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CAPITAL DATA FOR PRODUCTIVITY MEASUREMENT

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Abstract

The paper discuss the use of capital data from FADN (Farm Account Data Network) for agricultural total factor productivity measurement calculating multifactor productivity index.

Despite methodological problems related to construction of the indexes, as well as problems associated with the appropriate measurement of particular inputs, especially capital input, growth accounting estimates generally provide a great deal of information regarding productivity. The appropriate measurement of capital in the explanation of productivity change is an important and debated topic.

The purpose of this paper is to debate a method for deriving the appropriate measure of capital services and find a way to make the FADN supply data that allows measures for varying levels of capital utilization.

The capital data that can be obtained from the FADN are, in general terms, of better quality than the macroeconomics data when analysing the agricultural private sector. They are also very useful if we want to increase the level of desegregation on the productivity analysis should it be important to discuss the procedures involved in constructing the capital input index.

Keywords: Capital Measurement, Productivity, European Agriculture, Farm Accounting Data Network (FADN), Growth Accounting, Inter-Spatial Productivity, Inter-Temporal Productivity.

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Introduction

The aim of this paper is to discuss the use of capital data from FADN (Farm Account Data Network) for agricultural total factor productivity measurement calculating multifactor productivity index. However, before turning to an analysis of the existing statistics it is necessary to briefly mention the uses which may be made of the existing data.

When using capital data to build up productivity measurements, we assume that the most important uses of productivity statistics are:

1. Identifying sources of economic growth
2. Justifying the appropriation of agricultural research funds
3. Estimating production relationships or production functions
4. Serving as an indicator of technical changes
5. Comparing intersectoral or inter-country economic performance, and
6. Justifying price changes
7. Calibrating the effects of the structural policy

The meaning and concept of productivity and the meaning of alternative productivity indexes intended to measure productivity are currently under debate.

The measurement of technological change is frequently approached with the measurement of intertemporal total factor productivity (TFP).

Economic studies of TFP change have usually employed a growth accounting framework. The primary motivation for pursuing this approach was the ease with which various index numbers could be computed. These index number depend on no unknown parameters and are simple algebraic aggregates based on price and quantity data.

For practical reasons the translog index is one of the most used. Inter-spatial and inter-temporal comparison of productivity are possible with the translog index, a discrete approach to a Divisia index.

Also, the Fisher index has been recently used after the Diewert, W.E. (1992) paper that shows its interesting properties.

The formulas and theoretical implication of these indexes have been widely discussed in the literature, and has been summarised in the paper which presents our results on productivity comparisons in European agriculture, gathering the data from FADN. In this paper (San Juan and Decimavilla,1998), first, for inter-temporal and inter-spatial comparisons we use a translog index justifying that it is appropriate, from the economic point of view, to the multiple-input single-output case.

Denny and Fuss provided a general approach for measuring intertemporal and interspatial TFP and this has been adapted by Hazilla and Kopp (1984) for agricultural productivity measurement using a unique data set derived from the Firm Enterprise Data System (FEDS), a USA equivalent of the

European FADN.

Intertemporal TFP is usually interpreted *in primal space* as the rate of change over time of an index of outputs divided by an index of input (growth accounting approach), or by a rate of shift in a production function (structural analysis). The last one requires to assume no allocative inefficiency to be interpreted as technological progress. That's all input prices must by equal to it's marginal productivity.

In the *dual space,* intertemporal TFP, under the maintained assumption of producer cost minimisation and competitive factor markets, is equivalent to:

1) The rate of change of production cost minus the rate of change of an index of outputs minus the rate of change of an index of all inputs prices, or
2) A rate of shift in a cost function (the dual interpretation of a production function).

Interspatial TFP can be defined *in the primal* as the logarithmic difference in an index of outputs between two countries divided by the logarithmic difference of an index of inputs

Secondly, in the San Juan and Decimavilla (1998) paper we assume that most of the firms are multiple-input multiple-output, then we use the "Fisher ideal" total factor productivity indexing procedure. That allows intertemporal comparisons of productivity for European countries assuming that farms shift between a set of productions adjusting to market conditions and policy regulations (changes on the CAP common market

organisations).

Thirdly, the Hulten index of total factor productivity is used to allow for adjustments for variation in capital services and capacity utilisation.

Despite methodological problems related to construction of the indexes, as well as problems associated with the appropriate measurement of particular inputs, especially capital input, growth accounting estimates generally provide a great deal of information regarding productivity.

The appropriate measurement of capital in the explanation of productivity change is an important and debated topic.

The purpose of this paper is to debate a method for deriving the appropriate measure of capital services and find a way to make the FADN supply data that allows measures for varying levels of capital utilisation.

Capital Input

The capital data that can be obtained from the FADN are, in general terms, of better quality than the macroeconomics data when analysing the agricultural private sector. They are also very useful if we want to increase the level of desegregation on the productivity analysis should it be important to discuss the procedures involved in constructing the capital input index.

1 Real Estate

The real estate input index contains three main items intended to measure *service flows* provided by the capital stock:

1.a Buildings

- Interest charged on land and farm service buildings

- Depreciation of farms
- Other improvements: a remainder item composed of estimated accidental damage to buildings, cost of repairs to service buildings and grazing fees.

