THE USE OF PRICE STATISTICS IN NATIONAL ACCOUNTS

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ABSTRACT: *In the present paper we have aimed at outlining some of the central factors applying to the use of price statistics in connection with compiling agricultural accounts for use in national accounts. Prices are essentially information about preferences, costs and shortages. The subject of our paper is confined to three main themes in addition to a general introduction dealing with the broad-based need for price data, i.e.: Valuation of products which do not enter into the market finished/manufactured goods and raw materials, The need for base weighted, current weighted of chained indices and How representative are market values?*

I. Introduction.

At the sectoral level we need to monitor the level and development in the value of total agricultural production measured in terms of the market prices achieved, in the price level of the output achieved by the producer when taxes and subsidies on products are taken into account, which are ultimately tantamount to the value of gross value added which is available for compensation of the production factors, etc. used in the agricultural sector, i.e. following the deduction of taxes and subsidies on products as well as the general ditto. The various price concepts are due to the difference between the price paid by the buyer for a product or service, and the amount, which the seller actually receives after settlement of indirect taxes and any subsidies, which can be regarded as negative indirect taxes.This makes it necessary for us to apply three different price concepts: market prices, basic prices and factor prices to be able to estimate the market value of total agricultural production. *Gross value added at market prices*, the value of total agaricultural production prior to taxes and subsidies on products *Gross value added at basic prices* and the value of the total production available for compensation of the production factors used *Gross value added at factor prices*.

Production
Production is understood to mean any form of manufacturing of goods for sale and also any services which are sold, e.g. transport services, services in connection with the transaction, housing and other other services. In addition to these goods and services for which prices are fixed and whose value can consequently be determined as the outcome of price and quantity, the production concept also comprises goods and services, which are not sold and for which prices are not actually fixed, with respect to turnover. They concern primarily the following goods and services:

-consumption of goods from own agricultural production
-rent of own property
-changes in livestocks and other stocks
-collective consumption
-services rendered by banks and insurance institutes
-services rendered by a number of private non-profit-making institutions

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A characteristic feature of these groups is that prices are not fixed. In estimating the value, prices for goods and services of a similar nature must be used or the value must be estimated as the costs involved in manufacturing the goods or services. An example of the former, where prices for goods and services of a similar nature are used in the estimation, the compilation of the value of consumption of goods from own agricultural production can be stated, which are estimated at the prices achieved by the farmers for their agricultural sales products. Another example is the compilation of changes in stocks. When a product is in stock, its value is not really known as it depends on the price at which the product is sold at a given time. Consequently, the price basis used in estimating the value of stocks cannot be determined in a clear and consistent way. The basis on which the ruling prices for products of a similar nature, which are in stock, are as far as possible used in compiling the national accounts statistics.

Calculations at constant prices

Analyses of the economic development in society, including the individual industry, for example, agriculture, are undertaken by monitoring longer time series data for values formed on the basis of the outcome of a price and a quantity. In this context, it is essential to analyse whether changes over time are due to movements in quantities or prices. Consequently, the inflow and use of goods and services are estimated at current and at constant prices.

In connection with calculations at constant prices (deflation) the part of the values that can be ascribed to price developments, is identified, while the remaining part, the value at constant prices thus indicates the development in quantities.

The constant price calculations can be undertaken according to two principles, which differ fundamentally from each other. The first principle consists in assessing the flows of goods and services, using prices from a given base year. The object of the second principle is to estimate the real purchasing power of, e.g. incomes or net lending. A typical example of the latter principle is calculations of the development in real incomes, which are frequently undertaken on the basis of deflating nominal incomes and consumer price indices.

The constant price calculations in the national accounts form the basis of assessing the flows of goods and services using prices from a given base year. As a general rule, this implies that values at constant prices can be estimated for the parts in the national accounts relating to real transactions. The method implies that the quantity indices, which can be constructed on the basis of figures at constant prices, are Laspeyres indices, whereas the implicit price indices, which can be derived from the national accounts, are Paasche indices. In deflating the domestic output of agricultural and horticultural products, information on average sales prices ex farmer is used.

It is important to underline that economic aggregates estimated at constant prices only make sense if comparisons are made with figures from earlier years.

It is a general rule that if comparisons are made between different economic aggregates in a given year, current prices should be used in comparing these aggregates. If comparisons of the development over time are made, far more detailed information is obtained by adding figures at constant prices.

