we could include in our scenario this change of relative producer prices. We assume, however, that EC will use the CAP reform as the frame for its GATT commitments.

GEMFIN simulation will show whether these changes in agricultural policy will be adequate to reduce export volumes of Finnish agriculture by 24 % and whether they sustain the 3 % opening up of the import of agricultural products. These volume requirements have been suggested by Dunkel.

Common features of the two EC scenarios

As a member of EC Finland would be participating in EC´s Common Agricultural Policy. Producer prices of agricultural products would be reduced to European levels. While the GATT alternative would eliminate one fifth of the producer price gap, in the two EC alternatives the price gap would vanish totally.

The second common feature is the assumption that Finland would have to abolish the import quota system of agricultural products. We have also assumed that Finland will have to give up subsidizing exports of food processing industries.

The EC1 scenario

The key element of the EC1 scenario is the assumption that Finland would be able to benefit from the arctic nature of our agriculture. EC would admit for Finnish agriculture special treatment based on unfavorable production conditions. This is parametrized by assuming that while Finland´s EC membership fee is FIM 5.8 billion, EC would return FIM 4 billion as direct income compensation to farmers. This sum would be given to the group of remaining farmers.

The EC2 scenario

In the EC2 scenario we assume that Finland will obtain no special treatment. EC would return only FIM 2 billion as direct income compensation to farmers.

In all of these scenarios we have assumed that the producer price premium of farmers is abolished. The simulations have been implemented by holding the welfare of the government[4] constant. We have used the sales tax rate as a compensating instrument. The price of foreign exchange has been the numeraire in our analysis.

[4] *This is almost the same as holding the tax revenue of the government constant.*

3.2 General equilibrium effects

GEMFIN 4.0 emphasizes the role of prices. Prices will adjust until the economy has reached new equilibrium after a policy chock. Our model is purely competitive so commodity prices are defined as production costs divided by the produced quantity. Production costs, on the other hand, depend on factor prices. An increasing commodity price indicates that either production costs have become higher and/or that production of the commodity has decreased. In a numerical general equilibrium model everything influences everything. Factor and commodity prices, which by their changes cause substitution and income effects, are a natural starting point.

We have gathered main findings of the three simulations in several figures. These are presented at the end of this chapter. There is a separate figure both for the short and for the long run. We start by considering the general equilibrium effects of the three agricultural integration schemes on factor and commodity prices. When interpreting the results we have to bear in mind that the short run refers to a situation where only the labor factor has adjusted. In the long run also the capital and land factors have had time to fully adjust.

Effects on factor prices

According to our results the GATT and EC agreements would raise wages. This can be seen from figures FACPRIS/L which present the factor price changes for the short and for the long run. On the other hand, real factor price of capital would drop. Only in the GATT alternative the real price of capital is slightly increased in the long run. Factor price of land would drop in the short run if Finland would become a member in EC. In the long run the price of land would slightly raise, however. The GATT agreement would reduce the real factor price of land both in the short and in the long run.

The conclusion is that the EC agreement would sustain capital intensive production and undermine labor and land intensive production in the long run. In the GATT alternative higher labor and capital costs would be partly compensated by the fall of the real price of land in the long run.

Effects on commodity prices

The changes of domestic prices are presented in figures DOMPRIS/L. In this and in the subsequent figures the first (from below) six sectors refer to agriculture, and the last eight sectors refer to final consumption goods. Sectors numbered 9-15 refer to food processing industries and the sector 19 refer to the production of fertilizers and besticides.
The figures reveal that both the GATT and the EC agreement would reduce commodity prices in agriculture and in food processing industries on average. The price level of agricultural products would drop considerably in the short run. This is explained by

reduced capital and land costs and by the fact that domestic production will not drop much for most products in the short run.

A peculiarity is the short run increase of the price of other plants in the GATT alternative. This is explained by raising short run labor costs (see figure FACPRIS). This price increase is reflected in the final demand price of potatoes because of the strong intermediate demand link between the two products.

The GATT agreement would affect the price level of foodstuffs by much less than the EC-agreement. The price level would hardly change in the short run as a consequence of the GATT agreement but the price level would drop by about 10% if Finland would become a member in EC.

The long run picture of price changes deviates for agriculture much from the short run situation. Drops in production costs are compensated by the decreases of production. Prices of cowproduction and grains increase a lot when domestic subsidies are abolished in the two EC scenarios. The domestic subsidy for grains production is 108% (see Appendix 4). When this support is abolished the domestic price of grain rises so high that the demand will vanish.

The prices of milk production, milk processing and the final consumption price of milk would increase somewhat if Finland would become a member in EC. The GATT agreement would hardly change the price level of foodstuffs. The two EC alternatives would decrease foodstuff prices by about 2% in the long run.

Effects on relative prices

The most crucial point in our application is the progress of relative prices of foreign and domestic products. In figures RELPRIS/L we have presented this aspect. We can conclude that after short and long run adjustment foreign agricultural prices are cheaper. This is because foreign products benefit from the removal of trade barriers. The price difference is much larger for grains in the two EC scenarios compared to the GATT alternative.

The relative price difference will generate substitution effects that favor imports of agricultural products. The price difference is largest in the long run for cowproducts and for grains.

Effects on income

All three integration scenarios for agriculture have positive effects on general income level. When interpreting the results of figures INCS/L we have to remember that the GATT agreement scenario did not contain a compensation for farmers. This explains the fact that the GATT agreement would slightly reduce long run incomes of farmers in figure INCL. In the EC1 scenario farmers received FIM 4 billion as direct income

compensation from EC and the corresponding figure was FIM 2 billion in the EC2 scenario. Incomes of farmers increase in both the favorable and the unfavorable EC scenarios. This is true both for the short and for the long run.

The (population weighted) average long run increase of income is about 1% in different alternatives. A favorable EC agreement would clearly benefit the farmers in the long run. Wage earners would gain somewhat more purchasing power as the other entrepreneurs. Incomes of pensioners would grow below the average. Wage earners benefit from the increase of real wage while capital endowed pensioners suffer from lowering price of capital (interest rates).

Effects on domestic output

Output effects have two causes in the GEMFIN 4.0 model. The first comes from commodity substitution. If relative price changes favor imports then dearer domestic goods are substituted by cheaper imports.

The second cause comes from income effects. When real income increases on average it generates more purchasing power. It is even possible that a positive income effect outweighs a negative substitution effect. Our results for output effects are presented in figures DOMOUTS/L.

Short run losses of domestic production are less than 10% for all but for one agricultural product. Production of grains would reduce dramatically even in the short run. About 60 % of grains production would be lost in the short run if Finland would become a member in EC. The GATT alternative would lover but retain trade barriers so its effect on domestic production would be almost negligible in the short run.

The losses of domestic production are more fatal for agriculture in the long run. The GATT alternative would produce severe losses mainly in poultry and egg production and in grains production. If Finland would become a member in EC this would decrease agricultural production by about one third in the long run. Production of grains would vanish altogether. Over 50% of poultry and egg production would be lost and losses in production of pork would be over 40%.

In the EC membership alternative the best situation would be in cowproducts (milk and beef) and in other plants production. Domestic production of milk and beef would reduce only by about 30% and cuts in production of other plants (sugar beet, rye, potatoes, vegetables etc.) would be in the magnitude of less that 5%. The chain of dependence via intermediate demand is shown in losses of feedstuff production which goes down by about 26% and in production of fertilizers and besticides which suffers by about 24%.

We can conclude that the long run visions for agriculture are quite gloomy in the EC membership case. Agriculture would be run down considerably. About 30 % of

agricultural employment would be lost. The GATT alternative would rearrange only about 10 % of agricultural working places.

The future is clearer for food processing industries. The final demand price of most foodstuffs is reduced and real income is pushing up all demand, so it is understandable that most food processing industries are able to maintain their production volumes. Milk processing reduces, however, slightly in the EC-membership case in the long run.

Effects on foreign trade

Effects of the three agricultural integration scenarios on imports and on exports are reported in figures IMPS/L and EXPS/L. The effects on foreign trade are actually a mirror image of the changes in domestic production. Imports of agricultural products must grow heavily because domestic production goes down. In the same time exports of agricultural products must vanish because domestic overproduction will more than disappear.

It is also interesting to note that the slightly increased demand of foodstuffs will be satisfied by domestic supplies not by imports. GEMFIN predicts that the food processing industries would even have export potential especially in the short run. The export possibilities are sustained by the fact that relative price of food processing progresses in favor of domestic goods in our scenarios. Exports of these goods relate also to the increased domestic production of these goods.

Effects on labor supply

Wage increases will have a positive effect on labor supply. Labor demand will reduce, however, since the factor price ratio changes in favor of capital. Growing incomes will, on the other hand, push up leisure demand. The end result on labor supply can be seen from figures LABSUPS/L. Labor supply will drop for almost all consumers. The only exception is the EC1 scenario where farmers increase their labor supply. In their case the positive wage effect dominates the other causes of labor supply.

Final sentence: is there a Pareto improvement?

A policy change is a Pareto improvement if it makes at least one person better of without lowering the welfare of the others. This definition contains an idea of compensation. If a policy change is capable of producing welfare in net terms this means that the winners can afford to pay to the losers a compensation that will retain previous welfare level of the losers.

The Pareto improvement is a very important concept for our application. As our GEMFIN 4.0 simulations have shown, the farmers would be losers if Finland accepts the GATT agreement or becomes a member in EC. Our results show that if no

compensation is given to the farmers, their long run losses of income would be substantial. In our EC scenarios we have assumed that Finnish farmers would get either FIM 4 (EC1) or 2 (EC2) billion as direct income compensation from EC. There was no compensation in the GATT scenario.

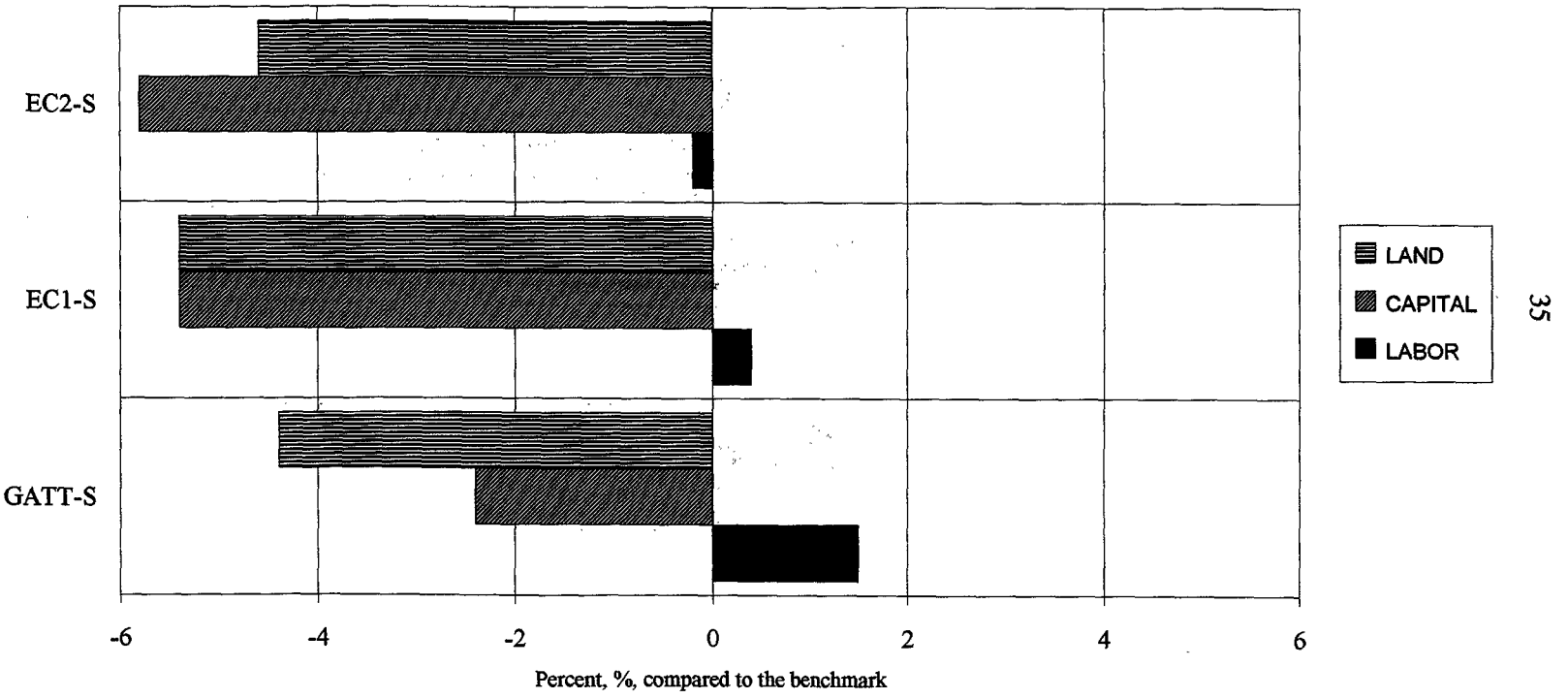
The final test whether the GATT or the EC membership agreements would be worth doing is a welfare calculation. It is not sufficient just to find out who gets or loses income in a policy change. We must dig deeper and find out the final change in consumer's consumption basket that is materialized after the extra/less money has been spent. These results have been presented in figures WELFARES/L.

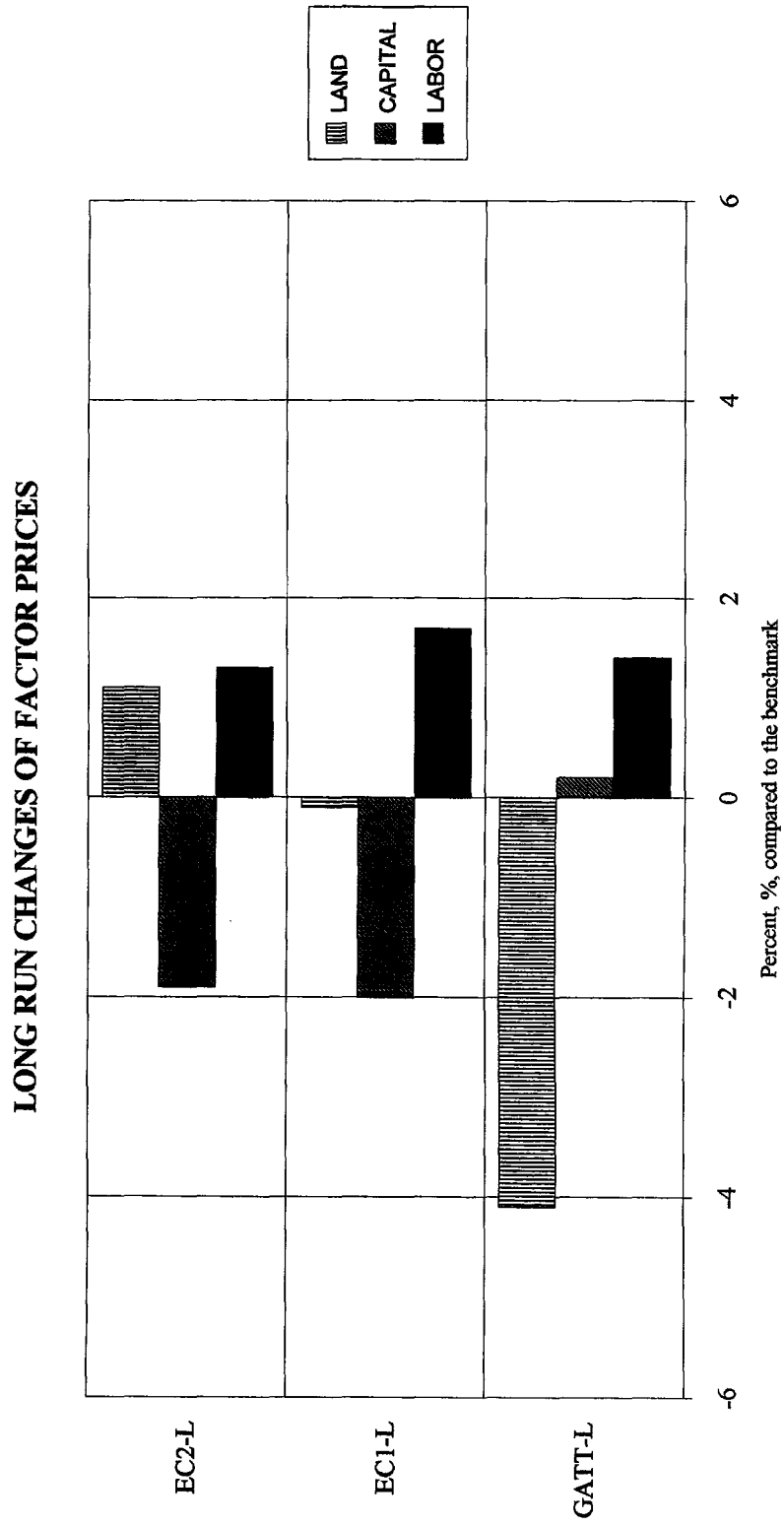
The GEMFIN 4.0 simulation results state that all three integration scenarios for agriculture would be Pareto improvements. In the GATT case the welfare of farmers would drop by about 1.5%. The society in general would, however, be better of because the gains of other consumers would outweigh these losses.

