

Application of the Gini index to measure the concentration on several agricultural international markets.

Ph. Burny and Ph. Lebailly*

Summary

This paper studies the level of concentration of several agricultural products exports whose roles are important in developing countries. The Gini index was determined as it measures the level of competition within the different markets. After a description of the index, eight products were studied: bovine meat, poultry meat, eggs in the shell, rice, sugar, tea, rubber and palm oil. For each of them, the Gini index was calculated according to the data of the Food and Agriculture Organization in 1965, 1970, 1975, 1980 and 1985. A comparison was made between the years 1965 and 1985 in order to show the evolution of the relative importance of the different exporting countries. In conclusion, the successes, failures or changing goals of the agricultural policy of these countries could be evaluated.

Résumé

Ce travail étudie le niveau de concentration sur plusieurs marchés à l'exportation de produits agricoles, où les pays en voie de développement jouent un rôle important. L'indice de Gini permet de mesurer le niveau de compétition à l'intérieur de chaque marché. Après une description de cet indice, huit produits sont passés en revue: la viande bovine, la viande de volaille, les œufs en coquille, le riz, le sucre, le thé, le caoutchouc et l'huile de palme. Pour chacun de ces produits, l'indice de Gini a été calculé, selon les données de la FAO, en 1965, 1970, 1975, 1980 et 1985. Une comparaison est faite entre les années 1965 et 1985 en vue de montrer l'évolution de l'importance relative des différents pays exportateurs. En conclusion, les succès, les échecs et les buts variables de la politique agricole de ces pays peuvent être évalués.

I. Introduction

The international trade of agricultural products has known a notable extension in the last decades. The United States, for example, has increased its production so considerably that the survival of many American farmers depends on the quantities that can be sold on the world market and on the price obtained. The EC is also playing an important role in the field now. Developed countries, however, are not the only partners: several developing countries have succeeded in promoting local productions, so that they can not only satisfy the needs of an increasing population but also ensure large exports. Some of them are also urged to get foreign currencies to pay their international debts.

Agricultural exports can thus be important for accelerating the development of several parts of the world which have a real agricultural potential. That is why it seemed interesting to measure the degree of competition existing on several markets where these countries can have a place. The markets chosen are all important in volume and in value. They cover several situations as different as possible: animal and vegetal products, originating from Latin America, Africa or Asia and containing rather pro-

tein, polysaccharides, fats or alcaloids. These outputs have been traditionally produced for decades or centuries, or are produced only since a few years, by modern methods. So it is possible to have a broad overview of the situation by describing relatively few markets. The products studied are: bovine meat, poultry meat, eggs in the shell, rice, sugar, tea, rubber and palm oil. The Gini index has been calculated from the data of the Food and Agriculture Organization. The unit chosen is the US dollar and not the metric ton. It is so easier to appreciate the real importance of each product.

In order to be able to determine what has been the evolution in the last twenty years, the index has been calculated for each product in 1965, 1970, 1975, 1980 and 1985, respectively. The Gini index gives an idea of the concentration of exports but it can hide several situations: it is possible that big (small) exporters in 1965 became small (big) exporters in 1985, although the index remained the same. It is therefore mandatory to carry out an in depth analysis.

The following paragraphs give the definition of the Gini index, its calculated values and a discussion for each product.

* Department of Agricultural Economics, Faculty of Agronomical Sciences, B - 5800 Gembloux (Belgium)

2. Description of the Gini index

More often, it is calculated from a class distribution or, more rigorously (exact index) by the following formula (6):

$$G = \frac{\sum_{i=1}^{n-1} i(n-i)(x_{i+1} - x_i)}{n^2 \bar{x}}$$

where:

G is the Gini index;

n is the number of observations;

\bar{x} is the arithmetic mean of the variable x;

x_i and x_{i+1} are two successive observations so that

$$x_1 \leq x_2 \leq \dots \leq x_i \leq x_{i+1} \leq \dots \leq x_n.$$

The error made in the calculation of the Gini index from a class distribution is a function of the number of classes and exponentially decreases when the number of classes increases (3).