Changes in quality

A special problem involved in constant price calculations is changes in quality over time. One ton of sugar beets with a high sugar level is not identical to one ton of sugar beets with a low sugar level. Changes in the quality of the products are corrected as far as possible, implying that price indices

indicate the "pure" price development. Changes in quality will thus be reflected in changes in values at constant prices. A product sold at an unchanged price but with a higher quality, indicates a fall in prices but an increase in value.

An almost similar problem appears when, for example, a sales product is substituted with another sales product and/or when individual factor inputs in the form of, for example, fertilizers or pesticides are replaced by other products having a greater effect. To which extent do the estimated values represent the real values?

In the following, we aim to give a practical approach to the three most important problem areas, with respect to the use of price data in compiling sectoral accounts for agriculture, but the price data are used in a wide range of other areas. I will only mention the subject productivity and prices, the terms of trade - where the relationship between sales prices and factor prices, valuation of the capital equipment forming the basis for calculations of depreciations, etc., is monitored.

II. Valuation of the products which do not enter into the market.

A. *Using of alternative sources in the Czech Republic*

Economic Accounts Agriculture (EAA) requires output of agricultural activity to be valued at basic prices, i.e. those prices received by the producer for his goods and services sold in the market after deduction of any taxes and after addition of any subsidies relating to those goods and services.

As Agriculture Statistics collects its data mostly expressed in quantities, the main source for producing price data are Agriculture Price Statistics (APS). Agricultural products in APS are priced for practical reasons in more easily obtainable producer (market) prices, because agricultural price indices are compiled every month and the time lag between the period to which the data relate and their publication deteriorates the value of price indicators. The conceptual difference between producer and basic prices does not cause any difficulties, as rate of subsidies and taxes on specific products are known at time when agricultural accounts are compiled.

Some problems may arise in using of yearly average prices from APS to value yearly quantities in agriculture accounts. Due to high seasonality the production pattern within a year is very unevenly distributed and may be different from year to year. APS usually performs survey to establish weighting structure for its indices once in a few years and the same applies to monthly shares of agricultural production of individual products within a year. Thus there are at least two possible distortions, which may influence calculation of yearly average prices for evaluating the output.

First, price statistics uses the same set of weights for several years to calculate yearly average price from regularly collected monthly prices, which may be incorrect in case of substantial shift in season for some particular year due to e.g. weather conditions. Second, this yearly pattern for particular product reflects usually only that part of production, that was sold, and may be for example different from the yearly pattern, which the producers consume themselves. For very seasonal products it would be therefore better to evaluate agricultural output separately for shorter parts of the year and preferably by using the current year’s structure, if, of course, such data are available and the resources necessary to obtain them are balanced by optimal decreasing of errors in statistics.

EAA requires all parts of output, that does not enter into the market to be valued in a consistent way with the output that goes through the market, i.e. at the basic price if there is any or at the basic price of

similar product. As indicated above, such evaluation using imputed prices inherits already some potential errors from the „normal“ evaluation using market prices. In addition to that we have to take into an account, that for products, where just very small part of the production enters the market, the price obtained from the market may be influenced by some specific conditions with temporary validity between sellers and buyers and this may be reason for volatility of this price between consecutive years. One solution may be to calculate an average price from several recent years with possible adjustment to general inflation movement between those years if the inflation is substantial. However, general possible bias contained in the prices of rarely marketable goods can be difficult to estimate.

Some intra-unit consumption products for which data, especially price data, are difficult to obtain, are excluded from the realm of observation by definition, e.g. some normally unmarketable animal feed products and animal by-products. On the other hand, there are some usually unmarketable animal feed products that are included by convention as hay, silage, fodder beet etc. The reason for inclusion is their relative significant economic value. In this case any price imputation from market interaction between supply and demand is hardly available. Another method, which may be useful for evaluation of the production here, may be the analysis of producer costs with aim to obtain the cost of the product.

This method can be also very useful when valuing changes in livestock population considered to be the stocks of work-in-progress (e.g. animals intended for slaughter). According to EAA, the basic price is the price to be used for valuing changes in stocks - entries, withdrawals or losses of finished products or work-in-progress. For entries of work-in-progress the price used should be the estimated basic price of the finished product at the pro-rata production costs incurred. This means that for animal livestock intended for slaughter it is useful to know production costs and its structure.

Analysis of the cost rate of agricultural products in the Czech Republic is not performed by Czech Statistical Office (CSO) but by Institute of Agricultural Economy (IAE). The main purpose of these analyses is to provide costs of the essential agricultural products, supplemented with the rate of quantity sold and the average realization price reached in order to analyze the profitability of agricultural sector over individual outputs of crop and animal production. The data collected for this analysis may be to some extent used for the evaluation purposes in agricultural accounts as well.

