Cost prices in pig production: Experiences with an EU-wide comparison

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This article describes the methodological problems encountered in comparing cost prices between countries or regions and makes a comparison of the cost price of pork in five European regions using data obtained from the Farm Accountancy Data Network (FADN).

First of all the problem of mixed farms is discussed. Different methods for allocating fixed costs to products are discussed (Activity Based Costing, regression analysis, dividing cost using the distribution of costs on specialised farms etc.). Other methodological problems are corrections necessitated by the influence of external factors in individual years (weather, for example), local currency or ecu versus purchasing power parity standards, the need to correct for differences in the structure of the farms in different countries and the influence of subsidies and taxes. The costs of equity and non-paid labour are given special attention.

Cost prices of pork per kilogram are presented for five European regions: Brittany, Belgium, Denmark, the Netherlands and Lower Saxony. The effect of applying different methods to the cost price is illustrated.

1. Introduction

International trade flows are becoming bigger and bigger. Each year trade records are broken. The international trade in pigs is certainly no exception (EC, 1996). Internal EU trade flows as well as the exports to non-EU countries are growing fast. As a result, the competitiveness of the national pig sectors on the international markets is of growing importance. Because in most countries there are no quota restrictions on the level of production (such as with milk and sugar beets) and there is no lack of natural resources in the EU countries (besides land for the manure in some regions), pig production in a country can be stepped up rather easily. The ease with which production can be shifted from one country to another and the growing international concentration of the 'processing industry' makes competitiveness even more important.

The competitiveness of the products of a country is influenced by a lot of factors. The more homogenous the products, the more important the role of pricing competition and thus the costs of production (Porter, 1990). Although there are some efforts to make pork more heterogenous (Integrated quality control, regional products), the product is still largely homogenous. So the cost of production is still one of the most important factors in determining competitiveness in the international marketplace.

The importance of the costs of production has triggered the publication of numerous articles in newspapers and periodicals on this subject. And greatly differing

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results have been obtained because different methods and sources are used. Sometimes, the costs of production in the countries compared are calculated in different ways in the individual countries. In their calculations of the cost of pork production, Salaün and Teffene (1996) used different sources for each individual country, but tried as far as possible to use the same methodology. Depending on the source, differences of up to 10 percent were obtained for a single country. This article is about the methodological and practical problems encountered when comparing the costs of production at the farm level. Although this article aims to discuss the major problems, its scope does not extend to the discussion of all problems.

The paper starts by describing why the survey approach is used for calculating the costs of production. After that the effects of the use of current cost accounting on production cost calculations are presented. In parts 5, 6 and 7 some special problems are analysed: mixed farms, subsidies and taxes, normalisation, exchange rates and calculated costs. Part 8 describes how these theoretical problems are dealt with and presents the resulting production costs. Finally, this paper sets out the effects on the results when other methods are used.

2. Different costs for different purposes

Estimates of production costs are used for many different purposes. One of their first applications was in decision-making at the farm level. Information about the profitability of the individual products can be important in the planning of future production. Besides that, comparisons between firms ('benchmarking') could lead to greater efficiency in the production process of individual farms. Later on, policy purposes were becoming more important. Governments used the estimates, for example, to determine a fair price level. It is important to note that in this paper the production costs are calculated for the aim of comparing competitiveness between countries. Calculations for other purposes could lead to different results ('different costs for different purposes').

3. Approaches

There are two widely used approaches for comparing production costs between countries. The first one, the engineering approach, starts with technical coefficients for the average farm in a given region and multiplies the technical results by prices (used by the USDA before 1980, for example, and Vaessen and Backus, 1997). In the Netherlands the average farm has x pigs. One pig (including its piglets) needs y kilos of feed a year and produces z piglets a year. The feed costs of one piglet are: $(y * P_y)/z$. The advantage of this method is that you only need to know the development in the technical coefficients and prices to calculate the development in production costs. This calculation is, however, only possible for a short period of time because in the long run structural changes will happen. The biggest drawback is that the production costs calculated in this way are not necessarily representative for the country as a whole. The average farm does not necessarily have average production costs. Mostly, it is not an average farm which is chosen, but a 'modern farm'. The term 'modern' is not easily harmonised between countries, though. The lack of information about the distribution of the production costs between the farms is another drawback to this method.

The second approach, the survey approach, is based on accounting information gathered from a sample of farms. Every farm in the sample is representative for a group of farms (with more or less the same characteristics), so that all the sample farms together are representative for (nearly) all the farms in the region. Calculations of the production costs based on this data do not have the disadvantages mentioned above (unrepresentative and lack of information about distribution). But this method also brings with it the problem of harmonisation of data between the countries. Each country uses its own rules to calculate income and production costs and compiles different variables. In the Farm Accountancy Data Network (FADN), however, all the countries in the European Union organise the harmonised compilation of accounting information from a sample of farms in their own country (in total more than 50,000 farms)[2]. The data is compiled and combined in one database by the European Commission in Brussels. The following part of this article will be based on the calculation of production costs using this network.