In the two EC scenarios only pensioners lose in the short run. After direct income compensation the farmers gain 4-5% in welfare if Finland is capable of negotiating a favorable membership agreement (EC1). If we are not so skilful (EC2) then the FIM 2 billion direct income compensation would be enough to sustain to the farmers a welfare improvement that is of the same quantity, about 0.8%, as the average level.

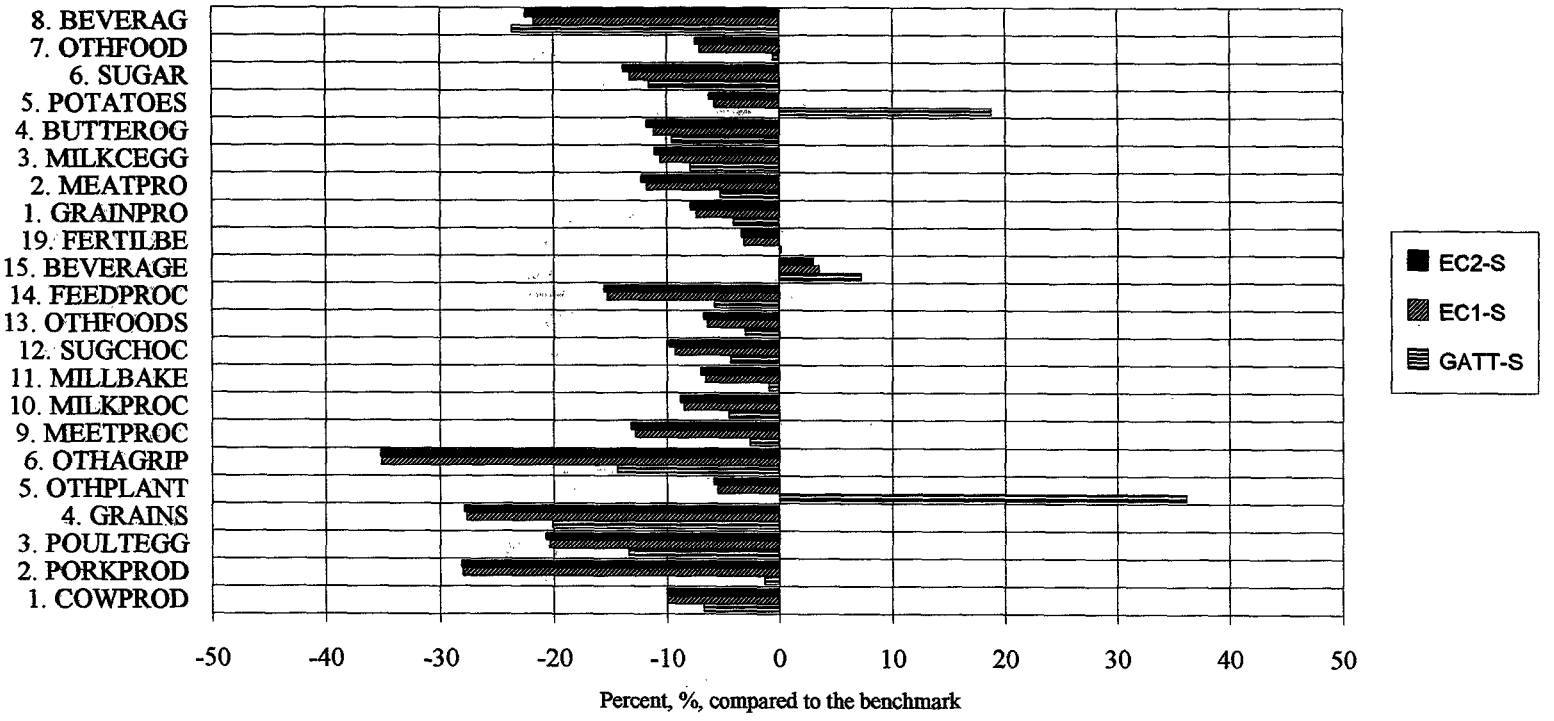
According to our results the wage earners would be the biggest winners in all three scenarios. Their welfare improvements are about a third greater compared to the average level. Pensioners even lose in the short run from Finnish membership in EC. In the long run pensioners gain slightly from the GATT agreement but mainly retain their welfare level if Finland becomes a member in EC. These distribution effects depend on changes of factor prices. Wage earners gain from raising wages while pensioners lose incomes when the factor price of capital (interest rates) drop.

SHORT RUN CHANGES OF FACTOR PRICES

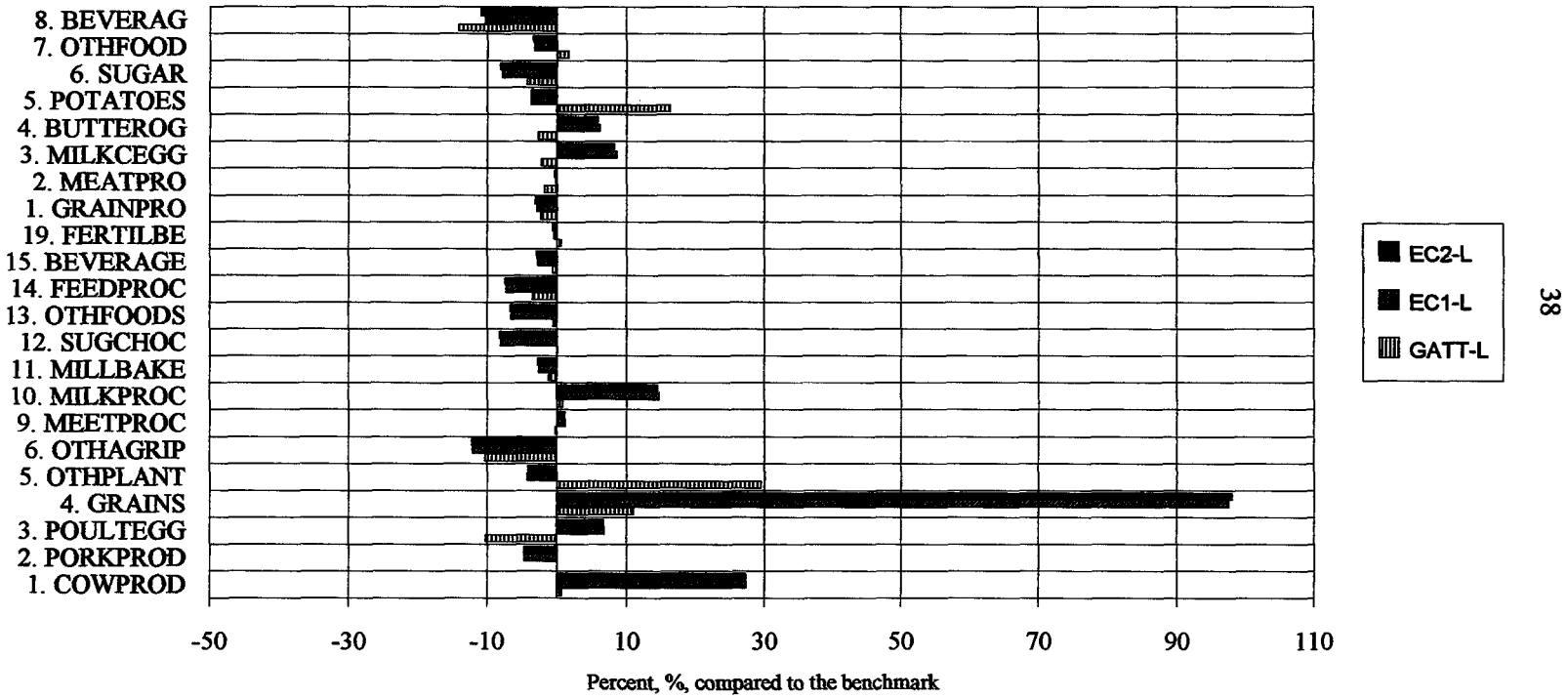



LONG RUN CHANGES OF FACTOR PRICES
LAND
CAPITAL
LABOR
EC2-L
EC1-L
GATT-L
-6
-4
-2
0
2
4
6
Percent, %, compared to the benchmark

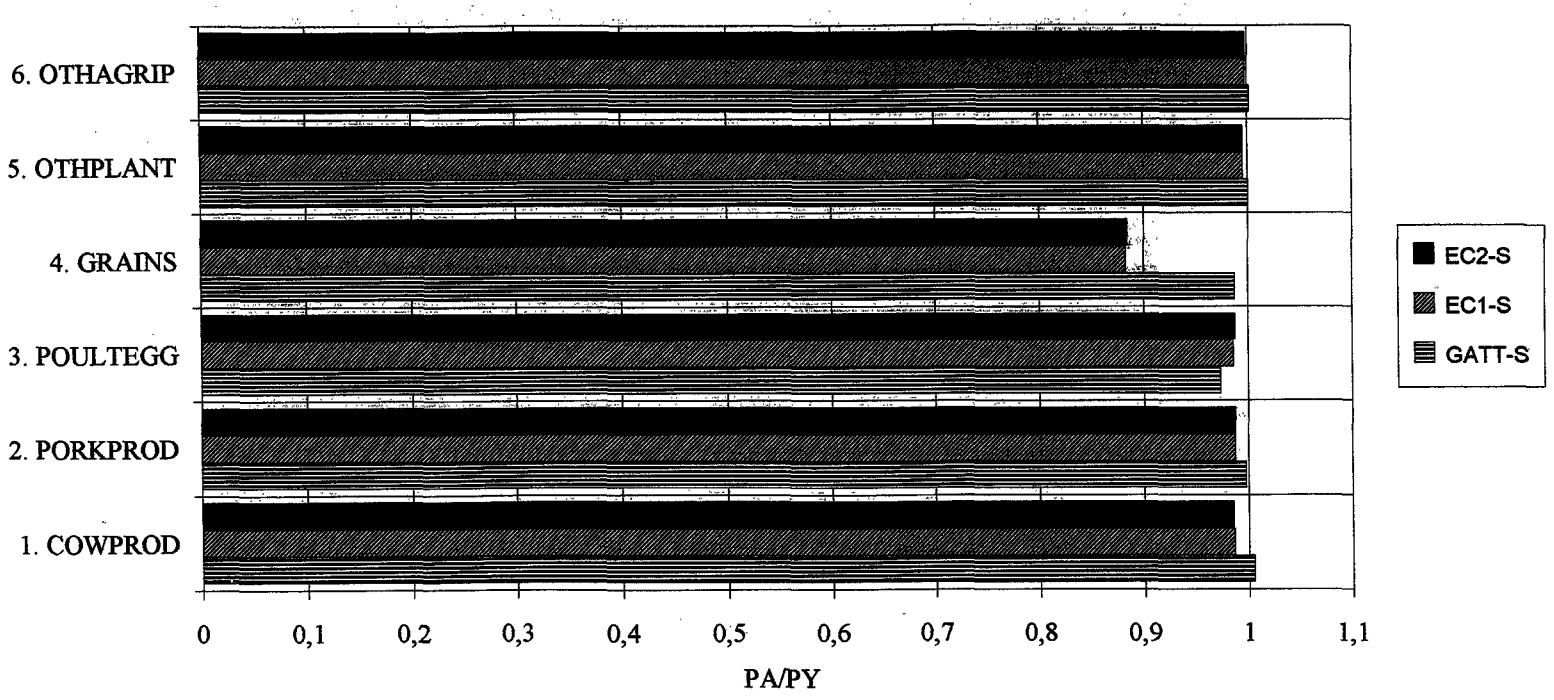
SHORT RUN CHANGES OF DOMESTIC PRICES



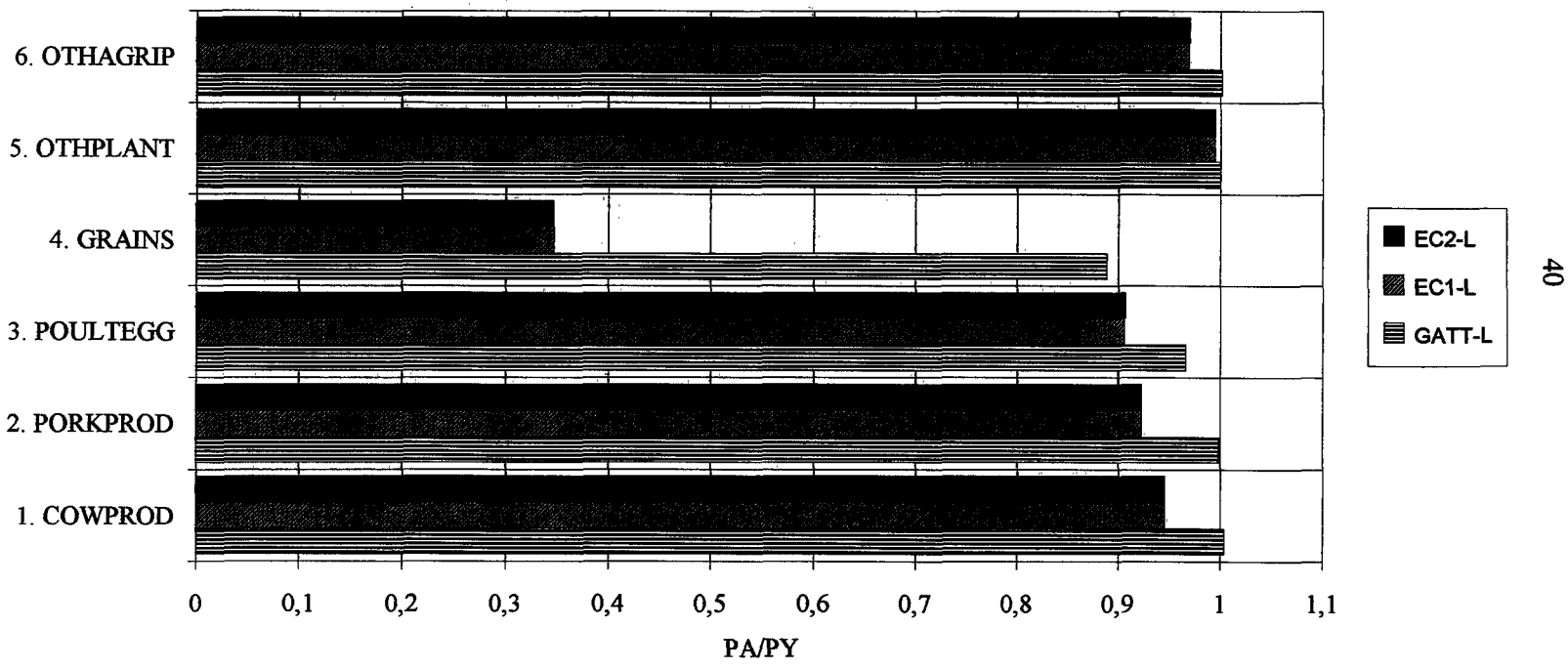
LONG RUN CHANGES OF DOMESTIC PRICES



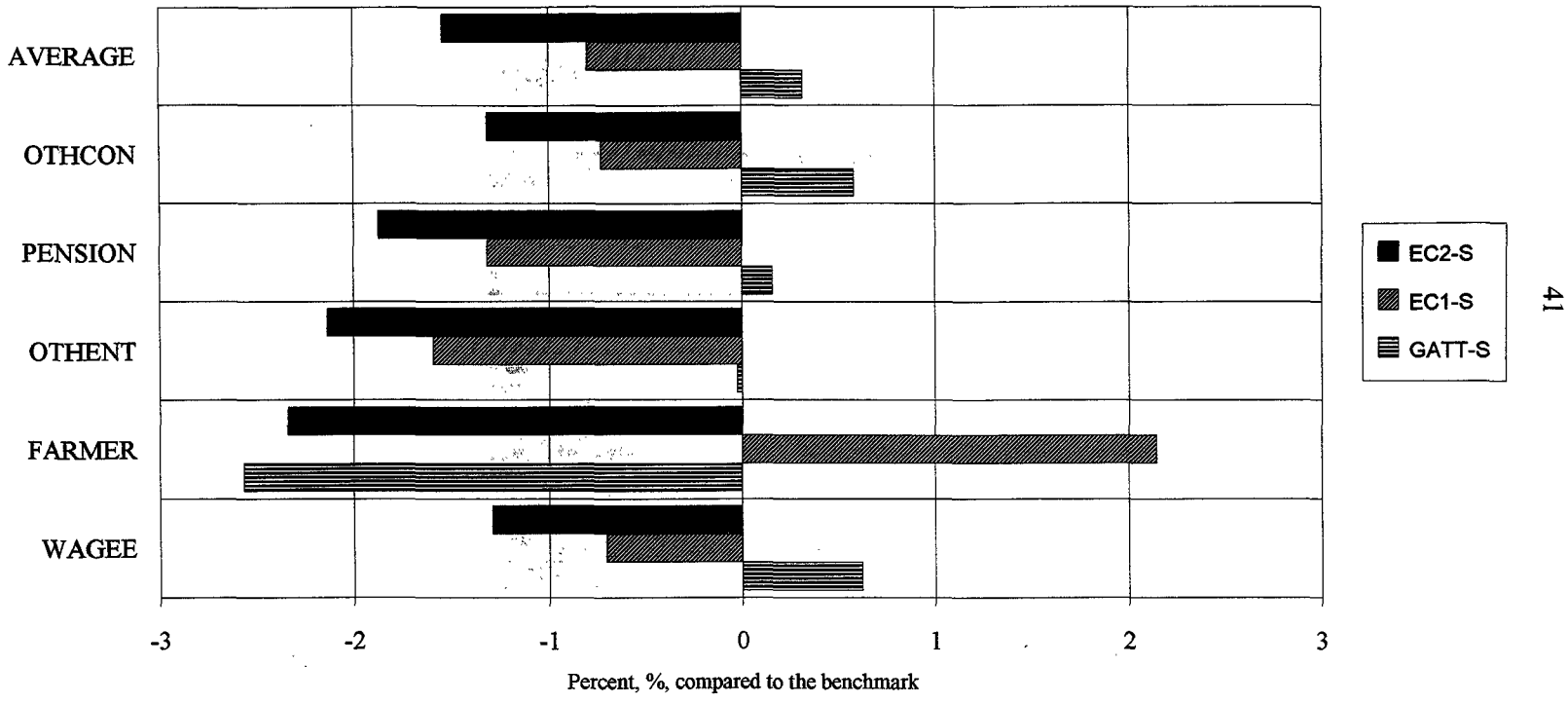
SHORT RUN RELATIVE PRICES OF FOREIGN (PA) AND DOMESTIC (PY) AGRICULTURAL PRODUCTS