The survey performed every year by IAE uses as its source accounting data of more than 700 reporting units. Data collected from those units come directly from their accountancy software systems in electronic form in pre-defined structure. To cover some possible gaps, this automatic system is supplemented by a survey questionnaire sent by mail. All agricultural producers covered by this survey cultivate together more than 11% of the total agricultural land in the Czech Republic. IAE aims to balance their distribution within 5 categories of various types of agricultural production regions, within 6 types of various legal categories of producers and partially within various categories defined by the total area of cultivated land per unit.

Concerning the extent of the set of reporting units, this survey is comparable with the survey designed for production of output price statistics in agriculture (output price indices and absolute prices) performed by CSO. The data flow is, of course, much lower, as this survey is done once a year only. On the other hand, theoretically all categories of crop and animal production are captured, which is important namely for those products, that usually do not enter the market. The selection of individual reporting units is independent from the selection used by CSO for APS.

The results show that the structure of producer costs for crop output is spread quite evenly among several different categories (while in animal output the animal feedingstuffs usually present the dominant part of all costs). The most important part of cost (some 30 - 40% of total costs) are formed by some material means of productions which are directly consumed, as seeds and plants, fertilizers

and soil improvers and plant protection products. Another important cost factor in crop production is presented by the costs of supplementary activities, i.e. work of tractors, harvesters and lorries (some 10-20% of total costs). Next follow depreciation of capital goods (machines, buildings), wages and salaries and various costs which can not be attributed directly to specific product, so they are redistributed proportionally. If the result of manufacturing of some specific item leads to production of some by-product (feedingstuffs, straw, etc.), the costs are divided between the main product and its by-products using predetermined fixed ratio.

It has been found out that the main influence on the change of the producer costs for a certain crop product is caused by :

a) the change in physical volume of used means of production (seeds, fertilizers)
b) the change of prices of those means
c) climatic and weather conditions with direct impact on yields.

Let us present now a typical example of the costs structure of the production of winter wheat as was published by IAE. Numbers are rounded values for the whole country in 1998 and are expressed in local currency unit - Czech crown (CZK) per hectare.

Seed - purchased	1148
Seed - own production	265
Fertilizers - purchased	1977
Fertilizers - own production	201
Plant protection products	1376
Other material inputs directly attributable to the product (water, fuel, energy)	167
Total material inputs directly attributable to the product	**5134**
Other costs directly attributable to the product (purchased services, insurance, taxes, rents of land)	**1392**
Wages and salaries (total)	**2409**
Depreciation of special machinery and equipment directly attributable to the product	**21**
Supplementary activities (operation of tractors, harvesters, lorries, etc. calculated proportionally to the shares of individual output products)	**2391**
Overhead production costs (including depreciation of machinery, buildings and equipment not attributable directly to the product)	**1552**
Overhead administrative costs	**584**
Total costs	**13482**
Share of main product (grain)	88 %
Total costs for main product	11864
Yield per hectare (tons)	4,69
Costs per ton for main product	**2529**

Corresponding schemes for animal output is similar, costs are not calculated per hectare but per „feeding day". The other difference is that for most animal output where the result of production includes by-products, the costs of those by-products are calculated separately (e.g. manure) and subtracted from the costs of the result of the production. For milk both methods are combined. First, cost for farming of diary cattle are calculated, from which costs of manure are subtracted and the result is divided in ratio 94:6 between costs of milk and costs of a calve. As already mentioned, the most important part of costs for animal outputs are material means of productions directly consumed (from which animal feedingstuffs 95%). Remaining factors are relatively much smaller then for crop products or even negligible.

Results of this survey are published for most important products of agriculture in tables separately for three main category types of agricultural production regions. The main importance for agricultural accounts is their possible use for imputing the prices of preserved animal feed products (e.g. silage) which EAA requires to be recorded in the agricultural production. These studies provide also significant supplementary information for valuation of livestock.

The results include for each category type of agricultural production region and each marketable product also an average realized price (producer price) for surveyed units and representativity expressed by the number of surveyed units. The data offer two types comparisons. First, costs can be compared with producer prices within the survey performed by IAE. Comparison in several consecutive years may reveal relation between costs and producer prices for many products. Then, when imputing prices for products which do not enter market, either costs of the product may be used or cost corrected by a factor coming from the comparison of costs and producer prices of similar products which enter into market. Second type of comparison is comparison of the results of IAE with yearly absolute prices of APS in CSO. This can serve either for improving the results of APS or for similar imputation using costs, where producer prices are those taken from APS instead of the producer prices coming from IAE.