4. Production costs and current cost accounting

The methods for the calculation of income and production costs in the Farm Accountancy Data Network are based on the ideas of current cost accounting. The foundations of this type accounting were laid by Schmidt and (in the Netherlands) Limperg. Horring (1948) used the work of these authors to develop the Dutch version of the FADN. The European version, which was developed years later, was (in part) based on the Dutch version. Originally the main purpose of the Dutch network was to calculate the production costs of the most important products so that the government could make a fair valuation of agricultural prices. Horring stated that the cost of fixed assets should be based on the replacement value instead of the historical expenditure. If the profit of a company during times of high inflation is based on the historical expenditure and the profit is used up for paying tax and private expenses, the company would not have enough resources to buy the same fixed asset again because inflation would make it more expensive. The company would then not have the money to continue its business. If the profit is calculated on a current cost base, the company would have just enough resources to buy the new asset again. Another advantage of current cost accounting is that it is well suited to inter-business comparisons. The cost of two companies who have exactly the same asset (of the same age), but who did not buy the asset at the same time (one farmer bought it second hand), and hence their historical expenditures are different, will be calculated in the same way. The original price they paid for the asset is irrelevant for comparing the production costs of the farms at this moment.

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[2] A lot of other countries (for example, the USA, Canada, Australia, New Zealand) also compile farm accountancy data from a sample of farms. Their methods however are not harmonised with EU methods, which makes comparisions of the results extremely difficult (Morisset, 1994).

Although from a theoretical viewpoint the current cost accounting has important advantages, the practical implications can be rather complicated. Each year a replacement value has to be calculated for every fixed asset. This is especially complicated for assets which change hands only seldom or never. This could be the case for old assets, but also for assets for which there has been a technical breakthrough. For these assets, and often for efficiency reasons also for other assets, rules of thumb are used to calculate the replacement value. These calculated replacement values can be very different from the real replacement values. Apart from that, each country may use different rules of thumb, a process which distorts the comparisons between countries and introduces a subjective element into the calculations.

Another problem with using the current cost accounting in the FADN is that it is not applied consistently. One example has to do with the loss of value of the net monetary assets (debtors less short term creditors) due to inflation. Because the real value of the monetary assets declines during inflationary times despite the nominal value remaining the same, the income has to be charged with an amount to compensate for that loss. This charge is not made in the FADN[3].

The conclusion that can be drawn from this is that current cost accounting has some great theoretical advantages above the historical expenditure system, but it also introduces some practical problems. If the FADN wants to continue with the current cost accounting, the solutions to these problems need more attention and should be harmonized between the countries.

5. Mixed farms

Although agricultural products are increasingly being produced on specialised farms (Poppe, 1997), the main part of total production is still produced on farms which produce more than one product. Some of the products are even necessarily produced together (joint products like cow milk & beef and cereals & straw). Some of the costs of those mixed farms are logically connected to one product. For other costs this is not possible. Labour, capital, machines etc. can be used for different products. For an individual farm it is possible to allocate these costs to the products using Activity Based Costing (Schoorlemmer et al. 1997). This method starts by attributing all costs to activities. The costs of the activities are attributed to the products depending on the

[3] Another inconsistency is that not only the fixed assets should be revalued, but also the liabilities. At the moment, the fixed assets are revalued to current value, the liabilities however are still valuated at historical cost. A lot of farmers have loans from relatives or the government, for example, with lower interest rates. These loans have a higher value than the nominal value because in the future a lower interest rate has to be paid than with other loans. On the balance sheet these loans should be revalued and the interest costs on the profit and loss account should be higher if current cost accounting is applied consistently. This is not the case at the moment with the FADN. A third aspect is that the part of the extra costs (revaluation which leads to higher sales costs and depreciation, and compensation for loss of net monetary assets) which are financed by long term creditors, should be credited on the profit and loss account again. Although the three inconsistencies influence the income ratios, they do not have to influence the production costs because they can be offset using the cost of capital.

amount of activities that are needed to produce that product. Because this method needs a lot of information (for example, about the hours of labour and machines used for the different activities) which is not collected in the FADN, this method is not possible using this network. Of course it is also possible to use the ABC philosophy for some of the costs for which information is available on the activities used for the different products. The USDA/ERS, for example, allocates machine costs based on the hours used for the different products, but allocates other fixed costs using non-ABC methods (Ahearn et al., 1992).