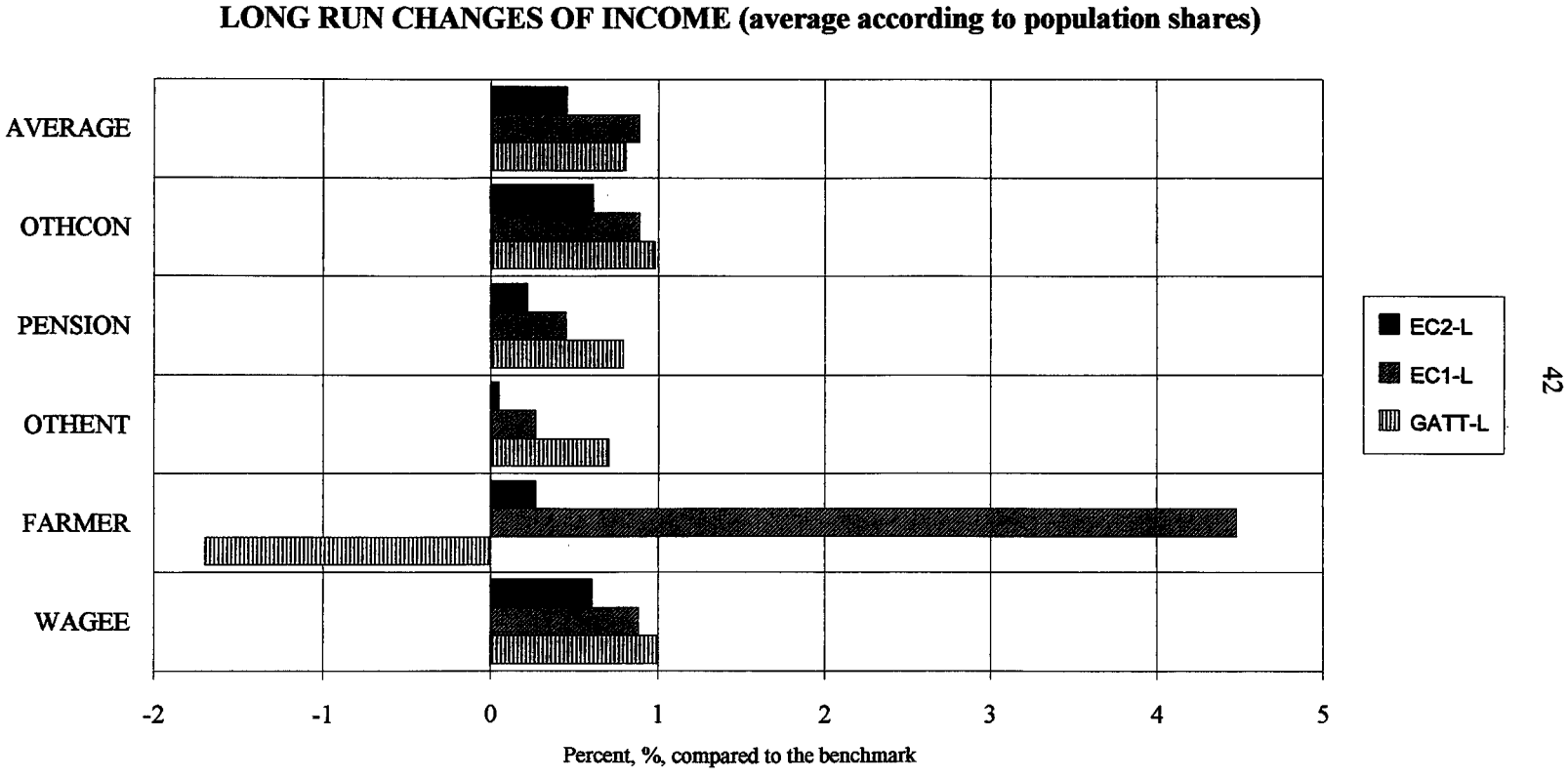


LONG RUN RELATIVE PRICES OF FOREIGN (PA) AND DOMESTIC (PY) AGRICULTURAL PRODUCTS

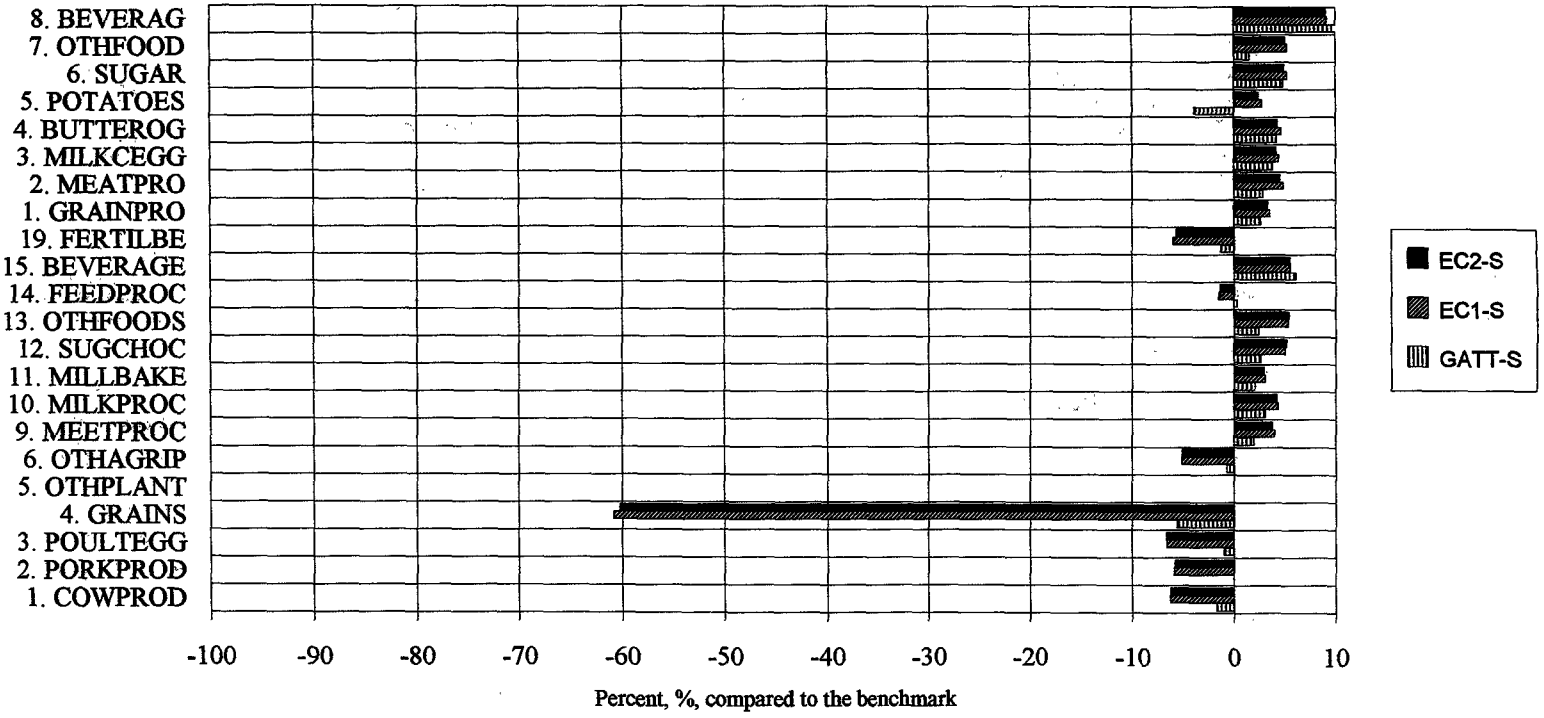


SHORT RUN CHANGES OF INCOME (average according to population shares)

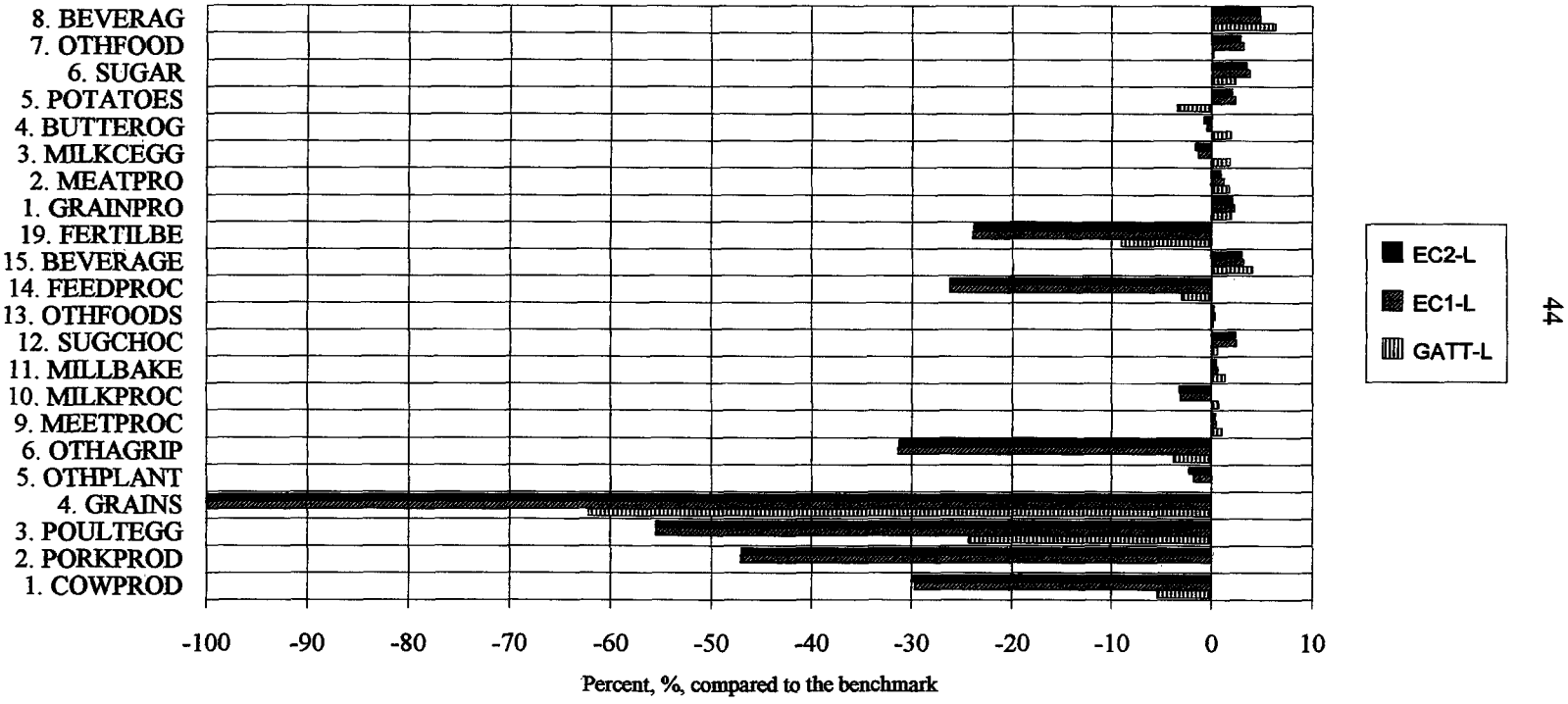



LONG RUN CHANGES OF INCOME (average according to population shares)
AVERAGE
OTHCON
PENSION
OTHENT
FARMER
WAGEE
-2
-1
0
1
2
3
4
5
Percent, %, compared to the benchmark
EC2-L
EC1-L
GATT-L