3. Calculated values of the Gini index

The values of the index, calculated for the different products and for different years, are shown in the table below (table 1):

TABLE 1
The calculated Gini index values

Products	Years				
	1965	1970	1975	1980	1985
Bovine meat	0.821	0.810	0.841	0.787	0.778
Poultry meat	0.887	0.888	0.876	0.800	0.800
Eggs in the shell	0.811	0.800	0.834	0.812	0.811
Rice	0.878	0.884	0.884	0.845	0.849
Sugar	0.789	0.815	0.798	0.791	0.849
Tea	0.879	0.871	0.861	0.834	0.853
Rubber	0.890	0.916	0.902	0.913	0.902
Palm oil	0.803	0.858	0.887	0.904	0.913

4. Discussion

The products studied in this paper followed different evolution between 1965 and 1985. Four vegetable products knew a moderate expansion in volume (rice, sugar, tea, rubber), their total world exports being increased from 30 to 70%. The animal products knew a larger expansion, and especially eggs in the shell (x 3.9) and poultry meat (x 4.4). The most important increase occurred for palm oil: x 8.5 in twenty years. The value of an exported ton generally doubled or tripled, except for poultry meat (x 1.6) and for eggs in the shell (x 0.5). This reflects the difficulties for countries which want to export large quantities of agricultural products to get a stable income to ensure their economic growth. It is

less crucial for developed countries than for developing ones which produce much less manufactured goods, though this is a question of great importance for rich countries too (see the huge sums spent by the United States and the EC to maintain the agricultural income, the problem of rural depopulation, the very important indebtedness of the developed countries farmers,...). So, world agricultural trade is now a topic of conflict for all countries in the world. Less developed countries often export few kinds of products and so heavily depend on each of them. The situation of these countries can be very different. Some have succeeded in getting a very large share of the market (Cuba with sugar, Malaysia with palm oil) by increasing their production (exceeding the local demand) or by focusing on export sales to obtain resources to invest in industrial development, or simply to reimburse their international debts. Other countries, on the contrary, completely disappeared because of several problems such as wars or political troubles, though some of them have particularly good soils and climates. So it seemed interesting to show the evolution of some important agricultural markets during the two last decades (1965-1985). For this purpose, the Gini index was used. It gives an idea of the competition on the markets, but similar values can be the results of variable structures. So one has to go further in the description.

For the eight products studied, the frame was as follows:

Bovine meat

The index was weaker in 1985 than in 1965 (0.778 compared with 0.821). Some West European countries became larger producers and exporters, the productivity of the bovine meat sector having made important progresses, notably by using much more concentrated feed (large imports of soybean meal, corn gluten feed, sweet potatoes,...). Considering the quantities produced, it was certainly one of the CAP successes. The EC exported large quantities to the other parts of the world but the intra-Community trade was also much more active than before the EC creation. The EC exports increase was also due to the high productivity of the milk production system and to the milk quotas application (livestock reduction). Many other regions of the world did not achieve such progresses and also had to satisfy the needs of a rapidly increasing population, which was not the case in Europe.

The quantities exported also depended on the prices offered on the national market and on the world market. Sometimes, a country can suffer from a local shortage because world prices are more attractive and farmers prefer to sell their products abroad. The currencies exchange rate plays here a non negligible role.

In fact, the bovine meat world market was rather dominated by the developed countries, and more so in 1985 than in 1965. Some less developed countries got a share mainly because of their large grass-land areas. Productivity however was rather poor. The situation can change because these countries are able to sell meat as much lower prices than developed countries can do.

Poultry meat

The Gini index fell here from 0.887 to 0.800. The leadership of the Netherlands and the United States considerably weakened in twenty years. Some developing countries (the most advanced among them) succeeded in exporting large quantities, industrially produced. This was especially true for Brazil and Thailand and explained that the market was more competitive. So, the poultry industry is in progress in several developing countries. Therefore, they can improve the standard of living of their population and even become serious competitors for the traditional exporters.

Eggs in the shell

The Gini index characterizing this sector was the same in 1965 and in 1985: 0.811. Nevertheless, the situation was different: the Netherlands, thanks to a well known commercial dynamism, got a much larger share, while China and Belgium-Luxemburg had a smaller one. Turkey appeared as an important exporter. Arabic countries also began to export eggs. This can seem to be curious but they are oil exporters and so have a high per capita income. So they can afford big investments and produce goods, such as barley in Saudi Arabia, at very high costs. But the eggs in the shell world market is rather saturated and so it is doubtful that these countries will continue to increase their share.

Rice

The main exporters here were essentially Asian countries. Their evolution was somewhat different. Thailand was the most successful, exporting in 1985 a larger share than twenty years before. China maintained its share, but Burma and Cambodia disappeared, showing once again that political stability is one of the main conditions for economic growth. Though they were not traditional producers, the United States and Italy exported large quantities, in spite of the "green revolution" in several less developed countries.

Sugar

This sector was much more concentrated in 1985 than in 1965 (0.849 against 0.789). Indeed, Cuba's share reached 53.1% in 1985 against 28.4% in 1965. Brazil and Mauritius also had a little share.