Butault and Cyncynatus (1991) and Moxey and Tiffen (1994) have investigated the possibility of calculating the production costs through econometric analysis based on linear programming, regression analysis and Bayesian theory. These methods are only possible if the results of a lot of farms can be used, as is the case with the FADN. The first problem with these methods is that they do not have any (economic) theoretical foundation. Besides that, they can only be used to find an average relation between costs and output for a group of farms. There is no information about the distribution of the costs between the farms. Although the Bayesian approach has some advantages above the other methods (Moxey et al., 1994), the empirical results of all 3 methods are not always very promising. This is partly to do with multicollinearity and heteroscedasticity in the data (Butault et al., 1991). Other reasons that these econometric methods do not give the desired results are the possible variance in production methods (using labour, machines or contract work) and the influence of factors which are normally not brought into accountancy surveys (like weather, soil quality, etc.).

At the Dutch Agricultural Economics Research Institute (LEI-DLO) two simple methods are used which have some economic theoretical foundation. The first method assumes that in the long run every product has the same profitability (expressed as revenues/costs) because otherwise the farmer would change his product composition. The costs that can not be directly allocated to a single product are allocated in such a way that every product has the same profitability. For an individual year this method is not correct, but as stated later, production costs should be based on several years and in that case it may be a reasonable approximation. The method is only possible for fairly specialised farms. If a farm has a lot of products, the approximation would be too rough. The USDA/ERS (Ahearn et al. 1992) uses a variant of this method where costs are attributed to a product on the share of gross value of a product in the farm's total gross value. This variant, however, can lead to the relatively low profitability of products with relatively high (variable) costs already allocated. If the gross value of two products is equal, both products are allocated half of the (fixed) costs. This will lead to low profitability of the product with high variable costs[4].

The second method can be used for products which are necessarily produced together (like cow milk and beef). The method supposes that the byproduct is only produced because of the main product. The revenues of the byproduct are supposed to be the same as the costs of it. The remaining costs are allocated to the main product. This approximation is also only possible when the byproduct forms only a small part of

[4] An example of this situation is a farm with both cereals and pigs. The cereals have relatively low variable costs and the pigs relatively high variable costs. The USDA method would lead to the relatively low profitability of pig production.

the total production. Another drawback of this method is that in situations where the total costs of the farm are higher than the total revenues, which is the case for most farms, the byproduct is the most profitable product.

Another method that is sometimes used in practice to overcome the allocation problem, is taking the cost of 100% specialised farms and using the level of those costs to divide the costs of the mixed farms over the products. This method is of course only possible if there are enough 100% specialised farms for the different products produced in a mixed farming system. Besides that, the cost per product of the 100% specialised farms can be different from the cost of that same product on the mixed farms, because of economics of scale, for example. Consequently, the results will only be rough approximations.

Because of the difficulties of allocating costs to individual products, production cost analysis is mostly based on more or less specialised farms. Depending on the level of specialisation, this can result in different costs per unit. Only by coincidence will the cost for the specialised farms be the same as the cost for all the farms. Significant distortions can occur especially when the degree of specialisation differs between the countries or when only a small percentage of the total number of farms are specialised and these farms have different characteristics than the average farm. Comparing the characteristics of the average farm with those of the specialised farms and sensitivity analysis for selecting different degrees of specialisation are essential in examining whether the analysis is still representative for the average in different regions. From a practical viewpoint, the choice of the degree of specialisation of the chosen sample of farms will be a trade-off between distortions due to an incorrect allocation of costs to the product on the one hand, and the representativeness of the sample on the other hand. The chosen degree of specialisation of the sample farms should differ depending on the degree of specialisation for the product in the different regions and the differences in characteristics between the specialised farms and the mixed farms.

In some situations, however, our main interest lies in the costs of the group of specialised farms. In some countries only the products of (some of the large and modern) specialised farms are exported. These are the farms that are competing on the international markets. The cost of these specialised farms, which sometimes produce ‘a different product’ (in terms of quality, for example) than the other farms, can be of more interest than the average of a region. But even in this situation, the average production cost is of interest because if prices in their own region are high (because of the high costs of most of the farms), the exporting farms will also be able to sell their products on their own markets.

6. Subsidies/taxes, normalisation and exchange rates

Even in the European Union there are still differences in both the tax system and the level of taxes. Differences in value added tax systems, for example, can distort comparisons of production costs. The calculated differences in costs between countries could be caused by treating the VAT in different ways. All figures in the FADN are for that reason exclusive of VAT. In the past, value added tax was used in some countries as a kind of indirect subsidy (Poppe, 1993). Farmers in these countries received a lot more VAT than they had to pay. Differences in VAT can influence the international

competitiveness of farmers and it can be interesting to show them as a separate subject in comparisons of costs. Nowadays however, the differences between the countries are not that large (FADN, 1993). Other farm taxes are included in the costs of the FADN. Their influence on the total costs is very small.