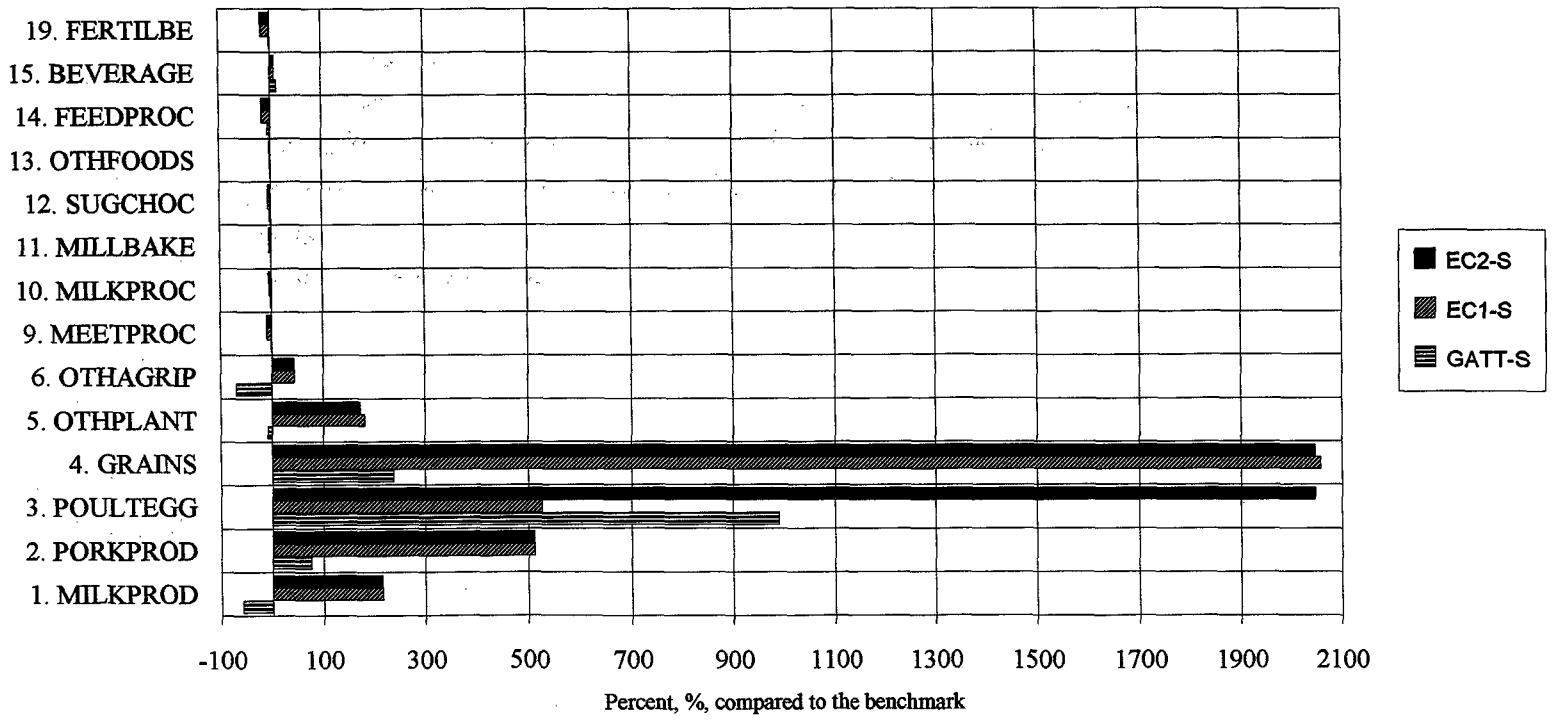
SHORT RUN CHANGES OF DOMESTIC OUTPUT



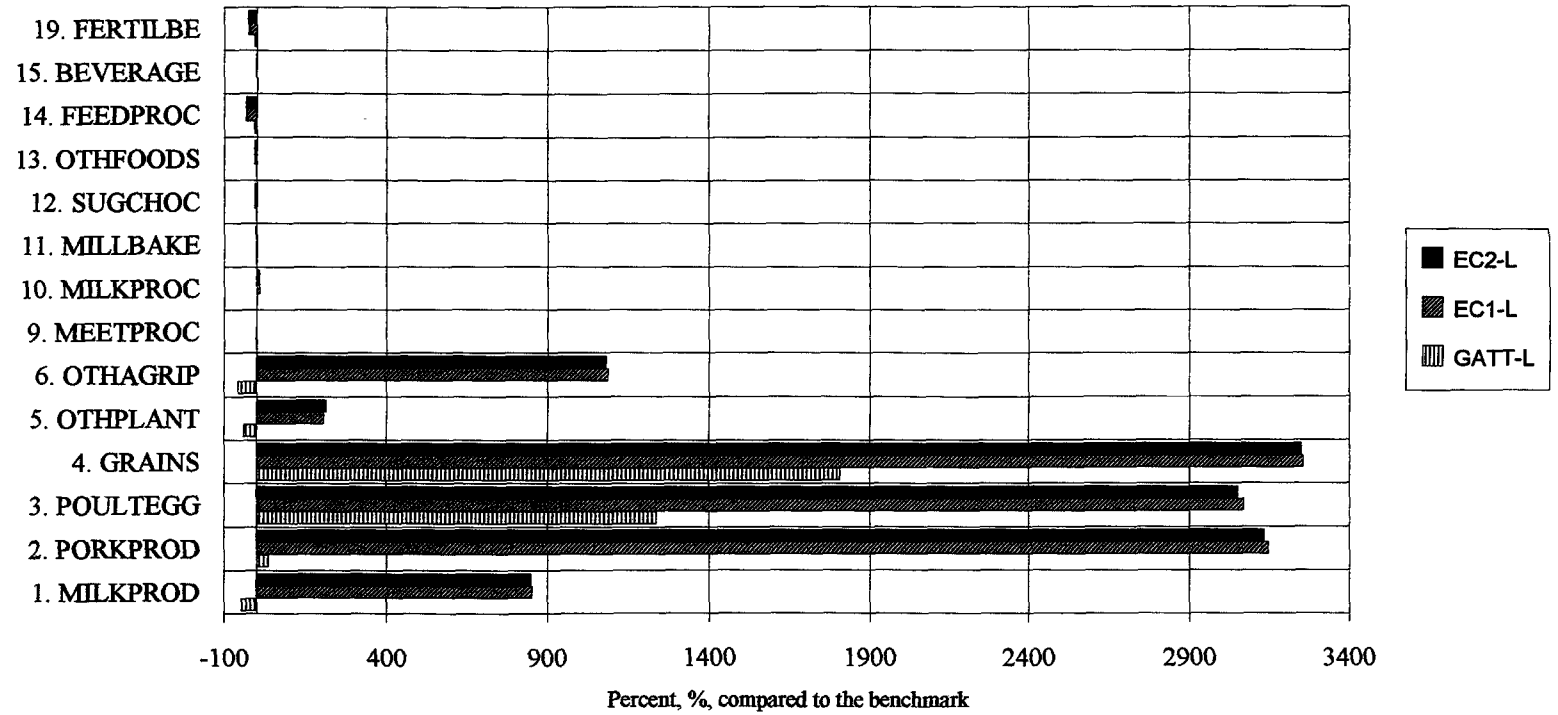
LONG RUN CHANGES OF DOMESTIC OUTPUT



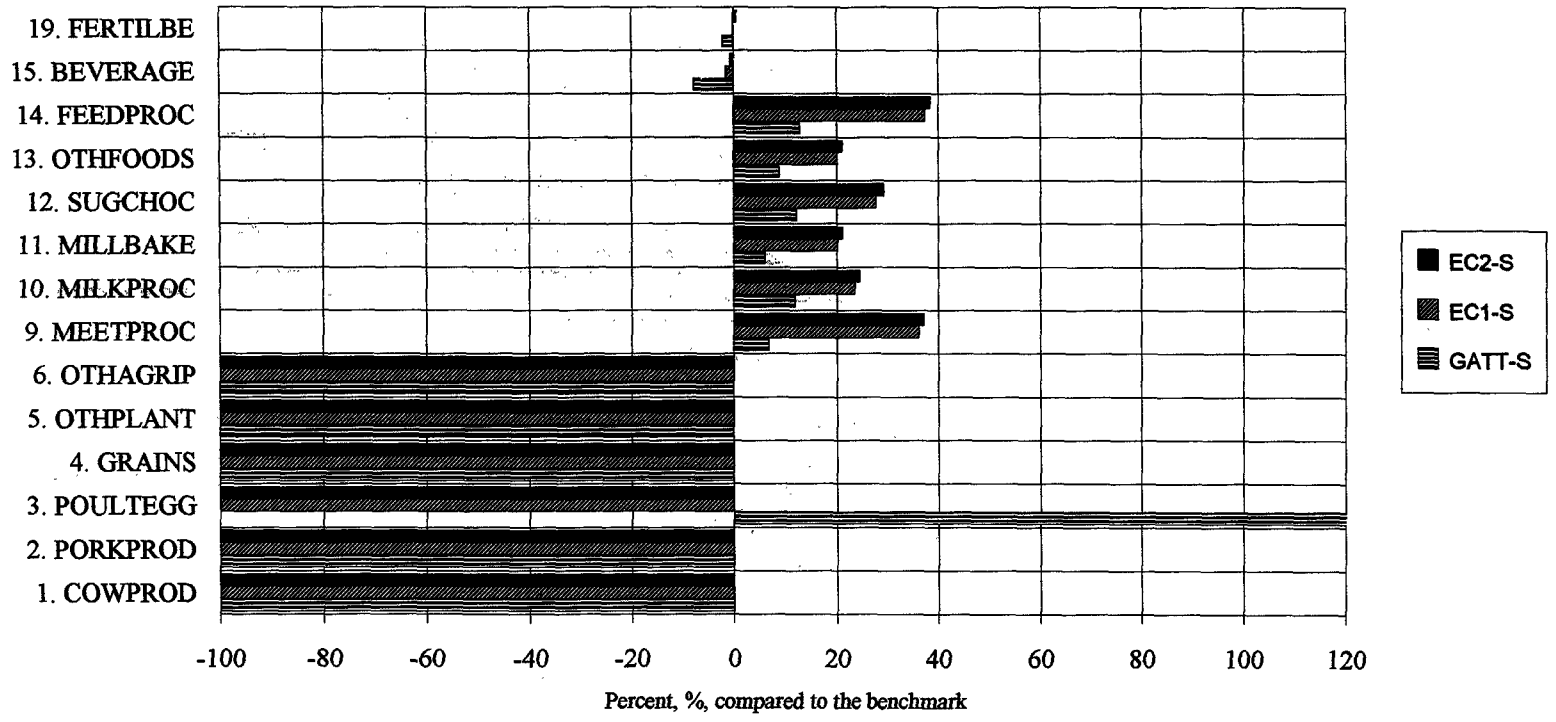
SHORT RUN CHANGES OF IMPORTS



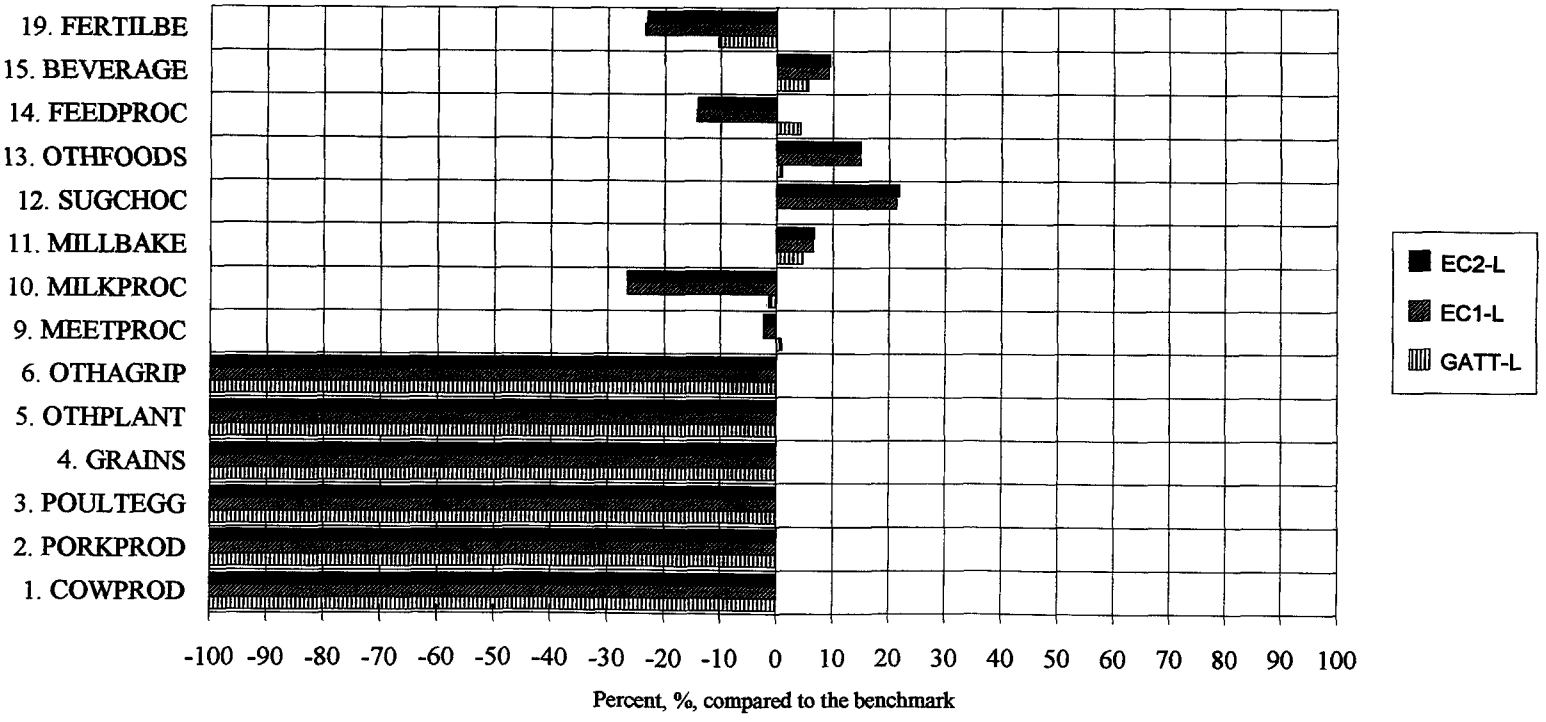
LONG RUN CHANGES OF IMPORTS



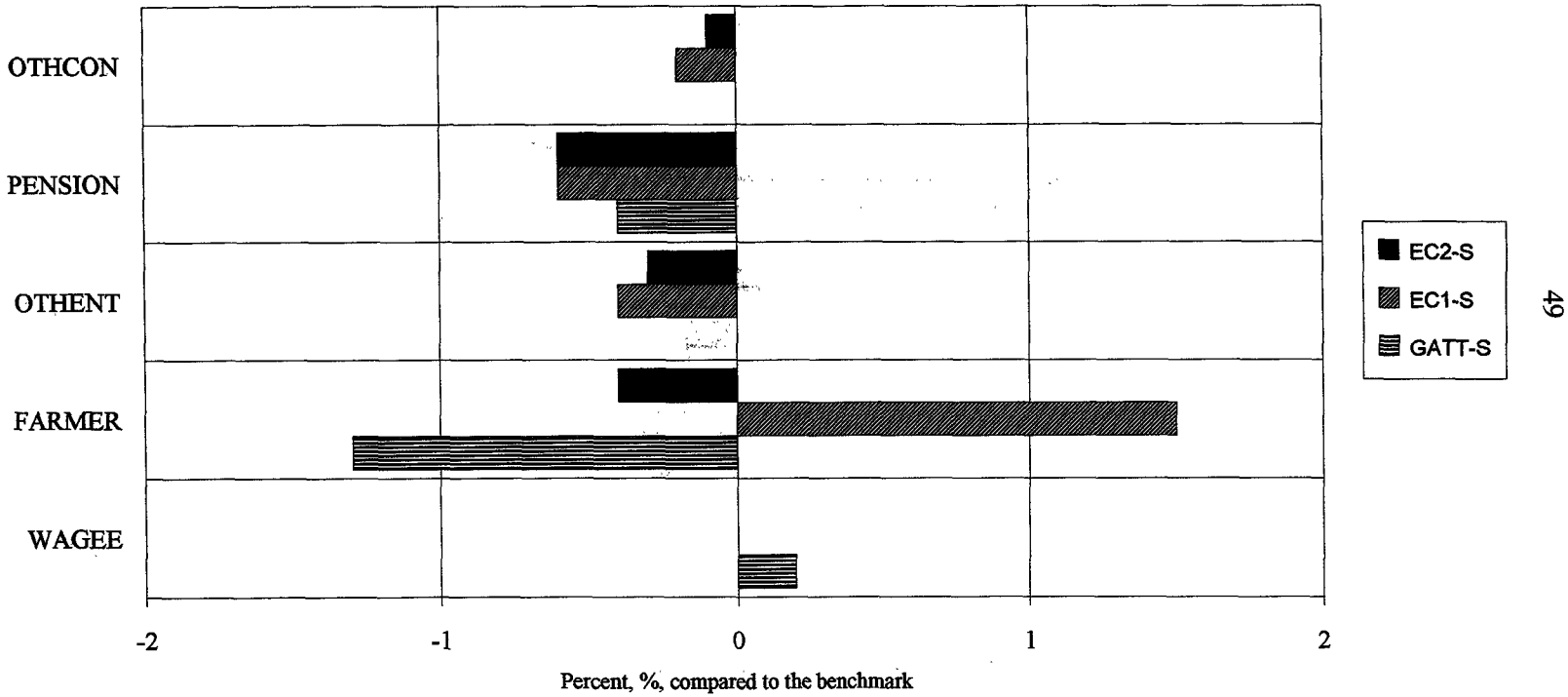
SHORT RUN CHANGES OF EXPORTS



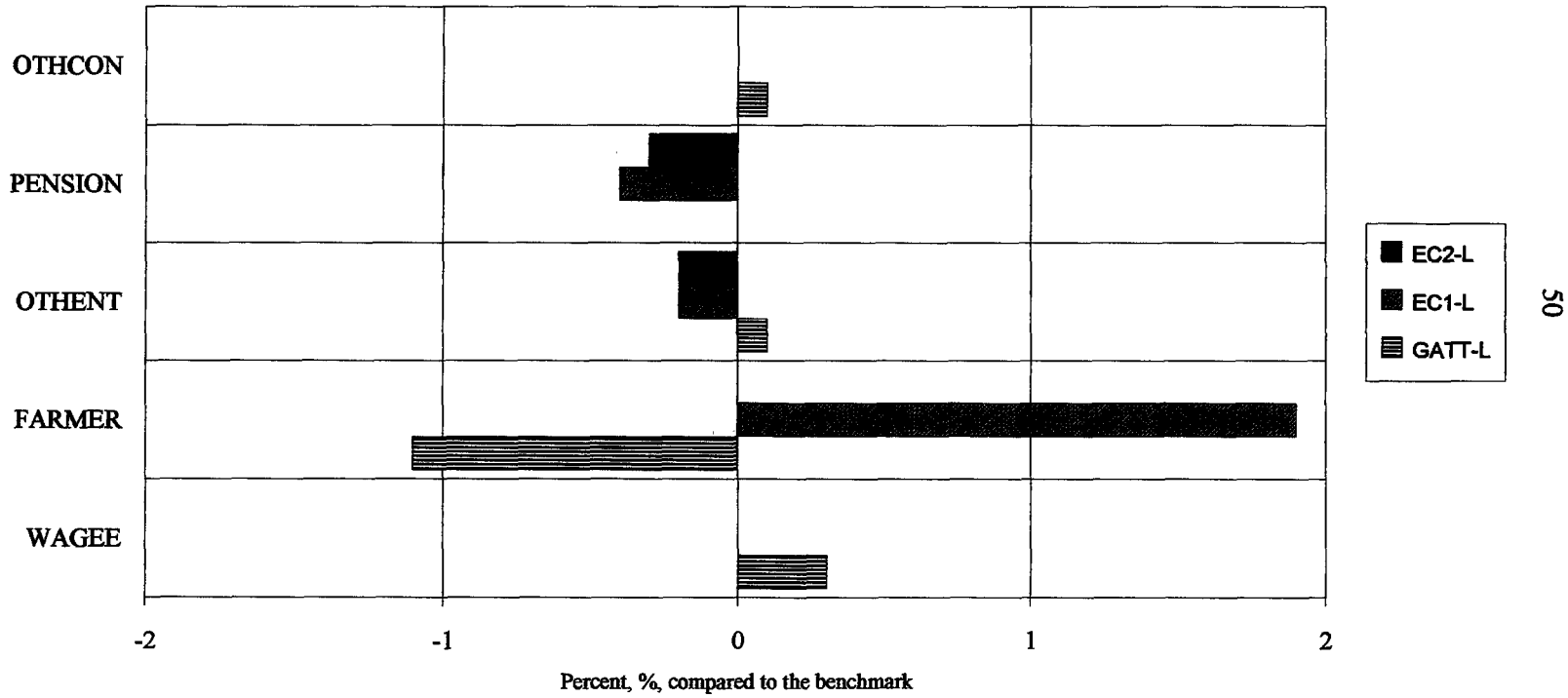
LONG RUN CHANGES OF EXPORTS

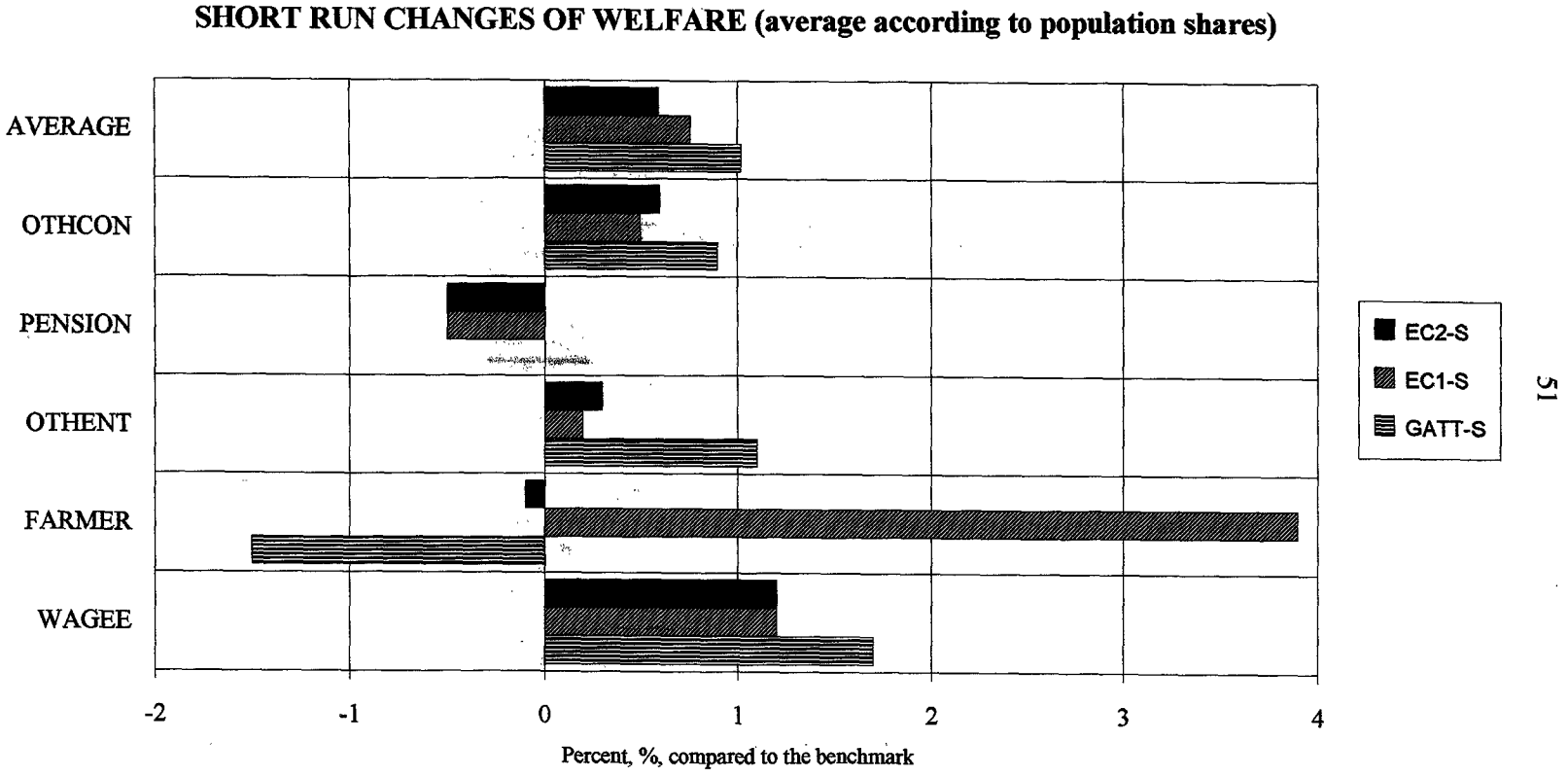


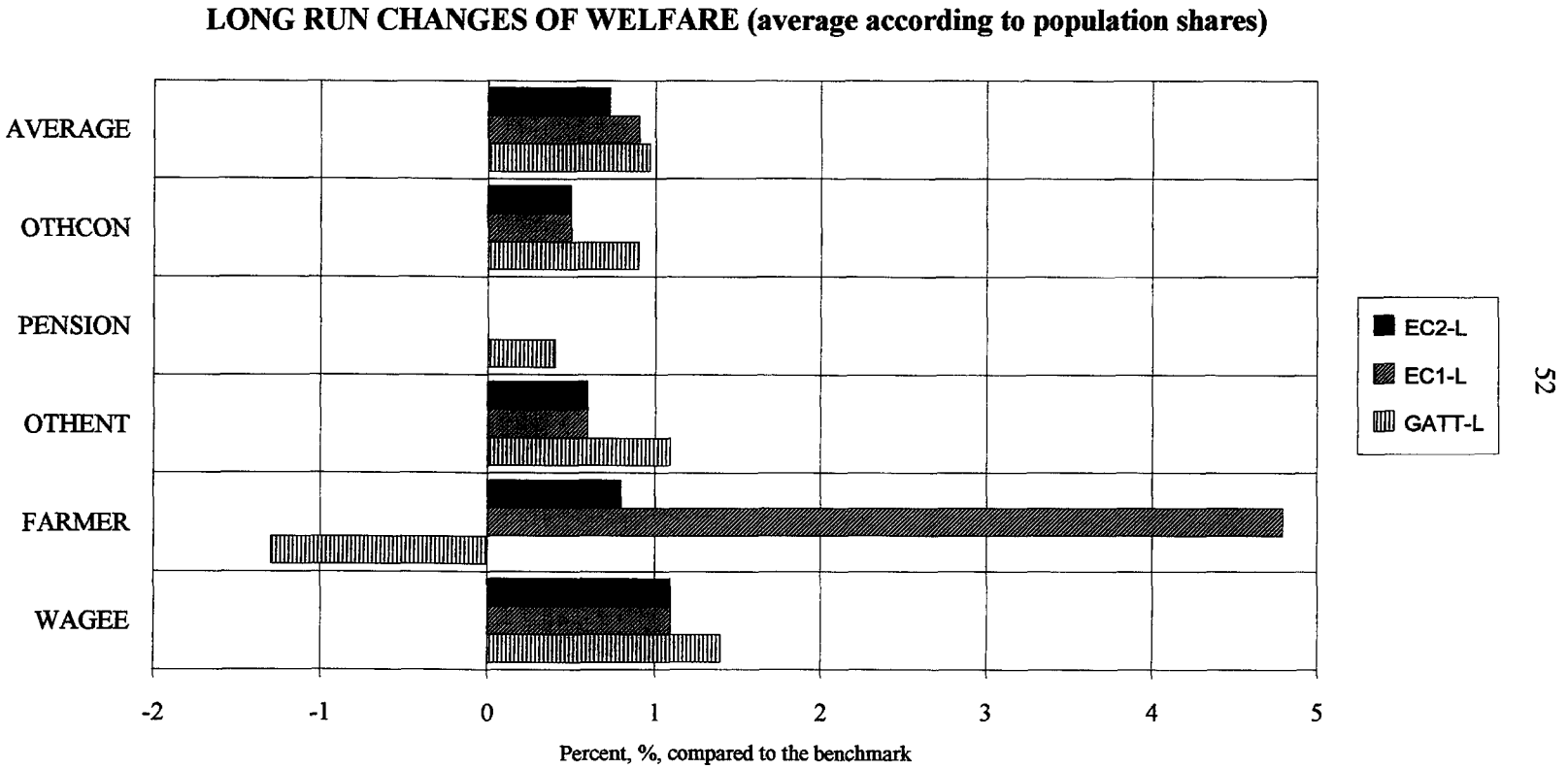
SHORT RUN CHANGES OF LABOR SUPPLY



LONG RUN CHANGES OF LABOR SUPPLY




SHORT RUN CHANGES OF WELFARE (average according to population shares)
AVERAGE
OTHCON
PENSION
OTHENT
FARMER
WAGEE
-2
-1
0
1
2
3
4
Percent, %, compared to the benchmark
EC2-S
EC1-S
GATT-S


LONG RUN CHANGES OF WELFARE (average according to population shares)
AVERAGE
OTHCON
PENSION
OTHENT
FARMER
WAGEE
-2
-1
0
1
2
3
4
5
Percent, %, compared to the benchmark
EC2-L
EC1-L
GATT-L

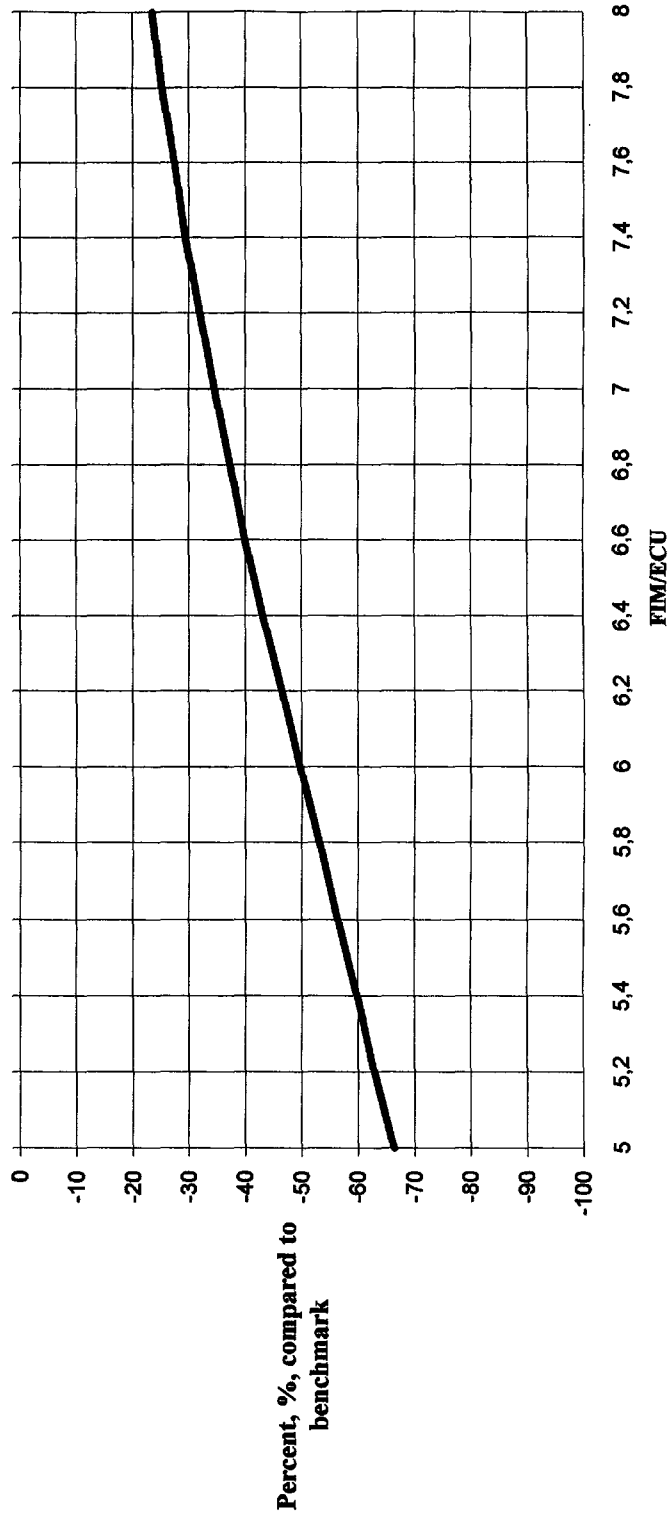
3.3 Sensitivity analysis of the results