It is interesting to note that some developing countries focus on the production of only one agricultural good (Cuba, Mauritius). So, they can get a leading position on the market, but this is dangerous because prices are often very volatile and larger exports don't necessarily mean bigger returns. American and EC markets are highly protected, and the EC only sells on the world market quantities exceeding defined quotas, whatever the price is. There is also an agreement between the EC and the ACP countries for the sale of sugar at special conditions (Lome III).

Tea

Here the developing countries played the major role. This is of course due to the fact that tea is cultivated in environmental conditions that only exist in less developed regions of the world. However, the United Kingdom had a non negligible place because the country was a large importer (this is due to the particular links it has kept with its former colonies) and reexported a part of its purchases.

The concentration was high, the index being equal to 0.879 in 1965 and to 0.853 in 1985. The market was dominated by Asian countries (India, Sri Lanka) while only Kenya had a significant share among African ones.

Rubber

This sector has always been highly concentrated ($G = \pm 0.9$). South Asian countries were the major producers and exporters, and especially Malaysia (half of the total exports). Some African countries played a minor role. On this market, developing countries were of course the most important because they dispose of the climatic conditions that make rubber production possible. Asian countries are once again much more present than African ones.

Palm oil

The palm oil market was more and more concentrated from 1965 to 1985. This was essentially due to the very important effort made by Malaysia to increase its production. Genetic improvement of trees and favourable economic environment made it easier for the government to extend the plantation area and to promote the refining industry. This was a significant success for Malaysia. However, "the golden crop loses its luster" (7), because prices continuously decreased to a very low level in 1984 and 1985, as too much oil had been produced as compared with the demand. Prices were stabilized after this period but hardly covered the production costs. Consequently, government planting projects had to be reviewed.

5. Conclusions

Some important agricultural export markets for LDCs have been studied by the utilization of the Gini index to measure their concentration. Tea, rubber, sugar and especially palm oil are exported in larger quantities now than twenty years ago. To be produced, these goods need specific climatic conditions that exist in less developed countries only (except for sugarbeet). The world demand has increased but will it continue in that way? Developed countries, which were net importers of several products some years ago, are now net exporters. Sometimes, they produce so much that they are obliged to stock huge quantities. So, they try now to promote new utilizations of their traditional productions or to increase those for which their domestic demand largely exceeds their output (ex: rapeseed and sunflower-seed in the EC).

Some developing countries have also succeeded in exporting products by using advanced technology, but developed countries are still more performant and can afford, to some extent, to sell products at very low prices (export subsidies), which is not the

case for developing countries. The rich countries' markets are stagnant, so it would be difficult for developing countries to increase their exports in that direction. They would probably have more opportunities by exporting to other less developed countries which sometimes enjoy a rapid economic growth. This is especially the case for South Asian countries, while African ones did not find yet their political equilibrium in their majority, are often disorganized and have sometimes known important decreases in several productions.

Another solution consists in agreements with developed countries concerning exports of defined quantities at predetermined prices, though these agreements sometimes meet the opposition of developed countries farmers (ex: sugar imports in the EC). This is a worldwide problem. This paper enlightens only one aspect, by measuring the competition on selected markets with the help of the Gini index. It is of simple conception and permits to characterize markets synthetically. It is necessary to go in further details however when more information is needed. The Gini index is relatively easy to calculate and can be useful to get a global view of a market.

Literature

1. Beghuin H., 1979, Méthodes d'analyse géographique quantitatives. Paris. Librairie technique, 252 p.
2. Blaylock J., and Smallwood D., 1982, Engel Analysis with Lorenz and Concentration Curves. American Journal of Agricultural Economics 64 (1) 134-139.
3. Breuer J.F., and Lange B., 1977, L'indice de Gini. sa théorie, son utilisation. Annales de Gembloux 83 (3) 283-294.
4. Gini C., 1912, Variabilità e Mutabilità. Contributo allo Studio delle Distribuzioni e Relazioni Statistiche. Studi. Econo. Giuridici della R. Univ. di Cagliari.
5. Lange B., 1982, Contribution à l'étude de la localisation des activités agricoles en Belgique. Gembloux. Faculté des Sciences Agronomiques de l'Etat, 316 p.
6. Tarrant F.J., 1987, Malaysian Palm Oil. The Golden Crop Loses its Luster. Foreign Agriculture XXV (3) 13-14.

Ph. Lebaillly. Belge, ingénieur Agronome, Candidat en sciences économiques. Assistant à l'Unité d'Economie et Sociologie rurales de la Faculté des Sciences Agronomiques de l'Etat à Gembloux

Ph. Burny. Belge, ingénieur Agronome, Assistant d'Economie et Sociologie rurales de la Faculté des Sciences agronomiques de l'Etat à Gembloux