All kinds of government programmes to support the agricultural farms (or "subsidies") can seriously influence the production costs. The costs can be influenced either directly (investment subsidies) or indirectly (land left fallow can restore the fertility of the soil). Because of the difficulties of valuing the indirect effects of subsidies, these effects will not be taken into account. Production costs including and excluding subsidies are interesting because in this way the influence of subsidies on the costs can be separated from other costs. Costs including subsidies give information on the competitiveness at this moment. Whereas costs excluding subsidies tell us more about real competitive advantages and future competitiveness when subsidies will be decreased. The allocation of some of the subsidies to products can, however, lead to the same difficulties as discussed above for fixed costs.

Because of the variable influence of external factors (such as weather and disease) on the production quantity, cost per unit of production based on one year can lead to big differences from year to year. Cost will not change that much, but because the output changes, the cost per unit varies. When costs are expressed per acre or animal, the difference in costs will be less. The competitiveness of a region, however, will not be based on the costs per acre but on the costs per produced unit. When costs are not related to the amount produced in a particular year, the use of normalised production would offer a solution (Horring, 1948). Most of the time, some costs are related to the amount produced and so corrections also have to be made on the cost side. Disease, for example, would lead to a decrease in the number of animals on the farm and the feeding costs would be lower and investment costs higher. Besides that, it can be difficult to arrive at a good estimate of normalised production for every region in an international comparison. An estimate of the normalised production costs, which has advantages from a practical viewpoint, can be reached by taking the average over a few years. This method can also partly compensate for the difference in financial year between the countries. Every country (and sometimes regions in countries) has its own financial year, making international comparison of an exactly equal period impossible. By using a three year period the differences between the periods are only in the beginning and the end of the three year period. A disadvantage of this method is that development over the years can no longer be shown.

When comparing values in an international perspective, numbers have to be expressed in a common currency/unit. If development over the years or an average of several years has to be calculated, the choice of the currency influences the results. When there are big fluctuations in (real) exchange rates, the results expressed in terms of both constant (real) exchange rates and actual exchange rates are interesting. In this way, we can separate the direct influence of exchange rates from other influences[5]. For comparisons in the European Union, the European Currency Unit is a logical choice because the differences in development of real exchange rates will be the lowest. The ECU is after all a weighted average of the currencies of the countries of the European Union.

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[5] Costs can of course also be influenced indirectly because some inputs can be imported.

7. Calculated costs

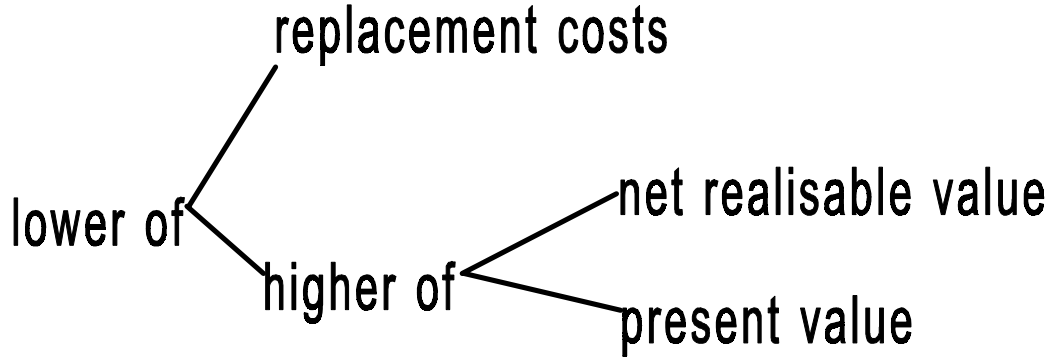
Total costs can be divided in three different categories depending on the time period analysed. All costs that lead to a cash outflow in the same period can be treated as the short term production costs. When receipts are smaller than these costs, this will always lead to a cash outflow for the farm and therefore also to a reduction in liquidity and/or liquidity problems. When depreciation is added to the short term costs, this gives us the medium term production costs. When receipts are equal to the medium term cost, there is just enough money for the (future) investments needed to replace the current assets. However, no income is retained for the farmer and his family. When calculated cost for the equity and unpaid labour are added to the medium term cost, this gives us the long term costs. Non-paid labour and capital are valuable because when it is not used for the farm, they can be used for other purposes (opportunity costs). In the long run, capital and labour will only stay in the business if the receipts are greater than or equal to the long term costs. A shortfall in the receipts compared to the long term costs can, however, result in an income that is sufficient for the expenditures of the farmer and his family.