The results of our general equilibrium calculation depend heavily on basic assumptions about the level of the exchange rate. Another key assumption that has importance is the exogenous level of Finnish EC membership fee assumed in our simulations. We have presented in figures REDAGECU, AVWELECU and in WELINPDS the sensitivity results based on key assumptions.

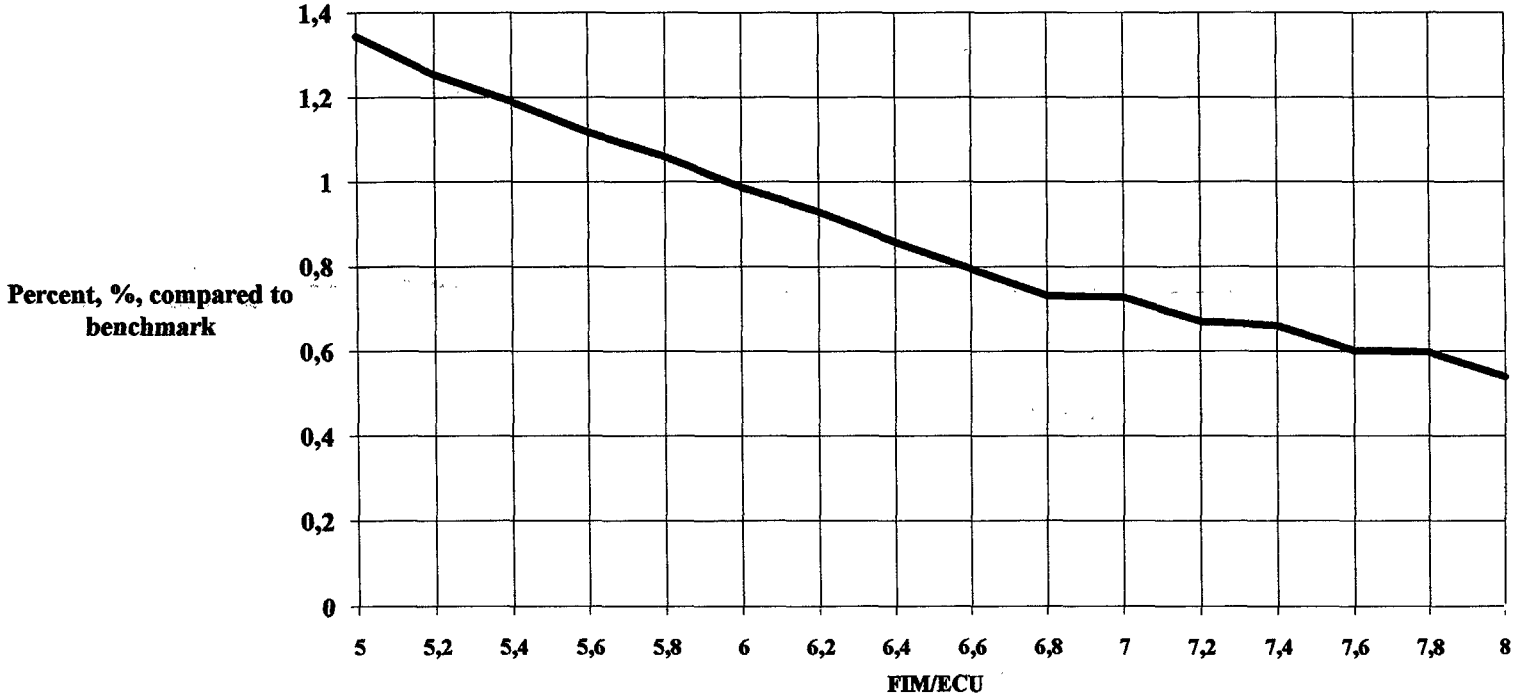
The end result of our analysis is revealed to be very sensitive to the level of ECU. This is understandable since the changes in ECU's price affect the producer price gap directly. Dearer ECU means smaller price gap between Finland and EC. From figure REDAGECU we can denote the present situation. If ECU costs FIM 7.0, Finland would lose only a little over 30 % of its agricultural produce. If ECU costs FIM 5.0 the loss is much higher, about 66 %. If Finnish markka keeps floating and depreciates further to the level of 8.0 per ECU, then only about 23% of agricultural production will vanish. In Figure AVWELECU the same pattern is presented. At ECU price FIM 5.0 the average welfare gain is nearly 1.4% but drops to the level of less than 0.6% at ECU price level FIM 8.0.