The purpose of this chapter was to offer alternative sources of agricultural prices in EAA, but the survey done by IAE may also of interest of APS, because it may be one of the important sources for weighting scheme of input price indices in agriculture, as the sources for actualization of such scheme are often difficult to obtain in reasonable time. It should be noted for completeness that IAE provides deeper analysis of their results, among other time series of indices of costs are calculated. These are often compared with relevant input price indices provided by APS CSO.

B. *The Agricultural sector in Lithuania*

In Lithuania agriculture is one of the most significant sectors of the whole economy.
The rural population constitutes around one third of the total population.
Agriculture in 1999 contributed to 11 per cent of the gross value added, with approximately 20 per cent of employees engaged in that sector. Of the 6.5 million hectares of total land, the area used for agriculture is 3.5 million hectares of which 84 per cent is under arable cultivation.

Economic Accounts for Agriculture

The Lithuanian Department of Statistics is responsible for the calculation Economic Accounts for Agriculture (EAA). This database provides consistent information on agricultural output, intermediate consumption, value added and income, and gross fixed capital formation. The implementation of the EAA'97 is now under construction.

According to the new EAA methodology, agricultural output represents the sum of production by all units in the ” industry”. Agricultural output is calculated as a sum of total value of agricultural production plus value of secondary activity (processing of agricultural products at farm level, income from non-agricultural activities etc.) plus change of stocks (finished and semi-finished production, goods meant for resale) plus subsidies on production and products. The output calculation is based on detailed balance sheets, which are compiled for most of the agricultural products: grain, potatoes, vegetables, fruit and berries, meat and meat products, milk and milk products, eggs. Agricultural companies data on value of stocks for total activity and data on stocks by main kind of agricultural products in natural weight are presented in annual financial report. The estimation of stocks is carried out for the household sector.

Estimates of agricultural production calculations are used for further calculations of National accounts. The value added in agriculture is further computed.

The Lithuanian EAA include production for own consumption of all agricultural units. About 40 per cent of total agricultural production is consumed for the needs of the farm (seeds, fodder) as well as for food. The share for own consumption by kind of products consists: grain-68%, potatoes- 80%, vegetables-78%, fruit and beries-68%, fodder roots, hay and green fodder-100%, meat-21%, milk-22%, eggs-28%.

Data sources

Information on output production is collected from agricultural processing enterprises and purchase companies. They purchase agricultural production from all producers (agricultural companies, farmers, and household farms). Only data about eggs are collected from agricultural companies- as sellers. Our questionnaires include nearly all products, which are produced in agriculture: grain, potatoes, sugar beet, flax fibre, vegetables, fresh fruit, animal by kinds, cow milk and eggs.

Annual financial account of agricultural partnerships and enterprises are the main data source referring to which non-merchandise production can be calculated. They include figures on production produced including production shares sold in the sale markets as well as production costs of production produced. Basing on production costs to produce one tonne of production, a share of production used by agricultural partnerships and enterprises as well as private farms for the needs of the farm and food is defined.

The value of intermediate consumption

The value of intermediate consumption is distributed by the following high level groups:

- -Raw materials, consumables purchased and own-produced (seeds, feeding stuffs, fertilizers, electricity, fuel, etc.)
- -Services purchased
- -Costs of insurance, leasing, business trips
- -Other intermediate consumption

<u>Calculation of intermediate consumption costs</u>

The sources providing data are as follows:

- Account data of crop areas, by culture in all farms;
- Account data on livestock and fowl;

- Annual reports on costs for all agricultural production and separately for crop production and livestock production, which are submitted by agricultural partnerships and enterprises to Statistics Lithuania. These reports contain the following estimates:

  -total costs, of which: seeds, fodder, fertilizers, refined oil products, electricity, remuneration for services and work accomplished.

  -depreciation of the main production means.

  -other total costs, of which: business trip expenses, interest charges, land rental, land tax and other taxes related production.
- Annual balance sheets of agricultural products produced. These balance sheets contain the following data on 17 agricultural products: stocks at the beginning and end of the year; produced, purchased, sold or otherwise acquired quantities or items, quantities used for fodder, seeds or processing; production storage losses; other costs.
- Annual reports on crop and livestock production factor costs. These reports contain data by crops and by livestock branch, including data on crop areas, the yield, number of cattle, livestock production and costs experienced for production of separate products.
- FADN sampling survey in farmers' farms under the coverage of 1000 farms. Our respondents i.e. farmers' farms are located in all the regions of the Republic, in various climatic zones and reflect different economic conditions. This informational system presents data (similar to agricultural partnerships and enterprises) about crop areas in the farms, the yield gained, the number of cattle, output of livestock production, income gained and expenses suffered as well as about financial situation in farmers' farms.

