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LUTHER TWEETEN

Agricultural Structure in a Service Economy

INTRODUCTION

Highly developed market economies have been described variously as affluent, technocratic, and urban-industrial (see Ruttan 1969; Tweeten 1979, chs. 1, 2). Such economies may also be characterised by *service* economies because a large portion of jobs are in service industries, such as, trade, finance, insurance, and government (see Table 1). Approximately three out of five jobs in the United States were in service industries in 1982. If service jobs in transportation, communications and public utilities are included, then nearly two out of three jobs were in service industries. Perhaps more important, as many as nine out of ten *new* jobs were in service industries. Non-metropolitan counties (essentially those not having a city of 50,000 or more) did not differ sharply in structure from metropolitan communities; the major difference was relatively lower employment in service industries and higher employment in extractive (agriculture and mining) industries in non-metropolitan counties (Table 1).

As buying power expands, consumers seek self-fulfilment and self-realisation as opposed to simply meeting basic needs for food, shelter and clothing. Income elasticities tend to be high for entertainment, health care, education, eating out, finance and insurance. Thus, normal workings of the price system cause advanced market economies to become service economies. The thesis of this paper is that transformation of nations into post-industrial service economies has pervasive implications for agriculture and rural communities. A number of such implications are explored herein.

SERVICE INDUSTRIES

Service industries and servcie employment are too diverse to be easily classified. On the one hand are low-paying jobs in fast-food chains, jobs often filled by teenagers and secondary family breadwinners. On the other hand are jobs in scientific research, education, medicine, and finance that are well paid and tend to be capital intensive, especially human capital intensive.

TABLE 1 *Structure of employment in metropolitan and non-metropolitan counties in the United States*

Item	United States		Metro		Non-Metro	
	1973	1982	1973	1982	1973	1982
			(per cent)			
Wage and Salary						
Agriculture and mining	2.2	2.6	1.1	1.5	4.7	4.9
Construction	4.9	4.2	4.8	4.1	5.3	4.4
Manufacturing	24.3	19.9	24.2	19.7	24.5	20.1
Transportation, communication, and public utilities	5.4	5.4	5.8	5.7	4.4	4.8
Services: trade, finance, insurance, government	53.6	58.3	57.1	61.4	45.5	51.5
Self-employed and family workers						
Agriculture	2.6	1.9	0.7	0.7	6.9	4.8
Other	7.0	7.7	6.3	6.9	8.7	9.5
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0

Source: US Department of Agriculture, September 1984, p. 38.

Features of service industries include:

Service industries are dynamic. Firms and jobs change so rapidly and many industries are so new and competitive that organised labour has made few inroads.

Service industries are basic as well as non-basic. Traditionally, service industries have been viewed as secondary or tertiary industries existing only to serve basic industries such as agriculture. Modern service industries such as finance, scientific research and development, and government frequently are basic 'export' industries, however, in that they draw revenue from outside the area in which they are located.

Some service industries, frequently basic service industries noted above, are characterised by agglomerative economies. They can reduce costs or increase revenues per unit of output by bunching several firms together to realise economies in finance, communication and skilled labour markets. Thus, many of the more progressive and well paid service industries and workers are in metropolitan areas.

On the whole, service industries are more footloose and less tied to specific locations than are extensive industries such as agriculture, mining, forestry and fisheries.

Compared to other industries, service industries less often entail 'traded goods' competing with imports or for export markets.

Service industries are often characterised by high human resources investment per worker but not necessarily by high material capital resources per worker.

Finally, service industries have made slower gains in productivity than

have other industries, such as, agriculture and transportation, but many are benefiting from automation of operations through emerging micro-computer and telecommunications technology.

SOME IMPLICATIONS FOR AGRICULTURAL AND RURAL AREAS

The implications for agricultural and rural areas from operating in a service economy are far-reaching, as noted in the following:

1. By the very nature of the development process, advanced industrial nations lose their comparative advantage in labour intensive industries such as textiles to emerging industrial economies. Fairly capital intensive industries such as steel and autos also may lose their comparative advantage, especially if organised labour has won outsized wage settlements. The process of adjusting from an industrial to a service economy is traumatic to displaced workers and industries. Rural areas particularly feel the impact in textile and mining industries. Displaced workers and industries understandably resist change with the tools available. One such tool is the political system used to erect barriers against 'cheap' imports. Although agriculture may not be directly affected by quotas and other barriers imposed on imports, it indirectly feels the impact in paying higher prices for imports and realising lower prices for exports because developing countries buy fewer farm products when they are shut out of US markets.