As comparing the competitiveness necessarily needs a long-term perspective, costs have to be calculated for unpaid labour and for the equity that is invested in the farm. In many articles published in periodicals, however, it is implied that the opportunity costs of these items are zero. As a result, costs are high in regions where production is highly mechanised, and costs are low in regions where most of the work is done by unpaid labour. Analysis without calculated costs can sometimes lead to the conclusion that farmers who stop their business have the lowest costs (Oogst, 1996). Farmers who stop their business usually have the smallest farms and do not have a lot of machines or debts, and so they do not have much cash outflow per product. Although in the scientific literature there is (mostly) agreement on the need to calculate costs for these items, the level of the costs is still much debated.

Earlier it was described how the current cost accounting offers some theoretical advantages for calculating production costs and is used in the FADN to calculate the costs of the assets. We can start the analysis of the calculated costs by applying the theoretical principles of this method. Figure 1 shows the scheme used to determine the value of a production factor while using current cost accounting. The current value can be found using three different valuation methods:

- The replacement cost (RC) is the amount that has to be paid to replace the asset;
- The net realisable value (NRV) is the amount the owner would receive if he sold the asset (less the cost of selling);
- The present value (PV) is the present value of the net cash flows that the assets would generate if they were used at the farm.

Figure 1 Determining current value



To find the current value, one should start by selecting the higher of the net realisable value and the present value. The resulting value has to be compared with the replacement costs and the lower of the two should be used as the current value. The value of a production factor cannot exceed the replacement costs because if an owner is deprived of an asset, he could restore his original position by replacing it. If the RC is greater than both the NRV and PV, the asset will not be replaced and the loss which the owner would experience if deprived of the asset, would be the higher of the NRV and PV.

An estimate of the PV of the assets can be found by calculating the realised returns on the assets in the past. When trying to calculate the PV in this way, we encounter the problem that it is impossible to make a distinction between the PV of non-paid labour and the PV of the capital, and so we first start with the NRV. As an estimate of the NRV of non-paid labour, we could use the returns that could be earned by the farmer by one hour's work outside the farm. Although these opportunity costs are different for every farmer, the average could be estimated by the average hourly wage paid in agriculture or a similar industry which could be treated as an alternative use for the farmer's labour. As a start, the net wage could be used because that is the amount that the farmer would really earn. However, we should also include some of the social security contributions that a self-employed person should arrange himself (like disability pensions), because the farmer would after all benefit from these provisions if he was in paid employment. The premium for unemployment insurance, income tax, etc. should not be included because there is no risk to the farmer of being fired and the amount of income tax the farmer has to pay is not included in the production costs anyway.

The cost of the equity should be based on the market rate of return for an investment with the same risk. It is not easy, however, to find the rate of return for an investment with the same risk. There is still no agreement in the finance literature about the trade-off between risk and return. Although the risk of equity will be higher than with debt, the risk of an investment in a farm will be relatively low because mostly a lot of money is invested in land[6] and buildings. A reasonable approximation could be found

[6] Land is an interesting investment objective because it does not readily depreciate, can be used for risk reduction (for example a hedge against inflation) in well-diversified investment portfolios and can have intangible and social benefits (Gustafson et al. in: Ahearn et al., 1992).

by using the average rate of return on long-term government bonds with some small premium for the extra risk of the equity.

When the costs of the assets have been calculated using current cost accounting, another adjustment has to be made to the cost of equity. Because revaluations of the assets are not included in the revenues, the cost of the capital used for these assets should be reduced by the rise in value. Corrections should not only be made for cost of equity but also for cost of debt. The revaluations of these assets are after all never included in revenues, regardless of the way the asset is financed.

If the yearly rise or loss in value of the assets is used, production costs will fluctuate heavily depending on the rise or fall of the asset values in that particular year. Therefore, we mostly use the average change recorded over a long period. Because it is rather complicated to calculate the average rise for every single asset, an average of all agricultural assets could be used, which is then applied to all the individual farms. However, a distinction between land and other agricultural assets would be rather expedient because land is such an important asset and the change in the price of land can be quite different from other agriculture assets. If there is a transparent tenant market with no government intervention, the level of the rent less the normal costs incurred by the owner of the land can be used as an estimate of the cost of land. For the cost of capital of the monetary assets, the nominal rate has to be used while these assets can either not be revalued (cash money) or the revaluations are included in the sales because they are sold within a year (fattening pigs).

When the costs of a farm are based on the net realisable value of capital and labour, revenues are a lot lower than costs. So the net realisable value of labour and capital together are higher than the present value. This is not only the case in all the European Union countries but also in the US. It can be argued that when the realised rate of return on labour and capital remain lower than the market level for a long period, the required level in agriculture must be lower. Farmers are apparently satisfied with lower compensation.