When estimating separate items of intermediate consumption, reference data mentioned above are used. First, costs for seeds, pesticides, fertilizers as well as costs per unit of crop area (one hectare) on a farm are assessed, and then, the result is multiplied by the total crop area (crop area of all farms).

Costs for fodder are assessed in the same way. They are calculated for one conditional animal and the result is multiplied by the total number of cattle in all farms.

A similar method is applied for the assessment of costs for fuel or electricity when certain costs per one hectare of crops or per unit of production are recalculated for the whole entirety.

Efforts were made to check the estimates of intermediate consumption basing on such data references like recommendations for consumption of seeds, pesticides, fertilizers and fuel per one hectare. Besides, data on consumption of fertilizers might be compared with that on production, sales, imports, exports and stocks of fertilizers.

Agricultural partnerships and enterprises as well as farmers' farms keep accounting of such raw materials like seeds, fodder, fuel fertilizers, pesticides, electricity as well as services rendered and other costs at purchasing prices. Seed, fodder and other products produced and consumed on the same farm are included and valued at production costs.

The difficulty of calculation of agricultural production intermediate consumption is connected with the assessment of technological level of production processes. The latter rather often depends on the size of the farm. Since the farms within the scope of the input survey are mainly big ones, work there is mostly mechanized, including such work as harvesting, feeding of cattle. Therefore, input or production expenditures there are less. Accordingly, such farms couldn't represent the entirety. After the total Agricultural Census is accomplished, our sampling surveys about agricultural production expenditures shall employ farms of different sizes and diverse profile.

Prices

Purchase prices

Purchase prices are provided to Statistics Lithuania each quarter by enterprises purchasing and processing agricultural production. Purchase prices and prices in market place are applied to evaluate merchandise production volumes.

For example, in 1999 average purchase prices and products sold in market place prices were as follows:

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	Purchase prices	Prices in market place
Grain	513	397
Potatoes	316	472
Vegetables	1164	2175
Fruit and berries	232	662
Livestock and poultry	3473	2983
Milk	581	678
Eggs, Litas/1000 pieces	173	154

Purchase prices are presented as the producer prices including subsidies and without tax.

Estimates of agricultural output, intermediate consumption and value added are compiled at current and constant prices.

There are cost prices for non-commodity production (fodder roots, hay, green fodder). The data are presented yearly by agricultural partnerships and enterprises. We are using this kind of price for evaluation of non-commodity part of agricultural production.

Constant prices:

Evaluation of agricultural output at constant prices is available from 1993. At present, price basis 1995 for the data calculation at constant prices has been created.

Input prices

Information on the amounts and value of raw and auxiliary material, used by agricultural companies in their activity, is collected every month.

For these data collection we use sample survey, which covers 10 per cent of total amount of agricultural companies. Coverage includes prices of most major agricultural inputs: fuel (4 items), gas, electricity, chemical precautions for plants (17 items), mineral fertilizers (14 items), seeds (9 items), concentrate feed, fodder additions and other fodder (13 items). Input prices have been collected since 1992 year.

Price indices

Purchase price indices have been calculated since 1992 and covered main agricultural products sold outside the agricultural sector (including and excluding subsidies). Indices are calculated aggregated for total production, crop production and livestock production quarterly and yearly.

Input price indices are calculated as aggregated for total input and for the input groups mentioned above.

We used the Paasche type formula for constant price calculation. This implied a yearly change of the base year.

III. The need for base weighted, current weighted and chained indices.

There are several types of index which can be chosen according to the nature of the phenomena they are to describe and to the sources of information available: the principle examples being Laspeyres, Paasche, Fisher's 'ideal' and Tornqvist. In addition the technique of chain-linking can be applied to each of these indices.

The conclusion reached by the Conference of the Directors-General of the National Statistical Institutes of the Community countries (DGINS) and documented in the 1995 European System of Accounts (ESA95)[1] is that Fisher indices should be preferred for year on year changes in price, volume and value indices. Changes over longer periods should be obtained by chain-linking the year on year movements.

This preference for Fisher indices was presumably based in part on the fact that these indices satisfy a number of mathematical properties that good formulae ought to have and that they are supported by economic theory (for example, because it is 'superlative'[2]). One further argument in favour of Fisher indices is that they take account of both historic and current patterns of production.