2. Traditional traded goods industries in service economies survive high labour costs and intense foreign competition only by increasing productivity to offset high labour costs. Agriculture is a notable example of an industry which has survived by unrestrained adoption of the products of a service economy – science and technology produced by education and research. The demands are great, however, by large numbers of farmers to retreat from world competition behind a wall of high support prices protected by tariffs, import quotas or export subsidies. Farmers in many advanced industrial nations have won such protection. Success of American agriculture in following the high price support-protectionist route would have serious implications not only for American farmers but for farmers and consumers around the world. However, the world-wide impact would be quite different depending on whether the strategy is to (a) use subsidies to export surpluses generated by higher support prices or (b) abandon the world market to other exporters of farm products.

3. As noted earlier, the highest-paying service industries tend to locate in metropolitan areas to achieve agglomerative economies. High-technology communications partly offset the comparative disadvantage of rural locations for such industries, but high technology is unlikely to be decisive. Growing awareness of costs of pollution and congestion and internalisation of such externality costs brought considerable decentralization of firms and workers in the 1970s. The demographic transition or

rural turn-around in the 1970s was probably a transitory digression from the longer-term pattern of urbanisation – a trend again manifest in the 1980s with faster rates of population and employment growth in urban than in rural areas.

4. Rural areas have reduced underemployment by attracting manufacturing firms which would be unable to compete with foreign imports at urban wage rates. These manufacturing industries, while a boom to many farmers who survive only by off-farm employment, are part of an overall declining industry and do not constitute the long-term economic future of rural areas. Not that farmers have entirely missed the attractions of service economy employment – the largest single source of off-farm employment is government.

5. Farms have adapted in unique ways to economic forces characterising a service economy. Some of the most notable accommodations include off-farm employment, part-ownership and leasing of assets, incorporation, vertical co-ordination, and greater reliance on debt capital. A problem is that these arrangements frequently compromise the family farm. On family farming units the operator and family ideally provide more than half of the labour, management, and equity capital and derive most of their income from farming. The following data reveal some of the departure from the family farm ideal in US farming (see Tweeten 1984):

Over 90 per cent of all farm families have at least one source of off-farm income and two-thirds of all income of farmers come from off-farm employment.

Part-owner operators accounted for one of eight acres operated in 1900 but for over half of all acres operated in 1978. The gains were accompanied by a decline in the full-renter class of operator – full-tenant operators accounted for only one-tenth of land operated and of all farm operators in 1978.

Larger than family size farms accounted for 6 per cent of all farms but for nearly half of all farm output in 1978. Most of these farms were considered 'larger than family size' because they hired over 1.5 person years of labour rather than because they were non-family corporations. If farms with crop and livestock sales of $20,000 or less are not classified as family farms because most of their income is from non-farm sources, then family farms accounted for only 30 per cent of all farms and 45 per cent of all output in 1978.

The proportion of crop and livestock output produced under vertical co-ordination increased from 20 per cent in 1960 to 30 per cent in 1980. Most of the vertical co-ordination was production contracts (23 per cent of farm output in 1980) rather than vertical integration (7.4 per cent of farm output in 1980), the latter a much more ominous threat to the family farm structure than the former.

Farmers have resorted to more debt financing to control assets required to form an economic farming unit, defined as an operation large enough to realise economies of size and a labour-management

return comparable to that in the non-farm sector. Real debt per farm increased 350 per cent between 1960 and 1984! This rate well exceeded the real gain in assets, hence the debt-asset ratio went from 12 per cent in 1960 to 21 per cent in 1984. Although real volume of assets in the US farming industry has remained almost unchanged for two decades, real assets per farm have increased substantially.