If the net realisable value of capital is higher than the present value, it is expected that the capital would be used for another purpose. One ecu invested in the farm should provide the same return as one ecu invested in any other way (assuming that both alternatives have the same risk).

One could say that the same argument could be used for unpaid labour. There are however two problems with using the average wage of paid labour as the NRV of unpaid labour. First of all, from a farmer's perspective, an hour of work on his own farm is not the same as an hour of work as a paid worker on his neighbour's farm. The farmer could accept a lower hourly rate if he has the freedom to make decisions on the future of the farm and on the kind of work he is going to do. While the alternatives for investing the capital are more or less homogenous, the alternatives for the application of labour are not. The second problem is that labour markets do not work perfectly. Not every farmer who wants to work as a paid worker, can find a job. A lot of small farmers are in fact (partly) unemployed. In that case the NRV of labour is practically zero.

While we know that the wage paid is not a good estimate of the NRV of unpaid labour, it is not easy to find a better one. It can be argued, however, that in the long run the real NRV of labour could not be much higher than the PV. Realising this, an

estimate of the current value of unpaid labour can be found by calculating the average realised return per unpaid hour of labour using the NRV of capital. In all the EU-countries this calculation results in a PV which is lower than the paid wage and consequently lower than the replacement value.

The first problem with this method is that every year a different level is used. This can lead to problems when the development of costs are analysed. If the average of a long period is used or the return is normalised, the changes in the level will be small. Another problem is that this kind of calculation of production costs leads to circular reasoning. Lower feeding costs for all farms combined with unchanged revenues, leads to higher costs for unpaid labour. In this way the total production costs are (on average) always the same as the revenues. This reasoning could also be made for the cost of land, though. Higher prices of agricultural products necessarily lead to higher prices of land and thus to higher land costs. A third problem is that every year a lot of farmers stop farming. They (or better: their potential successors) are apparently *not* satisfied with the remuneration they receive for labour and equity. It is possible that there is no equilibrium situation where the average farm is earning just that amount of money that it needs to stay in business, because of barriers to exit, for example. For this reason, the (gross or net) wage paid is often used for calculating the costs of unpaid labour.

8. Production costs of pork

When using the FADN to calculate the production costs of pork, we encounter some special problems (Vard, 1995). First of all, only the value of the purchases and sales of pigs is given. There is no information about the number of pigs or the weight of the pigs traded. Because technical data (productivity of breeding sows, duration of fattening period for pigs) is also absent, this means that without supplementary information nothing can be said about the costs per kilogram. It would be a great advancement if this information were actually collected, especially because most of this information is probably readily available in at least some of the countries. Vard (1995) tried to solve this problem by gathering technical coefficients in the individual countries. The validity and the representativeness of these coefficients is however unknown and this method relies heavily on the information about the average piglets, breeding sows, etc. on the farm. Vard (1995), Vaessen and Backus (1997) concluded that some countries interpret the definitions of the various pig categories differently and thus it is very difficult to use the coefficients in a harmonized way.

In this analysis we are using Eurostat prices. Total sales are divided by the price per kg live weight of fattening pigs, which gives us the amount sold in terms of kilograms. Because the Eurostat prices might not be representative for the FADN farms or not completely harmonized between the countries (Kelly and Healy, 1997), the results should be treated as an example. Checks using technical coefficients and results from other publications (Wisman, 1991; Backus et al., 1994) do however suggest that the results are a realistic example.

When the production costs of a kilogram of pork has to be calculated using the results of specialized breeding and fattening farms, information is needed about the amount and the weight of the piglets sold by the breeding farms and bought by the fattening farms. Apart from the problem that no volumes are collected, the distribution of the different types of animals traded is lacking. This leads to problems with farms

who sell (or buy) both piglets and fattening pigs. For that reason, only those farms should be selected with nearly no other sales than fattening pigs and with nearly no purchases of piglets at all. In this paper, the farms are selected where the average number of pigs for fattening divided by the average number of breeding sows, is between the 4 and 9. These numbers are based on the average relationship between these two types of pigs on an average closed farm (6.5).

The costs of pork (in the base case) are calculated with the following decisions on the theoretical problems described before:

Current cost accounting

As described above, the inconsistencies in the current cost accounting of the FADN do not necessarily have to influence the long-term production costs because the inconsistencies can be compensated using the cost of capital. When medium-term costs are calculated, we find that calculating the depreciation on an actual cost basis while not including other advantages and disadvantages of inflation is inconsistent. Because in this paper our aim is to compare competitiveness, the analysis will be concentrated on the long-term production costs.