As the Fisher index is the geometric mean of the Laspeyres and Paasche indices, the calculation is quite involved. However, as these calculations can be built into the computer systems, the computational intensity should not present an insurmountable barrier to the use of such an index.

A greater problem in producing a Fisher index is the unavailability of the information needed to calculate the Paasche part of the index. The Paasche index uses current period weights. These weights are derived from the Aggregate Agricultural Account, the definite figures for which will not be available within the required timeframe.

This timeliness issue contributed to the decision taken by the European Union (EU) Working Party on Agricultural Price Statistics to continue with the requirement for Laspeyres price indices. The use of Laspeyres indices is considered acceptable as long as the period between rebasements is not too long. As the EU Agricultural Prices Indices (API) are rebased every five years, this criterion is considered as being met.

In calculating the Laspeyres indices, changes to the basket of representative products or the weights need only be made when the products or their relative importance have evolved to such an extent that the basic structure is no longer appropriate. It is possible that the pace of evolution in the agricultural

[1] Eurostat (1996), *European System of Accounts ESA 1995*, Luxembourg: Office for Official Publications of the European Communities, Brussels, p239-241.

[2] See Silver, M. S. (1984) Criteria for choosing between alternative consumer price index number formulae with special reference to chained indices, *The Statistician*, **33**, 224-237.

sector is such that the Laspeyres indices can be calculated for a period of several years without the need to rebase.

Laspeyres price indices will tend to understate price changes. If the relative price of a particular commodity increases more quickly than other commodities, the relative value of that commodity will also tend to increase more quickly. However, the weight associated with that commodity will remain unchanged until the index is rebased. The reverse is true for Paasche price indices. This lends further support to the choice of Fisher indices since, as an average of the Laspeyres and Paasche indices, they will fall between these two 'extremes'.

In calculating price indices, the aim is to eliminate the effect of changes in the quality of the products. The price indices can then be used by accounts colleagues to derive volume indices from the value indices. Volume indices should be derived in this way so that they capture not just changes in the quantity of the products but also changes in quality.

If Laspeyres price indices are used, the resultant volume indices will be Paasche indices. This result stems from the factor reversal properties of the Laspeyres and Paasche indices. The factor reversal test is that the value should equal the price multiplied by the volume. The Laspeyres and Paasche indices jointly satisy this test (but not individually). That is, $Q_{Paasche} \times P_{Laspeyres} = Value$ and $Q_{Laspeyres} \times P_{Paasche} = Value$.

This is one reason why account scolleagues may choose not to use the EU Agricultural Prices Indices to derive volume indices. If the volume indices are derived in a different way then there will be a discrepancy between the published price indices and the price indices that are implied by the volume and value indices.

The production of a Laspeyres price index and a Paasche volume index contrasts with the ESA 95, which states that chain-linked Laspeyres and Paasche indices are acceptable alternatives to Fisher indices for volumes and prices respectively.

The Fisher index satisfies the factor reversal test. This is, $Q_{Fisher} \times P_{Fisher} = Value$. As a formula cannot pass both the factor reversal test and the transitivity test, Fisher indices do not satisfy the latter condition that $I_{a,c} = I_{a,b} \times I_{b,c}$ (that is, that the change in the index between years a and c should equal the product of the change in the index between years a and b and b and c).

An advantage of Laspeyres indices is that, unlike Fisher and Paasche indices, they do not have to be revised every year when new weights are adopted. Frequent revision can be problematic for some users of the indices, although this can be made less problematic by making the information available electronically so that users can download the whole time-series. Laspeyres indices are also easier for users to understand.

As mentioned earlier, the ESA 95 recommends chain-linking. Indices should be chain-linked where users are concerned with dynamic analyses (that is, the path that prices have followed over a certain period) rather than comparative static analyses (that is, how prices compare with the situation in the base year). Most users of agricultural price indices will be interested in the former, so chain-linking would be appropriate from a theoretic point of view.

The EU Working Party on Agricultural Price Statistics has decided not to make use of chain-linking. This decision was made principally because of the information requirements of chain-linking. For example, the formula for a chain-linked Laspeyres index might look like: $I_{1995,2000} = I_{1995,1996} \times I$

$_{1996,1997}$ x I $_{1997,1998}$ x I $_{1998,1999}$ x I $_{1999,2000}$. The last link in this chain (I $_{1999,2000}$) would require weights for 1999.

There are a number of other problems associated with chain-linking. Unlike unchained Laspeyres indices, chain-linked indices are not consistent in aggregation. For example, a chain-linked index for cereals may show a higher figure than all of the component subindices for wheat, barley, etc. Although not consistent in aggregation, chain-linked indices are more likely to add up to a figure that is closer to being correct than Laspeyres. However, this characteristic is likely to confuse some users.