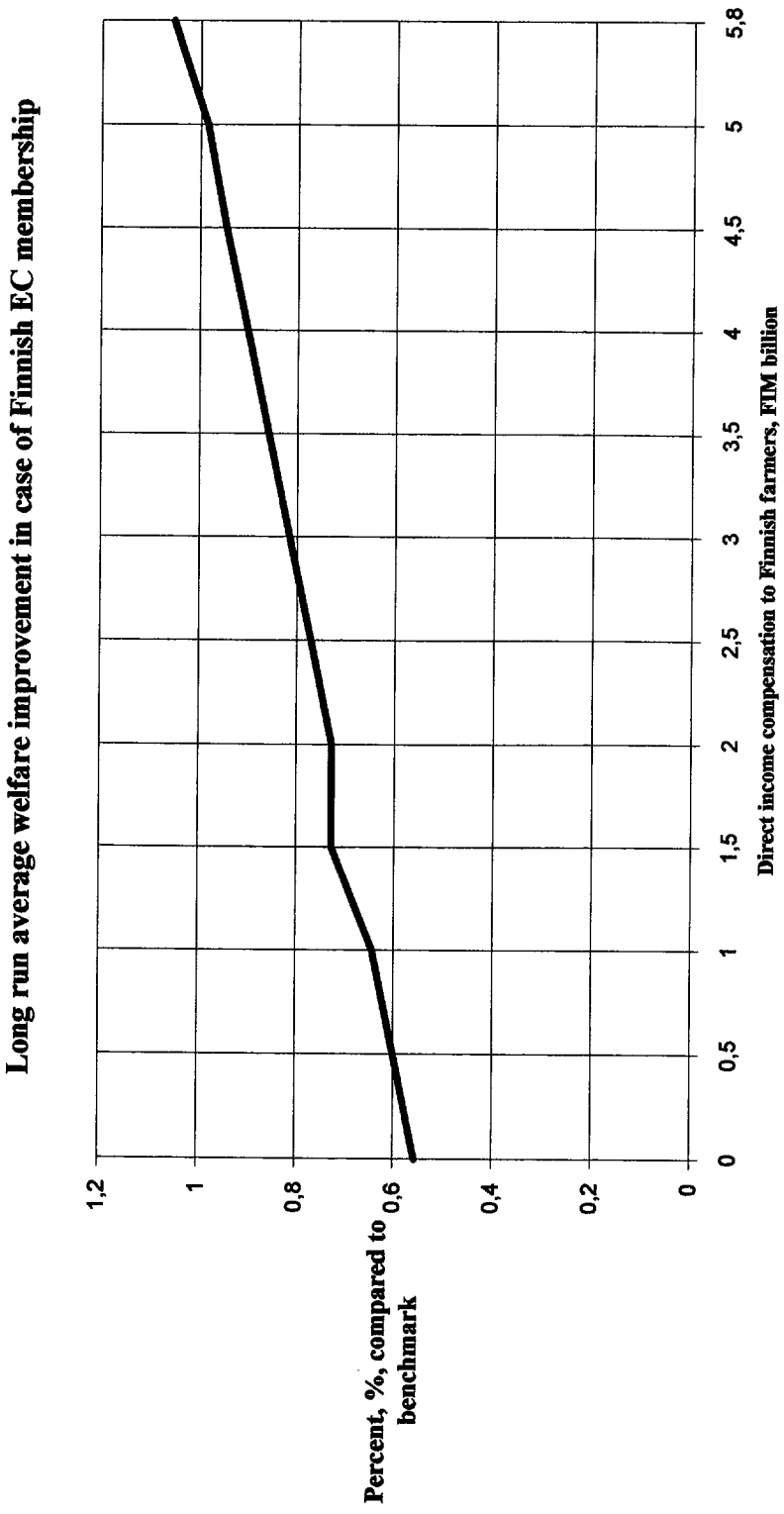
Results are also very sensitive toward the size of EC's direct income compensation. These results are presented in figure WELINPDS. The long run average welfare improvement would be about 0.6% if Finnish farmers receive no compensation at all. The welfare gain is much greater if Finnish farmers receive a positive compensation. The amount FIM 2.0 billion represents a current exchange rate a welfare improvement of about 0.7%. If the direct income compensation raises to FIM 4.0 billion, the average welfare gain would be about 0.9%.

Long run reduction of Finnish agricultural production in case of EC membership at different ECU prices



Long run average welfare improvement in case of Finnish EC membership




Long run average welfare improvement in case of Finnish EC membership
Percent, %, compared to benchmark
1,2
1
0,8
0,6
0,4
0,2
0
0
0,5
1
1,5
2
2,5
3
3,5
4
4,5
5
5,8
Direct income compensation to Finnish farmers, FIM billion

4. CONCLUSIONS

The purpose of this study has been to investigate the general equilibrium effects of three integration schemes for agriculture. These are the GATT agreement and the possible EC membership agreement. Strong emotions have been expressed both in favor and against these projects. People agree on the fact that these are great structural decisions. There will probably be a popular election on the EC membership agreement. Our task has been to provide impartial information on the allocation and welfare effects of the three scenarios for agriculture. We hope that after reading this report people have less pressures to toss a coin when deciding how to behave in the voting situation.

There are two main conclusions from our research. First, the GATT agreement and especially the EC membership agreement would have wide-spread allocation effects. Losses of domestic production in agriculture would be considerable in the long run. Grains production would vanish altogether and volumes of other agricultural activities would reduce from 30% to over 50 % if Finland would become a member in EC. The best resistance would be in milk and beef products and in another plant production which decrease by 5-30% in case of EC membership agreement. Third of all agricultural employment would have to be reallocated. The GATT agreement, which lovers but retains trade barriers would not be so dramatic. In the GATT agreement case only 10% of agricultural employment would have to be reallocated.

Second, there is the other side of the coin. According to our research all three integration schemes for agriculture would be Pareto improvements. Efficiency would grow by so much that the losing farmers could be given a compensation. In net terms Finns would be better off. The GATT and the EC membership agreements would sustain economic growth and better the allocation of resources. The end result is that the welfare of Finns would grow by nearly one percent in the long run if these scenarios would become reality. In our EC simulations a direct income compensation of FIM 2 billion would be enough to retain the pre agreement welfare level of farmers. The long run social cost of self-sufficiency in foodstuffs is thus a little below one percent in welfare. In the popular election we will find out whether this is too much for an average Finn.

We have not yet dealt with the question where the excess workers of agriculture go to. GEMFIN 4.0 model, used in this application, is a long run model. With a limited research time and budget we have not modeled imbalances of the labor market[5]. After an agricultural policy change the labor force is merely reallocated with adjusting wages. The model thus assumes that if 50000 farm workers lose their job, they will get other

[5] *There is a way to model unemployment with good style. That would be to treat the unemployed people as a separate consumer group. We have the framework developed but the lack of data prevented us from accomplishing this task. With limited resources we decided to focus on modeling the target price system and subsidy system of agriculture.*

jobs in the long run[6]. The loss of agriculture is a pleasing to other sectors since more worker resources are then available.

The general answer to this tough question is that the rest of the Finnish economy absorbs in the long run the workers that are released from agricultural activities. Employment in forestry will grow by 3 % in our EC simulations. The corresponding figure is 1% in the wood industry and paper industry would employ even 11% more work force in case of Finnish EC membership compared to the situation in 1990. These increases are based on positive volume growth of these industries which materialize when prices become lower and when efficiency is improved. These capital intensive sectors can benefit from lowering factor price of capital.

There still remains the important question of land values. In our simulations the price of the land input did not collapse. The reduction in land price was only 2-4%. These results are interesting because they predict that the property values would not vanish. Land is left laying fallow when the production of grains and other plants decreases. According to our simulations, 9% of the land used in the production of other plants would be released. When grains production vanishes, 100% of cultivated land must be reallocated. The long run solution to this supply shock of land is that the land use of forestry grows by 7%.

Finally, it is time to compare our results to the results of other Finnish researchers. We have already referenced three former Finnish studies (Kuhmonen 1991, Leppä 1992 and Vaittinen 1992). In the beginning of this year yet one important study on integration questions was published. Agriculture was not the main concern in Alho, Kotilainen and Widgrèn (1993) but in this study there are some interesting estimations on the importance of food economy. Using methods developed in international trade theory they estimate the benefit of better resource allocation in case of Finnish EC membership.

Alho, Kotilainen and Widgrèn (1993) assume in their calculation that producer prices of agriculture are lowered to European levels. They further assume that the produce of agriculture would be halved in the long run and that 25 % of present employers in agriculture could be employed in new jobs which would be as effective as the old ones. The researchers estimate that the long run resource allocation benefit would be about 1.5% of GDP. The study group also estimate that if resource allocation would be efficient allready in the present situation then the benefit would be only 0.5% of GDP. The researchers compare these figure to the total net benefit resulting from Finnish EC membership which is estimated to be about 4% of GDP.

At this point it is worth emphasizing that our results for the welfare gain correspond only to the adjustment of agriculture. There is a possibility that some part of the total welfare effect will flow back to agriculture and would thus ease the adjustment process.

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[6] *We have not modeled migration. In case of unemployment it is possible that a part of the unemployed people emigrate to other countries.*

These estimates correspond to ours. Our estimate for the average welfare improvement from Finnish EC membership was about 0.8%. This figure is in the interval of the results of Alho, Kotilainen and Widgrèn (1993). Our estimate correspond also to the result of Leppä (1992) who estimated that GDP would grow by about 0.6% when prices of food economy are lowered to European levels. Vaittinen (1992) estimated a welfare loss of present protectionistic agricultural policy to be about 1.4% of GDP. This is very close to the result of Alho, Kotilainen and Widgrèn (1993).

All Finnish estimates for agricultural integration point to the same conclusion. The present Finnish agricultural policy produces welfare losses. When the border is opened to imports of foreign food domestic resources could be more effectively allocated. The welfare gain from Finnish EC membership would not, on the other hand, be enormous. The correct estimate seems to be around 1% of GDP or about FIM 5 billion. The structural change benefit in net terms to the average Finn would thus be about FIM 1000 per head.

The decision situation is problematic for Finns. On the other side of the coin there is considerable run down of agriculture. The other side of the coin represents a net welfare improvement that would be nice to have. It seems to us that the decision whether Finland should join European Union cannot be solved purely on economic grounds. When the decision is made on political grounds it is, however, reassuring to know that the welfare of Finns will not alter considerably at present ECU price (FIM 7.0). We have to be avare of the fact that the end result of this reasoning is very much dependent on the level of the exchange rate and the amount of EC's direct income compensation to remaining Finnish farmers.

Much remains to be studied on the integration question of Finnish agriculture. The most important point is, however, the fact that now there is a developed tool for the Finnish economists. The GATT and particularly the EC membership negotiations have just begun. It is most important that the economists follow the monthly situation of the talks. GEMFIN 4.0 can serve as a tool for such analysis.

Two research topics should be given immediate attention. First, we have not modeled the basic production deduction of food processing industries in sales taxation. The money worth of this deduction is about FIM 4 billion. There is differing views concerning the treatment of this deduction when Finland adopts the value added tax system.

Second, the choise of the lenght of the agricultural adjustment period should be studied. There are differing views expressed on this matter. The agricultural organisations demand long, even 12 year, adjustment period for EC negotiations. Government officials prefer shorter, maybe 5 year, adjustment period.

INTEGRATING FINNISH AGRICULTURE INTO EC'S COMMON AGRICULTURAL POLICY

SUOMENKIELINEN YHTEENVETO

Suomen EY-jäsenyyden vaikutukset maatalouteen tutkittu

Maatalouden integraatiovaihtoehtoja on tutkittu yleisen tasapainon laskentamallilla, joka on kehitetty suomalais-amerikkalaisena tutkimusyhteistyönä. Mallissa kuvataan yksityiskohtaisesti Suomen maatalouden tavoitehintojen määräytyminen. Tällä GEMFIN-mallilla on tutkittu Suomen GATT-ratkaisun ja EY-jäsenyyden vaikutuksia maatalouteen ja elintarviketeollisuuteen. Tutkimus on Valtion taloudellisen tutkimuskeskuksen tilaama.

EY-jäsenyys veisi kolmanneksen maatalouden tuotannosta

Maatalouden tuotanto supistuisi laskelman mukaan nykyvaluuttakurssilla noin kolmanneksella jos Suomi liittyisi EY:n jäseneksi ja jos maatalouden tavoitehinnat alennettaisiin Euroopan tasolle. Viljaa ei kannattaisi viljellä pitkällä tähtäimellä ollenkaan ja sian- ja naudanlihaa voitaisiin tuottaa 30-45 % vähemmän kuin nykyisin. Maidon tuotanto supistuisi lähes 30 % ja siipikarjatuotteiden tuotannon määrä laskisi hieman alle puoleen nykytasosta. Parhaiten pärjäisivät muut kuin viljakasvit, joiden tuotanto ei juurikaan kärsisi.

Tuotannon aleneminen merkitsee noin 50 000 työpaikan menetystä maataloudessa sopeutumisjan jälkeen. Sopeutumisaikaa ei ole arvioitu. Maataloudesta tosin vapautuu työvoimaa muutenkin ensi vuosikymmenellä. Pitkällä tähtäimellä maataloudesta vapautuvan työvoiman voidaan ajatella sijoittuvan mm. metsätalouden ja teollisuuden palvelukseen.

Kotimaisen tuotannon laskiessa nykyisinkin vähäinen maatalousvienti loppuisi. Ruokaomavaraisuus laskisi ja valtaosa ruoasta olisi tuontitavaraa. Kuluttajan ruokakorin hinta laskisi 3-5 % pitkällä tähtäimellä.

Vastineeksi noin prosentti lisää hyvinvointia

Teknisesti laskien EY-jäsenyys kannattaisi. Laskelman mukaan vastineeksi elinkeinorakenteen muutokselle saataisiin noin 0.8 %:n suuruinen nettohyvinvoinnin lisäys. Tulosta voidaan tulkita myös niin, että nykyinen tehottomuutta aiheuttava rajasuojajärjestelmä maksaa suomalaisille hieman alle prosentin hyvinvoinnista. Eniten EY-jäsenyydestä hyötyisivät palkansaajat ja vähiten eläkeläiset.

Laskelmassa on oletettu, että EY myöntää suoraa tulotukea elinkeinonsa menettäville viljelijöille. Ilman tukea uudelleen työllistyvien viljelijöiden hyvinvoinnin menetys olisi 1.3 %. Tulosten mukaan noin 2 mrd. mk:n suuruinen suora tulotuki riittäisi korvaamaan uudelleen työllistyville viljelijöille entisen hyvinvoinnin tason.

GATT-ratkaisukin hyödyttäisi kansantaloutta

GATT-laskelmassa on oletettu, että Suomen nykyiset neuvottelutavoitteet hyväksyttäisiin. Tämä merkitsisi tuontikiintiö-järjestelmän muuttamista tuontimaksuiksi, vientituen leikkaamista 36 % ja kotimaisen tuen 20 %:n laskua. Laskelman mukaan tälläinen GATT-sopimus alentaisi maatalouden tuotantoa noin 10 % nykyisestä ja toisi korvauksena noin 1 %:n nettohyvinvoinnin lisäyksen.

Elintarviketeollisuus pärjäisi teknisesti laskien Euro-Suomessakin

Tutkimuksen tulosten mukaan elintarviketeollisuus voisi jopa hieman nostaa tuotantoaan GATT-sopimuksen ja EY-jäsenyyden toteutuessa. Elintarvikkeiden halpeneminen lisäisi niiden kysyntää ja ulkomaisten edullisten raaka-aineiden käyttö parantaisi kustannustehokkuutta. Suomi voisi jopa lisätä noin 15 %:lla elintarviketeollisuuden tuotteiden vientiä EY-jäsenyyden tapauksessa.

Lopputulos riippuu valuutan hinnasta ja EY:n jäsenmaksusta

Tutkimuksen laskelmat on suoritettu ECU:n kurssilla 7.0 mk. EY:n jäsenmaksun suuruudeksi on oletettu 5.8 mrd. mk. Suoritettujen herkkyyskokeiden mukaan ECU:n hinnan vaihdellessa 5 mk:sta 8 mk:n nettohyvinvoinnin lisäys vaihtelee välillä 1.3-0.6 %. Tämä perustuu tuottajahintaeron kaventumiseen ulkomaan valuutan kallistuessa. 5 mk:n ECU:n hinnalla maatalouden tuotanto alentuisi yli 60 %. Vastaavasti 8 mk:n ECU:n hinnalla menetys olisi vain noin 20 %.