Mixed farms

The farms in the FADN are categorised according to farm type by the Standard Gross Margin (SGM) of the individual products. The SGM is calculated as the average gross margin of a product in a given region, standardised over a number of years. The farm is categorized as a pig farm when the SGMs of pigs, for example, account for more than 2/3 of the total SGMs of a farm. Products that can be traded, but are used as input on the same farm as where they are produced, are also included in this calculation. In some regions farms have a large area of cereals which are mostly used as feed for the pigs. But these farms are not categorised as pig farms. Because these farms are in fact specialized pig farms, the farm types of the FADN are not used. We have selected those farms where the revenues from pork are at least 75% of the total revenue of the farm.

The costs that cannot be allocated on a causal basis, are allocated in such a way that every product has the same profitability (e.g. receipts/total costs is the same for every product). Because only specialized pig farms are chosen, the influence of this assumption will not be crucial. The method would however be strongly improved if information was available about the hours worked, buildings needed, etc. for the pig production on the farm.

Subsidies/taxes, normalization and exchange rate

Figures are exclusive of VAT, but inclusive of direct farm taxes (land and building taxes etc.). The influence of subsidies is separated from the costs. McSharry compensations are allocated using the percentage of cereal production used as feed for the pigs. Other subsidies are allocated using pig sales as a percentage of total sales. The numbers are normalized using the average costs of the three year period 1991-1993. All figures are in ecu. The influence of real exchange rates changes is small. All currencies were nominally revalued in relation to the ecu by 4 to 6% during this period. Differences in inflation between the countries were small (EC, 1992,1993 and 1994).

Calculated costs

To start with, the cost of non-paid labour is calculated as the hours worked multiplied by the average gross hourly wage in all industries of that country. The costs of equity are calculated using the return on long-term government bonds less the inflation rate. These are the methods that were previously used for the FADN at the Dutch Agricultural Economics Research Institute.

Both the medium-term costs and the long-term costs are lowest in Denmark (Table 1). Although the absolute level of costs might be influenced by inaccuracies in the Eurostat prices, the composition of the costs is not. Feeding costs and overheads in particular are low in Denmark. The paid interest is high.

The subsidies, which are only based on the year 1993, are for the most part McSharry compensations for the feed produced on the farm. Because compensations were raised in the years 1994 and 1995, the influence of the subsidies in recent years could be much greater.

Table 1 Production costs of pork (ecu per 100 kg live weight, 1991-1993)

	Belgium	Brittany	Denmark	Lower Saxony	Nether-lands
Feeding costs	80	67	54	65	62
of which produced on farm	2	5	10	12	0
Other direct costs	5	5	3	4	4
Overhead costs	6	14	10	19	13
Paid interest	6	6	12	3	8
Paid labour	0	2	5	2	2
Short-term costs	97	94	84	94	88
Depreciation	8	9	9	11	9
Medium-term costs	105	104	93	105	97
Calculated interest	6	4	6	6	5
Calculated labour	19	9	12	23	12
Long-term costs	130	116	110	134	114
Subsidies (1993)	1	2	4	5	1
Long-term costs incl. subsidies	128	114	106	128	114

Source: RICA-EEC-DG VI/A-3; adapted by LEI-DLO.

9. Sensitivity analysis

In part 8, the costs of production are calculated using sometimes arbitrary decisions on the theoretical problems. In particular, the decisions on mixed farms and calculated costs were complicated. We now present the effect on the costs if other answers to these problems are chosen.

Mixed farms

In Table 1, the cost of the specialised farms are set out (75% of total sales are pigs). Although these farms represent 40% to 50% of total pig production in Belgium, Brittany and Denmark, only 10% of all pigs in Lower Saxony are represented. Besides

that, in most countries farms which produce with a closed circuit farm system are larger than the average pig farm. In Table 2, the results are shown when farms are selected which have pig sales of at least 50% and/or no restrictions on the relationship between pigs for fattening and breeding sows. Costs are higher in all regions, but especially in Belgium, Denmark and Lower Saxony. For the less specialised farms which do not necessarily produce in a closed circuit system, costs in Denmark, Brittany and the Netherlands differ only slightly.

At the bottom of Table 2, the production costs are presented when costs are allocated using pork sales as a percentage of total sales instead of the assumption of equal profitability of all products. As described before, this method leads to a low profitability for pig trading of the farm because the pigs have relatively high variable costs. High variable costs combined with fixed costs which are allocated based on a percentage of sales, leads to relatively high costs per unit for pigs and low costs for the other side of the farm. As a result, the cost in regions with relatively high cereal production, such as Brittany and Denmark, are higher using this method. The method leads to equal cost per kilogram for the Netherlands and Denmark. The costs in Brittany are only slightly higher.