A further problem is that when relative prices oscillate (for example, due to seasonal variations), chain-linked indices drift outside the range given by the unchained Laspeyres and Paasche indices to an extent that appears unwarranted[3]. As the marketing of agricultural products is distinctly seasonal, this is an important factor in the choice of index.

However, chain-linked indices are representative in the sense that as production patterns change, these new weights are reflected in the measure. They also allow new products and new improved data to be readily included since, as soon as they are available for two successtive periods, they can be included fully in a link. They are transitive, but do not satisfy the factor reversal test.

The difference between Laspeyres and Paasche indices can be substantial. The large potential gap and the difficulty in choosing between them argue for compromise solutions such as Fisher.

In the United Kingdom, work is underway to construct alternative price indices to examine the differences between the Laspeyres, Paasche and Fisher indices and between chain-linked and unchained indices. The results will be presented to the EU Working Party on Agricultural Price Statistics. This will give the Group valuable evidence on which to base future decisions.

While the requirement to produce price indices that meet the EU Working Party specification will continue to be met, the intention is to establish an additional set of prices indices. This second set of indices will be used to derive volume indices for the accounts. These indices will meet the accounts requirement for chain-linked Fisher indices at basic prices and will cover intra-industry trade and inseparable secondary non-agricultural activities.

As mentioned earlier, difficulties arise with respect to the availability of information needed to construct current weighted or chain-linked indices. Volume indices are published as part of the provisional account in January. The price indices used to derive these volume indices cannot be calculated using weights from the provisional accounts. Instead, the price indices will need to be calculated using weights from the November forecast accounts. Provisional weights will be fed into the price indices after January and 'final' weights will be incorporated in advance of the following January.

In considering whether or not the EU Working Party should change from unchained Laspeyres price indices, thought needs to be given to the timetable for submission of these indices. Forecasts are submitted in September and November and the outturn is submitted in February. In producing the September forecast, the previous year's weights will need to be used. However, it is conceivable that the results from the forecast accounts could be used to produce the November forecast and that the results from the provisional accounts could be used to produce the February outturn. To achieve this, we need to be able to transfer data easily between the two computer systems.

[3] See Szulc, B. J. (1983) Linking price index numbers, in W. E. Diewert and C. Montmarquette (eds) *Price Level Measurement*, Proceedings from a conference sponsored by Statistics Canada, Ottawa: Ministry of Supply and Services, Canada, pp 527-598.

Of course, in producing and publishing two sets of indices, the UK will need to pay close attention to how the information is presented. Users need to understand the differences, why two sets are needed and which set they should use for a particular purpose.

This is by no means an exhaustive discussion. Delegates are invited to flag up any other theoretical and practical issues that should be bourne in mind when choosing the type of indices and presenting the results.

IV. How representative are the market values?

IV.0. Introduction

The question on how represantative market values are, refers in this case to those parts of the market values which are depending on the prices used in the calculations. Representativeness is an extensive and commonly discussed subject in the statistical science. However, in this short paper only a few aspects of this subject is discussed very briefly and mainly in terms of examples. Two interesting aspects of representativeness are the design of the price collection, which is of interest for statisticians, and the treatment of prices when product qualities are changing, which is of interest for accountants.

In economical analyses there are two different kinds of prices which are of interest. When following the pure price development as in price indices, the focus is on prices for certain fixed qualities of the products. These prices usually differ from the actual average prices on the market, because the average quality usually varies between years and therefore need not to be the same as the fixed qualities used in the price indices. When using prices for accounts on incomes or costs, the focus is usually on the total average prices on the market. When analysing these prices for different periods, it is important also to know whether there have been quality changes on the products. This depends on the fact that in economical theory a quality increase (decrease) results in a larger (less) value of the product. If such a quality change doesn't result in a price change in nominal terms, this is therefore considered as a relative price decrease (increase).

Much of the work with accounts, as in the Economis Accounts of Agriculture (EAA), in order to attain representiveness, is aimed at handling prices and quality changes in the right way. The appropriate methods for this are varying for different situations, i.e. for different products or in different countries, and are among other things depending on the market situation and available information.

Before answering questions of representativeness when using collected prices, it is important to know the answers of the following questions.
1. How are the prices collected?
2. Which kind of prices are collected?
3. How are the prices used in the calculations?

In this short paper we only consider market values from the production side, which means that only the producer prices are of interest.

IV.1. How are the prices collected?