6. Many of the above changes are inseparable from the pervasive substitution of capital for labour in agriculture. Because the price of capital was low relative to the price of labour, the proportion of all farm inputs accounted for by labour fell from just over 50 per cent in 1940 to 14 per cent in 1981. The proportion of inputs accounted for by labour was even less on large farms. Risk increases with these greater capital-labour ratios and farmers have made adaptations to cope.

7. These above adaptations by farmers to cope with economic instability and cash-flow problems while catching up in income with their city cousins irreversably changed the countryside. One notable change has been evolution towards a dual farm economy. The US *commercial sector* is comprised of a comparatively few large farms accounting for the majority of farm output. For example, 5 per cent of all farms account for half of US farm sales. The *non-commercial* sector, increasingly dominated by part-time small farms, accounts for a minor proportion of farm output but for most farm numbers.

Each of these sectors has accommodated to cash-flow and instability problems in its own unique way. The commercial sector thrives by exploiting market and production economies of size, by utilizing diverse sources of debt and equity capital and of earnings, and by sophisticated management and technical assistance. In short, large farms utilise the best products of a service economy to survive and even to prosper. In 1983, farms with sales of $500,000 or more on average earned an 18 per cent return on assets while smaller farms on the average lost money (Melichar November 1984). The small-farm sector thrives despite low returns on resources by extensive use of off-farm employment and income. Although the sector is not very efficient measured by earnings relative to opportunity cost, it provides families with a valued way of life and sizeable tax advantages.

Squeezed between these sectors and at risk is the mid-sized family farm which accounts for a declining share of farm output and numbers. It is often too large and demanding of time to allow the operator to find security in off-farm employment and too small to utilise sophisticated management, marketing, and financial arrangements common among large farms. The mid-size family farm, long the backbone of American agriculture, remains unsurpassed for operational efficiency – getting the crops in on time, overseeing farrowing, and executing cost control. But the value of operational management is increasingly being overshadowed by the value of organisational management apparent in sophisticated investment portfolio management, use of microcomputers or paid

consultants to help make marketing and management decisions, and access to diverse debt and equity capital on a corporate basis not subject to family farm life cycle problems. It is too strong to say that the once magnificent species known as the mid-sized family farm is obsolete and soon headed for extinction – generous parents will ensure that the heritage is passed to future generations. However, family farmers will be a continuing source of political agitation because in equilibrium the average mid-size family farm will not earn a return covering opportunity costs of resources. Even in normal economic times, family farms will engage in protest movements and political lobbying efforts to raise earnings. If large, medium and small farms receive the same higher commodity price, receipts will not cover all costs on medium-size and small farms after land prices are bid up. In short, society will have to determine whether to let the family farm fade away under a market-centred policy or preserve the family farm by income transfers targeted to mid-size and smaller farms.

8. If preserving family farms is deemed important, affluent service economies can afford to pursue such policies. The decision whether to follow such policies is ultimately political but the terms of debate can be informed by social and economic analysis. My results (Tweeten 1984, p. 49) indicate that mid-size family farms are much more efficient (measured by opportunity resource cost per dollar of farm output) than small farms but slightly less efficient on the average than larger farms. Mid-size farms practise better soil conservation than small farms but slightly poorer conservation than large farms. Farm operators do not differ significantly in quality of life among farm sizes – given the same income, education and age. Having many small farms as opposed to large farms creates more social activity in nearby communities. 'In strictly economic terms, however the gain to rural communities from a system of small farms is more than offset by higher food and other commodity costs to consumers due to lower economic efficiency on small farms' (Tweeten 1984, p. 50).

Some contend that unbridled operation of markets would lead to concentration of farm economic activity into so few hands that farm and food prices could be raised to arbitrarily high levels. That contention is groundless for the foreseeable future. Valid arguments might be assembled for the public to provide some protection against acute economic distress on farms (such as in the current financial crisis) to avoid a large and disorganised wave of family farm failure and out-migration with attendant real wealth losses, dislocation and personal trauma. But such arguments are more difficult to validate for avoiding longer-term farm adjustments to economic incentives – including adjustments towards more larger farms and fewer mid-size family farms. Perhaps the strongest argument for preserving the family farm is that it is a part of the national heritage.

9. Efforts to survive economically in a service economy have created a farm structure not well equipped for the pressures imposed on it by macroeconomic policies in the 1970s and 1980s. The major drama of American farm policy in the past decade has been the role of

macroeconomic policy in creating economic hardship for an economic sector increasingly ill-equipped to cope with that hardship.