Table 2 Change in production costs using several selections of farms and allocations of costs (ecu per 100 kg live weight, 1991-1993)

	Belgium	Brittany	Denmark	Lower Saxony	Nether-lands
Base selection (pig sales > 75% and closed circuit)	130	116	110	134	114
> 50% pig sales and closed circuit	+1	+1	+3	+2	+1
> 75% pig sales	+5	+2	+5	+9	+2
> 50% pig sales	+8	+3	+8	+9	+4
Cost allocated using % of pig sales in total sales	+2	+4	+4	+2	+0

Source: RICA-EEC-DG VI/A-3; adapted by LEI-DLO

Calculated costs

In Tables 1 and 2, the costs of equity and unpaid labour were calculated using the method which was previously used at the Dutch Agriculture Economics Research Institute. In Table 3, the cost of debts are also corrected for the fact that revaluations of the assets are not included in the farm's profit and loss account. Besides that, the costs of capital are split into three parts, depending on which assets the capital is used for. The cost of capital invested in land is 2% of the current value, regardless of the way the capital is financed. The 2% is equal to the rent that has to be paid in the Netherlands as tenant and similar to the rent that has to be paid in other EU-countries (EC, 1994). For the cost of capital invested in fixed assets, it is supposed that the average rise in value for these assets is equal to the rate of inflation in the various countries. For the part that is financed with equity, the real rate of return on long-term government bonds is used. For the part that is financed with debts, the average paid interest rate less inflation is used. The cost of capital used for the current assets is calculated in the same way as for the fixed assets, but now nominal rates are used. The cost in the Netherlands decline the most because the Dutch farms are heavily levered and use a lot of capital per kilogram.

At the top of Table 3, the cost of unpaid labour is calculated as before (average wage paid in industry). The cost of labour could, however, also be calculated using the average return realised per unpaid working hour in agriculture. The realised return can be calculated by subtracting all costs (except the cost of unpaid labour) from revenues and adding net paid VAT and subsidies. The resulting amount has to be divided by the hours worked in order to arrive at the average return per hour. Denmark has the lowest average return during the period 1990-1993 (Table 3). In 1992 the average return realised was negative for Danish farmers.

Because the cost of unpaid labour is an important part of total costs and the average realised return is low in all regions, total costs change considerably when costs of unpaid labour are calculated in this way. The costs decline the most in Denmark and Lower Saxony where industrial wages are high and realised returns on labour in agriculture are very low.

Table 3 Production costs using several methods for calculating costs of capital and unpaid labour (ecu per 100 kg live weight, 1991-1993) and average realised return on an hour of unpaid labour (ecu, 1990-1993)

	Belgium	Brittany	Denmark	Lower Saxony	Nether-lands
Cost base situation (real return government bonds and average wage in industry)	130	116	110	134	114
Change in cost when cost of capital is calculated using variant A[1]	-2	-3	-3	-1	-4
Average realised return on hour of unpaid labour6.7	5.2	1.6	3.1	6.5	
Change in cost when using A[1] for cost of capital and realised return for unpaid labour	-8	-6	-14	-18	-8

[1] Land: 2%,
Other fixed assets: %equity*real return government bonds + %debt*(average % paid on debt - inflation)
Current assets: %equity*nominal return government bonds + %debt *average % paid on debt
Source: RICA-EEC-DG VI/A-3; adapted by LEI-DLO

10. Conclusions

In this article, we describe the methodological problems encountered when comparing production costs in an international perspective. The aim of this calculation was to analyse one of the factors that determine the international competitiveness of a region. Because of the practical difficulties of implementing the theoretical best valid solutions and because some problems can only be solved by making arbitrary decisions, the influence on the costs of applying different methods, is showed. Although the use of different methods sometimes had considerable effects on the absolute level of production costs, the ranking of the regions remained the same, generally speaking. Denmark has the lowest costs followed by the Netherlands and Brittany, respectively.

It should be said though that the results presented can only be used as a (realistic) example because the database used (the FADN) contains no information about the prices and the Eurostat prices which are used as an alternative might not be completely harmonised between the countries. The use of the FADN for these calculations would be considerably enhanced if in the future information on prices is also gathered, or at least exchanged between those countries where it is available.

Although it is logical that different production costs result because calculations are made for different purposes, the harmonisation between countries (and researchers in a given country) of analyses used for the same purpose, could bring about a considerable reduction in the confusion surrounding the level of production costs in the different EU-countries. Therefore, agreement will have to be reached on the methodology and data used. If information on the prices of pork is going to be gathered in the future, the FADN could be used for the data exchange. We hope that this paper can be used as a springboard for further discussion on methodology.

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