Onnistuminen EY-neuvotteluissa merkitsee edun kasvamista. Tilanteessa jossa EY ei maksaisi lainkaan suoraa tulotukea suomalaisille viljelijöille hyvinvoinnin nettokasvu olisi vain 0.6 %. Vastaavasti jos viljelijöille maksettaisiin sama summa kuin mikä Suomen jäsenmaksu on, 5.8 mrd. mk, niin hyvinvoinnin nettolisäys olisi 1.1 % nykyvaluuttakurssilla.

Varovaisuus tarpeen tuloksia tulkittaessa

Tutkijat korostavat, että vaikka laskelmat onkin suoritettu kansainväliset mittapuut täyttävällä laskentakehikolla, on syytä muistaa laskelmien tekninen luonne. Tutkimus pyrkii pääasiassa osoittamaan vaihtoehtojen karkeat suuruusluokat.

INTEGRATING FINNISH AGRICULTURE INTO EC'S COMMON AGRICULTURAL POLICY

SVENSK RESUME

Effekterna på jordbruket i finländskt EG-medlemskap undersökta

Det finländska jordbrukets integrationsalternativ i EG har nu blivit undersökta via en allmän jämviktsberäkningsmodell, som utarbetats i ett finskt-amerikanskt forskningssamarbete. I modellen redogörs detaljerat för bestämningen av det finländska jordbrukets riktpriser. Med hjälp av denna GEMFIN-modell har man undersökt den effekt som Finlands GATT-uppgörelse och EG-medlemskap har på jordbruket och livsmedels-industrin. Undersökningen har gjorts i uppdrag av Statens ekonomiska forskningscentral.

EG-medlemskap skulle minska jordbruksproduktionen med en tredjedel

Jordbruksproduktionen skulle enligt denna kalkyl och enligt nuvarande valutakurs minska med ca en tredjedel om Finland blev EG-medlem och om jordbrukets riktpriser sänktes till europeisk nivå. Spannmålsodling vore på lång sikt inte alls lönsam och svin- och nötköttsproduktionen skulle minska med 30-45 % från dagens nivå. Mjölkproduktionen skulle minska med nästan 30 % och fjäderfäproduktionen skulle minska med drygt hälften av dagens nivå. All annan odling än spannmålsodling skulle klara sig bäst.

En nedskärning i produktionen innebär ett bortfall av ca 50 000 arbetsplatser inom jordbruket efter en viss anpassningstid. Denna anpassningstid har man inte kunnat uppskatta än. Jordbruket kommer visserligen ändå att frigöra arbetskraft under nästa årtionde. På lång sikt kunde man tänka sig att den arbetskraft som frigörs från jordbruket kunde placeras bl a inom skogsbruket och industrin.

När den inhemska produktionen reducerar skulle jordbruksexporten, som redan nu är liten, upphöra helt. Självförsörjningen inom livsmedelsproduktionen skulle minska och övervägande delen av livsmedlen vore importgods. Priset på konsumenternas matkorg skulle på lång sikt sjunka med 3-5 %.

En procents högre välstånd i gengäld

Ett EG-medlemskap skulle tekniskt sett löna sig. Enligt beräkningen skulle vi efter en förändring av näringsstrukturen få en ökning på ca 0,8 % av nettovälståndet. Man kan tolka resultatet även så att det nuvarande gränsskyddet, vilket inom EG vore omöjligt att upprätthålla, kostar finländarna en knapp procent av välståndet. Ett EG-medlemskap skulle gagna löntagarna mest och pensionärerna minst.

I beräkningen har man antagit att EG beviljar ett direkt inkomststöd för de jordbrukare som blivit tvungna att lägga ner sitt jordbruk. Utan detta stöd skulle välståndet för dessa jordbrukare, sjunka med 1,3 %. Enligt undersökningsresultatet skulle ett inkomststöd på ca 2 mrd mk vara tillräckligt för att kompensera jordbrukarnas tidigare välstånd.

Nationalekonomin skulle gagnas av enbart GATT-lösning

I GATT-beräkningarna har man antagit att Finlands nuvarande förhandlingsmålsättning godkändes. Detta skulle innebära att man omvandlade importkvotsystemet till en importavgift, en 36% nedskärning av exportstödet och en 20 % sänkning av det inhemska stödet. Enligt beräkningen skulle ett sådant GATT-avtal reducera dagens jordbruksproduktion med 10 % och skulle som kompensation öka nettovälståndet med ca 1 %.

Livsmedelsindustrin skulle tekniskt sett bära sig även i Euro-Finland

Enligt undersökningsresultatet skulle livsmedelsindustrin till och med kunna öka sin produktion något om GATT-förhandlingarna och EG-medlemskapet förverkligades. Allteftersom prisen på livsmedlen sjönk skulle efterfrågan på dem bli livligare och användningen av utländska förmånliga råvaror skulle sänka prisnivån. Finland kunde till och med öka sin export av livsmedelsindustriprodukter med ca 15 % om vi blev medlem i EG.

Resultatet beror på valutapriset och EG-medlemsavgiften

Undersökningens beräkningar har utförts enligt en ECU-kurs på 7,0 mk. EG-medlemsavgiften har beräknats vara 5,8 mrd mk. Enligt utförda robusthetstests skulle en ökning av nettovälståndet variera mellan 1,3-0,6 % om ECU-priset varierade mellan 5-8 mk. Detta baserar sig på en reducering av producentpris skillnaden om kursen på utlandsvalutan steg. Jordbruksproduktionen skulle minska över 60 % om kursen för ECU var 5 mk. Om däremot ECUns värde vore 8 mk skulle förlusten utgöra endast ca 20 %.

Om EG-förhandlingarna godkändes skulle det innebära en ökning av ekonomiska förmåner. Om EG inte alls betalade ett direkt inkomststöd åt de finländska jordbrukarna skulle netto-ökningen av välståndet innebära endast 0,6 %. Om staten däremot betalade jordbrukarna samma summa som EG-medlemskapet kostar, dvs 5,8 mrd mk, skulle välståndets netto-ökning utgöra 1,1 % enligt dagens valutakurs.

Försiktighet nödvändig vid tolkning av resultaten

Forskarna betonar att även om beräkningarna utförts inom internationellt godkända forskningsnormer, är det skäl att beakta den tekniska karaktären av beräkningarna. Undersökningen strävar i huvudsak till att påvisa de grova riktlinjerna för alternativen.

Appendix 1. Production Sectors in GEMFIN 4.0 model

PRIMARY PRODUCTION:

1. COWPROD	Production of milk and beef.
2. PORKPROD.	Production of pork.
3. POULTEGG.	Production of poultry and eggs.
4. GRAINS.	Production of grains.
5. OTHPLANT.	Production of other plants.
6. OTHAGRIP.	Other agricultural production..
7. FORESTRY.	Forestry, fishing and hunting.

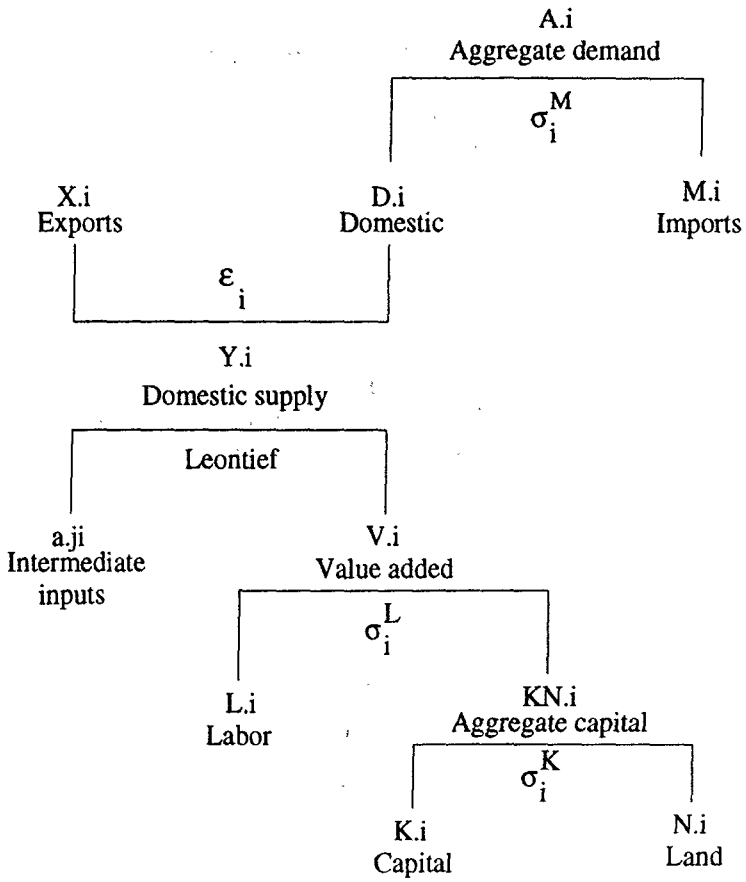
FOOD PROCESSING INDUSTRIES:

9. MEETPROC.	Slaughtering and meat processing.
10. MILKPROC.	Milk processing.
11. MILLBAKE.	Production of mill and bakery goods.
12. SUGCHOC.	Production of sugar, chocolate and candies.
13. OTHFOODS.	Production of other foodstuffs.
14. FEEDPROC.	Production of feedingstuffs.
15. BEVERAGE.	Production of beverages.

OTHER MANUFACTURING AND SERVICE INDUSTRIES

8. MINIQUAR.	Mining and quarrying.
16. TEXTWALE.	Textile, wearing apparel and leather industries.
17. WOODPROS.	Production of wood and wood products.
18. PAPERPRO.	Production of paper and paper products.
19. FERTILPES.	Production of fertilizers and pesticides.
20. OTHCHEM.	Other chemicals and chemical products.
21. METALIND.	Metal industries.
22. OTHMANUF.	Other manufacturing industries.
23. ELCAHEWA.	Electricity, gas, heating and water services.
24. BUILDING.	Building and construction.
25. TRADEREH.	Trade, restaurants and hotels.
26. TRANSSCO.	Transport, storage and communication.
27. FININSBSE.	Financing, incurance and business services.
28. DWELLING.	Rented and owner-occupied dwellings.
29. OTHPSERV.	Other private services.

Appendix 2. The Structure of Production in GEMFIN 4.0 model



A.i = Aggregate domestic demand, sector i
M.i = Imports, sector i
D.i = Domestic sales, sector i
X.i = Exports, sector i
Y.i = Aggregate production, sector i
a.ji = Intermediate resources from sector j
V.i = Value added, sector i
L.i = Labor use, sector i
K.i = Capital use, sector i
KN.i = Aggregate capital, sector i
N.i = Land use, sector i

σ_i^M = Armington elasticity, imported goods

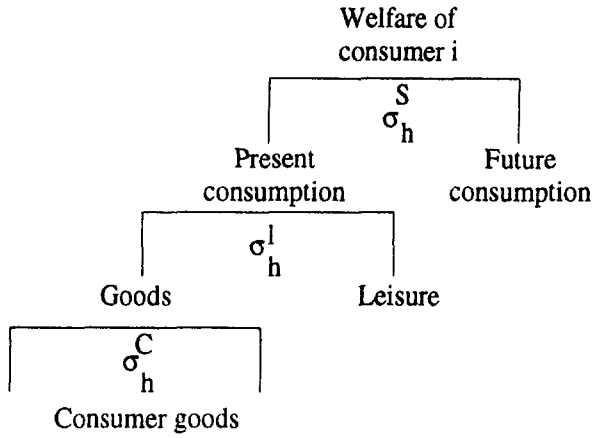
ε_i = Transformation elasticity, exported goods

σ_i^L = Aggregate capital-labor substitution elasticity

σ_i^K = Capital-land substitution elasticity

Appendix 3. Consumer Goods and Utility Structure in GEMFIN 4.0 model

1. GRAINPRO. Grain and grain products.
2. MEATPRO. Meat and meat products.
3. MILKCEGG. Milk, cheese and eggs.
4. BUTTEROG. Butter and other greases.
5. POTATOES. Potatoe.
6. SUGAR. Sugar.
7. OTHFOOD. Other foodstuffs.
8. BEVERAG. Beverages.
9. CLOTHFW. Clothing and footwear.
10. DWELLIN. Housing.
11. HHEQUIP. Household equipment.
12. HEALTHCA. Health care.
13. TRANSPOR. Transportation.
14. RECRCULT. Recreation and culture.
15. OGOODSER. Other goods and services.



σ_h^S substitution elasticity of present and future consumption

σ_h^I substitution elasticity of goods and leisure

σ_h^C intra-commodity substitution elasticity

Appendix 4. Benchmark production tax rates (%)

	TE	TM	TL	TX
COWPROD	-49.000	2.876	38.005	-39.154
PORKPROD	-77.000	1.945	27.863	-10.126
POULTEGG	-59.000		8.772	-29.136
GRAINS	-142.000	10.756	1.550	-107.685
OTHPLANT	-21.000	2.814	4.098	-3.066
OTHAGRIP	106.864	6.892	16.000	
FORESTRY		3.125	23.898	0.742
MINIQUAR		1.205	26.437	1.651
MEETPROC		7.018	26.544	1.449
MILKPROC		8.416	26.506	2.552
MILLBAKE		4.217	26.549	-5.886
SUGCHOC		9.091	26.514	
OTHFOODS		2.427	26.499	
FEEDPROC		3.168	25.490	
BEVERAGE		11.524	29.344	
TEXTWALE		1.571	24.504	-0.407
WOODPROS		0.668	28.119	0.946
PAPERPRO		0.305	27.367	5.114
FERTILPE		0.209	28.947	0.931
OTHCHEM		0.139	27.461	2.097
METALIND		0.834	26.433	1.548
OTHMANUF		0.971	25.206	-0.192
ELCAHEWA		0.065	30.307	0.954
BUILDING		3.042	28.207	8.253
TRADEREH		1.040	24.888	5.519
TRANSSCO		1.110	26.115	3.708
FININBSE		0.806	34.058	0.595
DWELLING		3.274	23.636	0.915
OTHPSERV		1.944	24.299	1.571

TE	Subsidy rate of exports
TM	Import duty rate
TL	Payroll tax rate
TX	Net commodity tax rate

Appendix 5. Elasticities of Production in Foreign Studies

	Elasticity values* used for capital-labor substitution elasticity in studies: (1)	(2)	(3)	σ_i^L This study
PRIMARY PRODUCTION:				
1. Production of milk and beef.	0.7	0.8	0.7	0.6
2. Production of pork.				
3. Production of poultry and eggs.				
4. Production of grains.				
5. Production of other plants.				
6. Other agricultural production.				
7. Forestry, fishing and hunting			1.5	1.1
FOOD PROCESSING INDUSTRIES:				
9. Slaughtering and meat processing.	0.7	0.9		0.8
10. Milk processing.				
11. Production of mill and bakery goods.				
12. Production of sugar, chocolate and candies.				
13. Production of other foodstuffs.				
14. Production of feedingstuffs.				
15. Production of beverages.				
OTHER MANUFACTURING AND SERVICE INDUSTRIES				
8. Mining and quarrying.				0.7
16. Textile, wear. apparel and leather indust.	0.9			1.0
17. Production of wood and wood products.				0.8
18. Production of paper and paper products.				0.8
19. Production of fertilizers and pesticides.	1.0	1.1		1.1
20. Other chemicals and chemical products.				
21. Metal industries.	0.7			
22. Other manufacturing industries.		1.0		0.9
23. Electricity, gas, heating and water services.	1.0	1.0		0.7
24. Building and construction.				0.8
25. Trade, restaurants and hotels.				0.8
26. Transport, storage and communication.				0.9
27. Financing, incurance and business services.				0.3
28. Rented and owner-occupied dwellings.				1.0
29. Other private services.				0.3

* = Elasticity values have been rounded into one decimal. Industrial classifications don't match perfectly.

(1) Ballard et. al., 1985

(2) Burniaux et. al., 1988

(3) Boyd and Newman, 1991

Appendix 6. Elasticities of Production in Foreign Studies

	Elasticity values* used for capital-land substitution elasticity in studies: σ_i^K		
	(1)	(2)	This study
PRIMARY PRODUCTION:			
1. Production of milk and beef.	0.5	0.4	
2. Production of pork.			
3. Production of poultry and eggs.			
4. Production of grains.			
5. Production of other plants.		0.3	0.5
6. Other agricultural production.			
7. Forestry, fishing and hunting		1.5	1.0

* = Elasticity values have been rounded into one decimal. Industrial classifications don't match perfectly.