In agriculture there are mainly three methods of collecting market producer prices.
a. From surveys among the producers.
b. From surveys among the buyers of agricultural products.

c. From the buyers' price lists. This can also be seen as an alternative of method b.

Different methods are appropriate for different kinds of prices. Usually method a is appropriate for collecting prices actually received for the sold products, while methods b and c are appropriate when collecting prices for certain qualities.

Usually method a is much more expensive and time-consuming than methods b and c, because the number of sampled units must be much larger in order to get reliable results. This is the case if it is not possible to derive prices as by-products from other surveys, i.e. FADN. In order to reduce costs, it is therefore more interesting to use methods b and c.

In Sweden only methods b and c are used when collecting producer prices for the EAA. The situation in Sweden is different from the situation in many other countries. Most farmers in Sweden are members of cooperative farmers organisations, whose enterprises buy agricultural products from the farmers and sell means of productions to the farmers. These farmer-owned enterprises are few but large. There are also a few other, private, important enterprises which buy from and sell to the agricultural sector. This means that usually it is enough to collect prices from a small number of enterprises in order to get relevant information about price levels and price trends.

When collecting producer prices, sample surveys are not used in Sweden. Instead a few enterprises are chosen which together have large market shares and a regional spreading. As an extreme example, the collection of prices for cattle and pig meat can be mentioned. For these products, there is now in Sweden very few farmer-owned enterprises with slaughter houses covering nearly all Sweden and having a market share of 70 - 80 % for slaughtered quantities. These enterprises have a common service division, which calculates the actual average prices received by the farmers for all slaughtered animals in all slaughterhouses of these enterprises. These average prices are used when calculating market values in the EAA.

If there is a tendence that large enterprises pay higher prices or lower prices than smaller enterprises, this collection method will give biased estimations of the actual mean prices. In that case the estimated *levels* of market values may not be considered as representative. On the other hand, if this tendence is constant during a number of consecutive years, the estimated *development* of market values can be considered as representative. In many cases, the development of market prices is more interesting than the level.

An important question when using this method is:
How large share of the market should be covered with this method in order to get representative prices?

IV.2. Which kind of prices are collected?

When collecting price information from the buyers of agricultural products, it may be difficult to get the desirable actual average prices for the total bought quantities. It is usually easier to to get prices for different product qualities. When collecting such prices, it is therefore important to use additional information on the actual product qualities and on the price differences for different qualities.

For cereals, one of the important quality parameters is water content. In Sweden much of the statistics on quantities of cereals (i.e. harvests) concerns grain with water content 15% even if the actual water content is different from 15%. But as prices on cereals are collected for grain with water content 14%, the quantities are corrected with the factor 85/86 to refer to quantities with water content 14%. Then the market values are calculated as prices multiplied with quantities, both referring to water content

14%. This means that the market values in this respect can be considered as representative if the relative difference between quantities with actual water content and corresponding quantities with 14% water content is the same as the relative difference between prices for grain of actual water content and 14% water content. If not, there will be a bias when estimating the level of the market value. However, the development of the market values may be considered as representative consequtive years if there are only small changes in the water content.

An important question when using this method is:
How large difference between the quality for the collected price and the actual average quality can be accepted in order to get representative market values?

IV.3. How are the prices used in the calculations?

Different methods can be used when calculating market values. A common one is to multiply a quantity with the corresponding actual average price. When calculating preliminary market values or forecasts of market values for year n, the actual average prices are often not known. Therefore the market value for year n-1 may be multiplied with a quantity index and an some kind of price index between years n-1 and n. In the calculation of this price index, effects of quality changes should be included. Usually these are not known at the time of calculations, why pure price indices usually have to be used.

Also in this case there will be a positive or negative bias in the estimation of the level of the market value depending on the sign of quality changes, but if no (or very small) quality changes have occurred the development will be accurately estimated.

For Sweden, milk and slaughtered chickens are two examples of products for which the pure price index is supposed to to give representative results. For these products, the main quality parameters, fat content and protein content for milk and carcass weight for chickens, are nearly constant between two consecutive years. On the other hand sugar beet is a product, for which this method may not be appropriate, because the most important quality parameter sugar content is strongly dependent on the weather conditions. When calculating a forecast of the market value in Sweden, in this case an early estimate of the sugar content for the present year (or of the change in sugar content compared to the last year) is received from the only enterprise buying sugar beets from farmers in Sweden. Then it is possible to use the price scale for sugar beets in order to correct the pure price index to a price index which takes into account the change in the quality parameter sugar content.

An interesting question when using this method is:
For which agricultural products can pure price indices be expected to give representative market values?