Money supply was overly expansive and erratic in much of the 1970s. Resulting high inflation created cash-flow problems for farmers. Since 1981 money supply has been well managed – perhaps as much by luck as design. Since 1982 the problem has been large structural (full employment) deficits. Teamed with restrictive money supply, such deficits have brought high real interest and exchange rates. American farmers have been especially disadvantaged because they (a) have approximately double the capital per worker as other industries, and interest is a major cost of capital; (b) are net debtors, with only $23 of financial claims on others for each $100 of claims on them; and (c) depend much more heavily on export markets than do other sectors on the average. Agriculture, with about 3 per cent of the nation's national income, accounts for about 20 per cent of the nation's exports. Creditors gain from high real interest rates; consumers gain from a strong dollar. Consumer-oriented service sectors that dominate the US economy are less concerned than is agriculture about the high value of the dollar.

10. The incidence of farm financial stress was much higher on mid-size than on large or small farms in 1983. The proximate cause of the stress was high real interest and exchange rates stemming from large structural federal deficits, but the more basic cause was a breakdown of the political process. It is not possible to tightly link unfavourable macroeconomic policies to the service economy. But under normal circumstances an affluent service economy might be committed to goals of justice, democracy, and security. Perhaps these commitments underlie Congressional reforms which enhanced the power of subcommittees and staffs and diminished the power of Congressional leaders and political parties. Whatever the intended impact of the 'democratisation' of Congress, the result has been a decline of *encompassing* institutions which have interests coinciding with the public interest, and a rise in power of special interest groups which aggrandise themselves at the expense of society. As noted earlier, service industries are often 'non-traded goods' which are not exported and also do not have to compete with imports, and are not material capital intensive. They tend not to be hurt by current macroeconomic policies. The result is that industries such as agriculture are relatively isolated in their call for sound macroeconomic policies.

11. A service society characterised by generally high income and wealth is especially concerned about security. Food security is near the top of the list. Such a society is especially responsive to calls by farm groups to maintain the family farm and maintain reserves of idle acres or commodity stocks to guard against food shortfalls and high food prices. A service economy is almost certain to subsidise agriculture. One result is international trade problems because subsidies frequently lead to dumping of surpluses on foreign markets and to depressing international food prices. Thus a service economy world is likely to be a protectionist economy world. A case can be made that heavy subsidies to farmers and

protectionist trade policies in aggregate diminish world food security. When world food supplies are short and prices high, the developed service economies protecting their agriculture with high price supports and variable levies receive no signal for their producers to increase output and for their consumers to decrease consumption. Receipt of such signals could reduce world price fluctuations. The burden is great on multilateral trade negotiations attempting to maintain more open markets in an international service economy.

12. As governments have undertaken larger interventions in agricultural markets, a growing proportion of the economic problems confronting farmers in the US and elsewhere may be traced to those interventions. As governments in service economies seek security for people, government failure has been as pervasive as market failure was once thought to be. Clearly, a government role is essential in dealing with long-term farm problems of instability, family farm demise, environmental degradation, poverty and financial stress. But it appears that the advice to service economies is the same as the advice to developing countries: utilise markets to the extent possible to make decisions of what, when, and where to produce; ration scarce public decision-making and administrative resources by directing them to relatively few key areas where markets do not function well or at all.

SUMMARY AND CONCLUSIONS

The United States and several other nations can now be classified as service economies. Although other industries are frequently driven out by service industries in such societies, agriculture need not necessarily fare badly. It survives by using service industries, such as science, education and information to improve technology and overall efficiency, thus remaining competitive despite cheaper labour in other countries. It also survives by appealing to political instincts of a service economy to seek security through protecting agriculture from international competition. This drive for food security in world perspective is probably counterproductive.

American farms have adapted to a service economy in numerous ways. Through part-time farming, part-ownership of land, extensive use of debt capital, and substitution of capital for labour, many American farm operators have survived. Some have prospered. Income from all sources per farm has become more evenly distributed among farm sizes. Pursuit of the above strategies to save the family farm is giving rise to a dual farm economy with a relatively few large industrial farms producing most of the output and with a large contingent of part-time smaller operators accounting for most farms. Fewer and fewer mid-size units conforming to the family farm ideal remain.