(1) Burniaux et. al., 1988

(2) Boyd and Newman, 1991

Appendix 7. Elasticities of Production in Foreign Studies

	Elasticity values* used for Import-domestic Armington elasticity σ_i^M in studies: (1)	(2)	This study
PRIMARY PRODUCTION:			
1. Production of milk and beef.			4.0
2. Production of pork.			
3. Production of poultry and eggs.			
4. Production of grains.			8.0
5. Production of other plants.			
6. Other agricultural production.			
7. Forestry, fishing and hunting			2.0
FOOD PROCESSING INDUSTRIES:			
9. Slaughtering and meat processing.			
10. Milk processing.		10.9	
11. Production of mill and bakery goods.		1.4	
12. Production of sugar, chocolate and candies.	1.1	0.3	1.0
13. Production of other foodstuffs.			
14. Production of feedingstuffs.			
15. Production of beverages.		0.5	
OTHER MANUFACTURING AND SERVICE INDUSTRIES			
8. Mining and quarrying.			
16. Textile, wear. apparel and leather indust.	1.2	2.6	
17. Production of wood and wood products.	1.8	0.3	2.0
18. Production of paper and paper products.	1.6	1.8	
19. Production of fertilizers and pesticides.			4.0
20. Other chemicals and chemical products.	2.6	6.1	
21. Metal industries.	2.2	3.0	2.0
22. Other manufacturing industries.			
23. Electricity, gas, heating and water services.			
24. Building and construction.			
25. Trade, restaurants and hotels.			1.0
26. Transport, storage and communication.			
27. Financing, incurance and business services.			
28. Rented and owner-occupied dwellings.			
29. Other private services.			

* = Elasticity values have been rounded into one decimal. Industrial classifications don't match perfectly.

(1) Dearndorf and Stern, 1981

(2) Shiells, Stern and Deardorff, 1986

Appendix 8. Elasticities of Production in Foreign Studies

	Elasticity values* used for domestic-export transformation elasticity in studies: ε_i This study
PRIMARY PRODUCTION:	
1. Production of milk and beef.	+INF
2. Production of pork.	
3. Production of poultry and eggs.	
4. Production of grains.	
5. Production of other plants.	
6. Other agricultural production.	
7. Forestry, fishing and hunting	
FOOD PROCESSING INDUSTRIES:	
9. Slaughtering and meat processing.	2.0
10. Milk processing.	
11. Production of mill and bakery goods.	
12. Production of sugar, chocolate and candies.	
13. Production of other foodstuffs.	
14. Production of feedingstuffs.	
15. Production of beverages.	
OTHER MANUFACTURING AND SERVICE INDUSTRIES	
8. Mining and quarrying.	2.0
16. Textile, wear. apparel and leather indust.	
17. Production of wood and wood products.	
18. Production of paper and paper products.	
19. Production of fertilizers and pesticides.	
20. Other chemicals and chemical products.	
21. Metal industries.	
22. Other manufacturing industries.	
23. Electricity, gas, heating and water services.	1.5
24. Building and construction.	
25. Trade, restaurants and hotels.	
26. Transport, storage and communication.	
27. Financing, incurance and business services.	
28. Rented and owner-occupied dwellings.	
29. Other private services.	

* = Elasticity values have been rounded into one decimal. Industrial classifications don't match perfectly.

Appendix 9. Elasticities of Consumption in Foreign Studies

Consumers:	Elasticity values* used for present and future consumption substitution elasticity in studies: (1)	σ^S_h This Study
Wage earners Farmers Other entrepeneurs Pensioners Students and other	Values vary according to income class: 1.3 (poor) to 1.7 (rich)	1.0

Consumers:	Elasticity values* used for substitution elasticity of goods and leisure in studies: (1)	σ^J_h This Study
Wage earners Farmers Other entrepeneurs Pensioners Students and other	Values vary according to income class: 0.6 (poor) to 1.0 (rich)	0.5

Consumers:	Elasticity values* used for intra-commodity substitution elasticity in studies:	σ^C_h This Study
Wage earners Farmers Other entrepeneurs Pensioners Students and other		0.3

* = Elasticity values have been rounded into one decimal. Consumer classifications don't match.

(1) Ballard et.al., 1985

GEMFIN 4.0: An Algebraic Summary

Overview

GEMFIN is a static open economy model designed to investigate trade and agricultural policy issues in the Finnish economy. In formulating this model, we regard Finland as sufficiently small that the effects of Finnish exports and imports on international prices can be ignored. Within this small open economy (SOE) framework, the model incorporates both Armington (regionally differentiated) and Heckscher-Ohlin (homogeneous) commodities.

The model is formulated as a system of nonlinear equations corresponding to the three classes of equilibrium conditions associated with an Arrow-Debreu general equilibrium: supply-demand balance for commodity and factor markets (including balance of payments), price-cost relations for producers, and income-expenditure balance for domestic consumers and government. In GEMFIN, these equations are generated using the GAMS programming language and solved using the MPS/GE solution system.

This appendix provides an algebraic summary of equilibrium conditions for the "generic" model in which (i) all factors are inter-sectorally mobile and (ii) domestic, imported and exported varieties of all commodities are differentiated (the Armington formulation). For the sake of brevity, certain details are summarized in words. The interested reader is referred to the GAMS-MPS/GE source code for details.

Market Clearance Conditions

This section presents the basic consistency requirements satisfied by an equilibrium allocation. The basic idea is that for all "commodities" (final goods, primary factors and quotas), supply equals or exceeds demand. For each market there is an associated market price. After accounting for tax distortions, this price indicates both the amount received by sellers and the amount paid by buyers per unit of the associated commodity. In the algebraic exposition below, the associated market price is indicated following each equation.

We begin by focusing on markets for produced commodities. For each class of commodity i, there are three associated markets, one for goods produced for the domestic market, another for goods produced for the export market and a third for imported goods. Goods produced for the domestic market (D_i) enter intermediate demand, consumer demand and government demand.

Government demand for domestic output consists of purchases for the provision of public services (G_i^D) and intervention purchases (for export) undertaken as part of agricultural price support program (E_i). The market clearance condition for the domestic variety of commodity i is written:

$$D_i = \sum_j a_{ij}^D Y_j + \sum_h C_{ih}^D + G_i^D + E_i \quad \perp p_i^D \tag{1}$$

In this equation, the intermediate demand coefficients, a_{ij}^D, is price-responsive, depending on the relative prices of domestic and imported varieties of commodity i.

The market for imports is analogous to the market for domestic output except that there are no intervention purchases. The supply-demand balance is written:

$$M_i = \sum_j a_{ij}^M Y_j + \sum_h C_{ih}^M + G_i^M \quad \perp p_i^M \tag{2}$$

Equations (1) and (2) are the conceptual basis of the model. In order to simplify computations, we include a separate market for the composite of domestic and imported varieties. This market clearance condition is written:

$$S_i = \sum_j a_{ij} Y_j + \sum_h C_{ih} + G_i \quad \perp p_i \tag{3}$$

in which S_i represents the aggregate supply of Armington composite good. The use of a composite good is appropriate provided that the same homogeneous Armington aggregation function applies for intermediate, government and consumer demand. In this case, the relative composition of domestic and imported varieties will be the same in all uses (i.e. $\frac{a_{ij}^D}{a_{ij}^M} = \frac{G_i^D}{G_i^M} = \frac{C_{ih}^D}{C_{ih}^M} \quad \forall\, i,j,h$), for any set of relative prices, p_i^D/p_i^M.[1]

[1] *We have made this assumption both to simplify the structure of demand as well as to simplify data requirements. In a subsequent version of the model, we may want to estimate and separately specify import demand equations for individual sectors and households.*

We next consider primary factors of production of which there are three: labor, capital and land. The market clearance conditions for labor is written:

$$\sum_h \left(\bar{L}_h - l_h\right) = \sum_j L_j \quad \perp w \tag{4}$$

in which $\bar{L}_h$ is the total (time) endowment of labor for household h, l_h is leisure demand by household h and L_j is labor demand by sector j.

The supply-demand balance for capital is written:

$$\sum_h \bar{K}_h = \sum_j K_j \quad \perp r \tag{5}$$

where $\bar{K}_h$ is the capital endowment of household h and K_j is sector j demand.

The supply-demand balance for land is written:

$$\sum_h \bar{N}_h = \sum_j N_j \quad \perp n \tag{6}$$

where $\bar{N}_h$ is household h endowment and N_j is sector j demand.

In the small open economy framework, CIF import prices and FOB export prices are exogenous and unaffected by the level of imports and exports. All of our simulations are static, long run equilibria in which we presume a balance between the world market value of imports and exports.

In this framework, international capital flows are specified exogenously. The trade balance equation is written:

$$\sum_i \bar{p}_i^X \left(X_i + E_i\right) = \sum_i \bar{p}_i^M M_i + \bar{B} \quad \perp \mu \tag{7}$$

in which $\bar{p}_i^X$ and $\bar{p}_i^M$ are international prices, and $\bar{B}$ is the exogenously specified net capital account surplus. One can think of the units of the trade balance equation as being ECUs, in which case the associated price, μ, is interpreted as the "real exchange rate" of Fm per ECU.

Two types of quotas are included in the model to represent government agricultural programs. The first is a quantitative restriction on agricultural imports and the second is a quantitative restriction on agricultural production. These constraints are written:

$$M_i \leq Q_i^M \perp q_i^M$$
$$Y_i \leq Q_i^Y \perp q_i^Y \quad (8)$$

The prices associated with quota restrictions, q_i^M and q_i^Y, represent quota rents. These are the price wedge between the marginal cost and market price which results in the specified quantity. In the case of import restrictions, quota rents accrue to the government, whereas in the case of production quotas the rents accrue to farmers.

We write both classes of quota restraints in inequality form, recognizing that in a given scenario, they may or may not be binding. When in equilibrium a quota restriction is non-binding, the associated quota rent will equal zero.

Intervention Purchases and Target Prices

The level of intervention purchase, E_i, is determined by a target price constraint:

$$p_i^D \geq \bar{p}_i \quad (9)$$

These constraints apply only for certain agricultural commodities. This constraint is written as an inequality form to indicate that it may not bind in every scenario. In a scenario in which the domestic price of a particular rises above the target price, the level of intervention purchase then falls to zero.

The production and import quotas also tend to support domestic agricultural prices, but we have chosen to treat intervention purchases as the endogenous government instrument.

Functional Forms

Two aggregation functions are used to characterize technology, one characterizing transformation possibilities on the output side (between production for domestic and export markets), and the other characterizing substitution possibilities on the input side (between alternative combinations of primary factor inputs). In the model, these substitution possibilities are "separable", i.e. the optimal domestic-export combination is independent of the choice of factor inputs. An index, Y_i, measures the aggregate level of activity (inputs and outputs) for sector *i*.

The domestic-export output transformation function is based on a constant-elasticity of transformation (CET) form:

$$Y_i = \left(\alpha_i^D \, D_i^{\frac{\epsilon-1}{\epsilon}} + \alpha_i^X \, X_i^{\frac{\epsilon-1}{\epsilon}} \right)^{\frac{\epsilon}{\epsilon-1}} \qquad (10)$$

On the input side, the production technology is characterized by Leontief (fixed-coefficient) demand for intermediate inputs and value-added. In turn, value-added is represented by a two-level nested constant elasticity of substitution (CES) aggregation of the three primary inputs. The Leontief function is written:

$$Y_{ii} = \min\left(\frac{x_{1i}}{a_{1i}}, \ldots, \frac{x_{ni}}{a_{ni}}, V_i(L_i,K_i,N_i) \right) \qquad (11)$$

within which the value-added aggregate is written:[2]

$$V_i(L_i,K_i,N_i) = \left[\delta_i^L \, L_i^\rho + \left(\delta_i^K \, K_i^\gamma + \delta_i^N \, N_i^\gamma \right)^{\rho/\gamma} \right]^{1/\rho} \qquad (12)$$

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[2] *In this equation, the exponents are interpreted as* $\rho = \frac{\sigma_i^L - 1}{\sigma_i^L}$, and $\gamma = \frac{\sigma_i^K - 1}{\sigma_i^K}$, *where* σ_i^L *is the Allen elasticity of substitution between labor and the other two primary in sector i, and* $\sigma^K{}_i$ *is the elasticity of substitution between capital and land.*

The Armington aggregation function provides a constant elasticity of substitution between domestic and imported varieties of commodity *i* for all buyers in the domestic market. This function can be written:

$$S_i = \left(\beta_i^D \left(D_i - E_i\right)^{\frac{\sigma-1}{\sigma}} + \beta_i^M M_i^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \qquad (13)$$

in which D_i is production of the domestic variety and E_i is government intervention purchase which is positive only for certain agricultural goods. The difference, D_i-E_i, represents the net amount of the domestic variety of good *i* sold on the domestic market.

Two level nested CES functions characterize consumer preferences. At the top level, savings trades off with current consumption. At the next level, leisure demand trades off with goods consumption, and at the final level there is a CES aggregate of different goods. This is written:[3]

$$U_h(l_h, C_{1h}, \ldots, C_{nh}) = \left\{ \theta_{sh} C_{sh}^{\rho} + \left[\theta_{Lh} l_h^{\gamma} + \left(\sum_{i \neq s} \theta_{ih} C_{ih}^{\varepsilon} \right)^{\gamma/\varepsilon} \right]^{\rho/\gamma} \right\}^{1/\rho} \qquad (14)$$

Consumer Income and Demand

The level of consumer expenditures depends on factor prices, transfers and both average and marginal tax rates. In the model, increasing marginal tax rates are approximated using the benchmark tax payment and a exogenously specified marginal tax which determines net income for given changes in factor prices.

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[3] *The exponents used here are related to the associated Allen elasticities of substitution as follows:* $\rho = \frac{\sigma_i^s - 1}{\sigma_i^s}$, $\gamma = \frac{\sigma_i^l - 1}{\sigma_i^l}$, and $\varepsilon = \frac{\sigma_i^c - 1}{\sigma_i^c}$.

The following equation incorporates these ideas:

$$I_h = w(\bar{L}_h - l_h) + r\bar{K}_h + n\bar{N}_h + TR_h - \bar{T}_h - \left[(w-\bar{w})(\bar{L}_h - l_h) + (r-\bar{r})\bar{K}_h + (n-\bar{n})\bar{N}_h \right] \tau_h \quad \textbf{(15)}$$

The terms on the first line of this equation relate net of tax income to gross endowment earnings plus transfers and less benchmark tax revenue. The term multiplied by τ_h captures the marginal tax which applies to increases in income from the benchmark level.

Given factor prices and commodity prices, consumer demand functions are determined as the solution to the following problem:

$$\max\ U_h(l_h, C_{1h}, \ldots, C_{nh}) \quad \text{s.t.} \quad \sum_i p_i C_{ih} = I_h(l_h) \quad \textbf{(16)}$$

We see from the equation for I_h that the coefficient for l_h is $w\ (1-\tau_h)$, capturing the excess burden of the marginal tax rate.

Taxes and Producer Choice

Three classes of ad-valorem taxes apply to production and two types of ad-valorem taxes apply to trade. In production, there are excise taxes (t_i^Y), labor taxes (t_i^L) and capital taxes (t_i^K). Producers are modeled as perfectly competitive, choosing factor inputs which minimize unit cost at given (net of tax) factor prices.

Exogenous Parameters

a_{ij}	Intermediate input coefficient - specified in units of the Armington composite per unit of activity.
$\overline{L}_h$, $\overline{K}_h$, $\overline{N}_h$	Primary factor endowments - labor, capital and land.
$\overline{p}_i^X$, $\overline{p}_i^M$	Traded goods prices for exports and imports
$\overline{B}$	Trade balance
α_i^D, α_i^X	Domestic and export share parameters in production
β_i^D, β_i^M	Domestic and import share parameters in demand
θ_{ih}, θ_{Lh}	Commodity and leisure share parameters in final demand
δ_i^L, δ_i^K, δ_i^N	Labor, capital and land share parameters in production
ϵ_i	Elasticity of transformation between domestic and exports
σ_i^M	Elasticity of substitution between domestic and imports
t_i^Y, t_i^K, t_i^L, t_i^M, t_i^X	Ad-valorem tax rates - output, capital, labor, imports and exports
$\overline{T}_h$, τ_h	Income taxes - benchmark level and marginal tax rates.
Q_i^Y, Q_i^M	Agricultural quotas for production and imports
$\overline{p}_i$	Intervention price for agricultural goods
σ_i^L, σ_i^K	Elasticities of factor substitution in production.
σ_h^s, σ_h^l, σ_h^c	Elasticities of substitution in consumer demand - consumption versus savings, leisure, and goods.

Variables

Y_i	Output index
D_i	Production for the domestic market.
X_i	Competitive exports
E_i	Exports associated with intervention purchases
M_i	Aggregate imports
S_i	Supply of Armington composite.
G_i	Government demand
C_{ih}, l_h	Consumer demand for goods and leisure.
μ	Real exchange rate
p_i^D, p_i^M, p_i	Commodity prices - domestic, imports and the Armington aggregate. (N.B. These prices are expressed in domestic currency. The price for imports is related to the international price through the real exchange rate: $p_i^M \equiv \bar{p}_i^M \mu$.)
w, r, n	Factor prices

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