1.b Land

The main problem is to obtain a constant quality land index both in inter-temporal and inter-spatial comparisons. Then separate information is required about the:

- area of cropland (FADN distinguishes: Cereals, Other field crops, Vegetables and flower areas measured in ha.)
- irrigated area of cropland (It is on the farm return but not on the published results of FADN)
- permanent crops (FADN distinguishes: Vineyards and Other permanent crop areas measured in ha)
- window house area (not on the published results of FADN, but can be gathered from the farm return)
- pasture area (FADN includes forage crops. Is always calculate in the same way for European countries)

- woodland area
- agricultural fallow (all uncultivated but potentially arable areas) FADN also distinguishes land diverted from current production under special programs like Set Aside)
- non-agricultural areas in farms are included in Others (rural tourist

facilities: horse riding areas, hunting areas, environmental preservation areas are not included)

All the stock should be measured at constant prices. That means that we need to use a land price index. The problem is that if not all the UE countries have this information then we are forced to use the implicit deflator obtained from the land value and the SAU. The point is that we have to assume that the land values in the account are at current prices and not at historical prices. And also that the land depreciation (the declining of the flow of services from land) is appropriately calculated.

1c Buildings

The farm return in FADN has a separate item for buildings. Within the buildings, farm dwellings are excluded because they don't produce capital services but services to the farmer is family. In order to exclude the dwelling from total farm building the USDA uses a ratio of dwelling/building equal to .54 and building/land equal to .18 but, of course, it is better to have direct information when possible or even to estimate an appropriate ratio in each country or region if necessary. Does the information on FADN include dwellings in some countries? That point has been discussed with national statistical offices. The accounting data do not include dwellings.

The value should include insurance of buildings. This information is included on the FADN.

To obtain a service flow from the capital stock a conversion is necessary.

The USDA does the conversion differently for the equity and debt portions of real estate value.

- For the **equity** portion, the ratio of net cash rent (after property taxes) to current value is multiplied by the (base period) constant prices value of real estate. The current value of the equity proportion is estimated by subtracting the value of outstanding mortgages from the total value of farm real estate.
- For the **debt** proportion, the constant prices value is multiplied by the base period average mortgage interest rate to obtain the annual flow.

The FADN has sufficient information about interest paid on the farm return. Actually, it is not included on the published results but an implicit interest rate paid by farms can be calculated from loans and annual payments for borrowed capital. When European countries have appropriate statistical information to calculate a representative mortgage interest rate paid for the farm loans, that allows us to contrast the FADN data.

1.d Depreciation

Estimated depreciation must be added to the services flow of buildings. It is difficult to find a figure for the rate of depreciation of buildings. It should reflect the flow of services that they provide during their useful life. The USDA accepts 2 per cent but other authors use much higher figures. The problem of over valuing the depreciation rate is that the stock of building vanishes in the statistics but continues in use in reality, and in this way, productivity measurement can be biased.

This problem is especially complicated when the amortisation period is fixed (normally limited) by fiscal law. Then farmers are forced to include capital amortisation of their investments in their accounts but this legislation is not yet harmonised in the EU and then the productivity comparisons risk being biased.

Currently depreciation is published on the FADN but it is not certain that the method of calculation is homogeneous. This situation can be easily improved. Anyway, it is a point for discussion.

Service flows from public or communal lands should be also included. Then these data should be collected.

2 Machinery services

Services flows from machinery and mechanical power is calculated from capital stock of farm. Purchases minus estimated depreciation indicate changes in stocks. The stock of motor vehicles and farm machinery should be aggregate in a HP index as a way to obtain a constant price index.

The basic service flow from capital goods in this category is an estimate of capital used up, or depreciated, during the year. The accounting information needs to use the information for the capital balance but FADN does not publish the data. So individual farm return data has to be used for gathering this information.

The USDA estimates are based on a declining balance method in which a constant percentage represents the annual rate of depreciation of each type of capital.

The percentages used are:

- automobiles 22%
- trucks 21%
- tractors 12%
- other machinery 14%

The stock values are put in real terms by deflating through a price index. To deflate the FADN date value of stock of machinery the prices index used are available from EUROSTAT input prices.

In addition to depreciation, the opportunity cost of funds invested in machinery and other capital equipment should be included as input. This flow can be estimated by multiplying the farm share of the deflated capital stock values by the base period interest rates on farm real estate debt. The implicit interest rate on farm real estate debt can be directly obtained from FADN information about paid interest and loans. Some European countries publish series of paid interest rate on loans for agricultural machinery. These are especially important to take into account in periods with subsidised interest rates.

3 Irrigation

Operating and maintenance expenditures on irrigation are included as input. The use of electricity and fuel for pumping are included elsewhere. Then pumps, tubs and other irrigation materials amortisation should be included as capital flows of services. Even though the USDA does not calculate these items due to lack of information, in most of the European countries, for practical reasons, payments for water supply index can be used as a proxy for

irrigation prices.

4 Livestock services

Livestock services from breeding livestock in LU (Livestock Units) is included on the FADN published results. The livestock FADN data also includes values and LU per dairy cows, other cattle, pigs and poultry.

Also quotas (milk quotas, e.g.) are included and then we should calculate the flow of services from quotas using a published index of quantity (e.g. litres per farm)

5 Taxes and subsidies

This information is available on the FADN. The intention of including taxes is to reflect the intangible inputs such as education, farm to market roads, and research.

Also subsidies on investments should be considered as a capital transfer from the public sector. A proxy price index is available from Eurostat input prices and can be used to deflate these series.

FINAL COMMENTS

The FADN data constitutes an interesting source for gathering statistical data to calculate the total factor productivity index for the agricultural private sector in Europe. In general terms, these data are more homogeneous and have higher quality than the alternative macro-data.

Macro-data include several items in which it is difficult to distinguish private from public flows of capital services and makes it more difficult to

capture technical change of the productive sector, especially when the objective is international productivity comparisons.

FADN and the Eurostat data about wages, input and output prices provide a reasonable homogeneous set of data which joint with carefully treatment, can yield a good approximation of the total factor productivity comparisons.

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