NOTE

Comments on the paper by Daryll Ray and Dean Schreiner are much appreciated.

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DISCUSSION OPENING I – FERNANDO B. SOARES

I will try to follow Ulf Renborg's advice to place before the Conference the main issues to be discussed from the floor as well as making some personal remarks on the papers presented. I must confess however that my task is quite difficult given the limited time at my disposal. The main reason for this is because both papers undoubtedly contain an above average content of new provocative ideas.

My first comment on my friend Dr Boussard's paper is to support his statement that the absence of economies of scale, or to put it in another way, the quick vanishing of economies of scale for the generality of agricultural production, is at the core of the reason for heterogeneity of farm sizes. In this respect Denis Britton and others have already provided us with sufficient empirical evidence.

Now let me comment more closely on the dynamic model presented. For obvious reasons the model must be a simplified one. Thus this is not the criticism I have in mind. What I think could have enriched the analysis and may or may not have given additional support to the author's conclusions would have been to perform some simulations considering prices as exogenously determined. Of course the general equilibrium framework must, in my opinion, remain the reference scenario for sound economic analysis, but if, as it is well known, price fixing is a permanent temptation for policy-makers, my suggestion may not be completely inadequate.

Another type of simulation would have been on the value of the parameter in order to approach the question that markets for durable factors are not in general of the perfect competition type.

My last remark on this paper pertains to what I view as his fundamental implicit conclusion: traditional structural policy, understood as land consolidation, farm size enlargement, land retirement plans, etc., is self-defeating because one easily can find oneself back to square one; not to speak about its costs. Let me, if I may, be also a little provocative on

going along with Dr Boussard's conclusions: if we want to improve farmers' incomes, we had better address our attentions to credit and fiscal policies, including direct income compensation schemes, and leave half of the job to be done by markets.

This I think is a good bridge to start my few comments on Professor Tweeten's paper. One of his first statements is, and I quote: 'Farmers have adapted in unique ways to economic forces characterising a service economy. Some of the most notable accommodations include off-farm employment, part-ownership and leasing of assets, incorporation, vertical co-ordination, and greater reliance on debt capital.'

Although US agriculture is quite different from agriculture in Western Europe, they used to have a common feature: the overwhelming importance of the family farm despite the fact that they could not compare in size.

What I think could be some interesting questions to discuss from the floor in regard to Tweeten's paper are:

1. Is it foreseeable that the process of becoming service economies, that Western European countries are going through, will have the same disruptive effect on the importance of the family farm as happened in the US?
2. In what concerns EEC countries, the Treaty of Rome clearly states the objective of maintaining that importance (of the family farm). The question then is what is the least costly way of doing so if that political decision is to be maintained?
3. Why not put fewer eggs in the basket of structural policies and handle with more care macropolicy decisions which Tweeten so rightly emphasises in his paper and which unfortunately have not received attention in accordance with the effects they have on the agricultural sector?

DISCUSSION OPENING II – J. A. GROENEWALD

These two papers are, as anyone who has previously read publications of Dr Boussard and Dr Tweeten would expect, of a high quality. High quality does not necessarily imply full agreement. There are overlapping domains in these two papers, but they also differ considerably in nature, in main thrust and to a certain respect, in reasoning.

All the causes which according to Dr Boussard, cause heterogeneity, should in effect be accepted as such. But some ruled out, also induce heterogeneity. There is at least one respect, however, in which this particular discussion opener has to disagree with Dr Boussard. This is concerning his assertion of lack of economies of scale in agriculture, thus the lack of optimal size and hence its role in explaining heterogeneity. Whilst most empirical production functions do not show anything but constant returns to scale, this is largely because over the short and medium

term, management is a fixed resource, and any bundle of the other resources will therefore obey the Law of Variable Proportions.* This then implies that since it varies among farmers, each manager has his own particular optimum size, depending on his own management. Neither will he, if he is a profit maximiser, strive towards minimum cost per unit product. He will expand as long as his expected marginal returns exceed marginal costs, provided he can gain control over needed finance.

Dr Boussard is correct in stating that optimal farm structures exist. These, however, are extremely heterogenous, as each farm is probably unique with respect to natural resources endowment, economic location, access to loan capital and, especially, management as well as committed resources in, particularly, fixed plant. As stated by Dr Tweeten, farmers' ability to manage funds are also variant. If one adds to this differences in relative prices, then much heterogeneity is to be expected. In a dynamic world, uncertainty or risk prevails. There is as shown by Dr Boussard, uncertainty concerning prices. There are in addition other sources of risk. Risk aversion (at varying degrees) and differing desires to maintain liquidity, provide another source of heterogeneity. In such a framework, use of the turnpike theorem is still useful, but one may picture it differently, like a man trying to catch up with and board a moving vehicle. Economic conditions also change. Farmers do leave agriculture. But *n* farmers' assets are sold to fewer than *n* farmers, particularly with full-time operators. One cannot, with all these various factors, really expect convergence. We rather have continuous disequilibrium.

Dr Tweeten convincingly argues that the continued development of already highly developed market economies renders adjustment in agriculture necessary. His exposition of the whole process is both interesting and stimulating. Different farmers do have different perceptions of what would benefit them most, thereby causing adjustments to differ and increasing heterogeneity. Neither can different objectives for large commercial units, medium-sized family farms and part-time operators in the small farm sector be ruled out. There has obviously, at least lately, been a movement toward drastic change in the whole socio-economic nature of farming. One can be certain that the patterns already identified in the USA, will over time, also become evident in the other service economies.

However, if it is the desire of farm legislators to preserve medium-sized family farms, the question of appropriate policy measures becomes a very difficult one. Dr Boussard argues convincingly that structural policy is both ineffective and expensive. But, also, that price policy will be completely inappropriate. It will be of disproportionate benefit to the

*In one study a scale of managerial inputs, based on farmers' future image, record systems, office organisation, maintenance and labour organisation (Burger 1971) was included in Cobb-Douglas functions. After inclusion, increasing returns to scale was evident, unless other factors such as farm size were limiting. When the same functions were fitted but the management scale was omitted, results indicated constant returns to scale (Jansen et al. 1972).

very large farms relative to medium-sized farms. Then the large units will also increasingly be able to bid resources, particularly capital, away from the others. Benefits are often also capitalised in land and quota prices, thus increasing opportunity costs. Windfall gains to one generation become a cost to the next.

Therefore the protectionist tendencies, which according to Dr Tweeten, go hand in hand with development of service economies, is disturbing. Larger intervention does not succeed in solving these socio-economic structural problems. In fact they even do worse. They remove the necessary economic signals. They distort agricultural prices away from those which would be efficient and which would clear markets. Through import controls and export subsidies they also weaken the agricultural sector – and hence, also the industrial sectors – of developing countries. They retard development where it is most needed. We should heed the words of Dr T. W. Schultz (1982): 'No government which has abolished markets has been successful in modernizing agriculture'.

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GENERAL DISCUSSION – RAPPORTEUR: J. GORECKI

The two papers created a great deal of interest and there were many who commented on the contents, as well as raised some points including questions related to them and the discussion openers' remarks. Some participants asked also for clarification of the figures presented by M. Boussard and related to the reasons for decreasing and/or increasing the output.

One participant discussed and questioned the relationship between value and size from the point of view of economic theory. In his opinion we should give more attention to the division of labour and management which may influence growth of farm business through duplication of technical units. A participant from the United States asked – does reliance on gross value of products sold as an indicator of farm size distort interpretations of economies of size? Value added tends to be inversely related to sales volume. The same participant noted that increasing specialisation in grain farming is creating part-time farms with large sale volumes but unable to employ resources fully through the year. What does this do to our concepts of part-time farming? Regarding the paper of Professor Tweeten, one participant asked that if subsidies are given to agriculture in the USA and in the EEC, can he explain why the IMF

insists on removal of subsidies on fertilizer before Third World countries can qualify for IMF loans?

Another participant referring to the dangers of linking farm income via farm size to incomes in non-agricultural sectors, stressed that farm size is an important parameter in the planning process, especially as executed in LDCs.

M. Boussard in reply, thanked the discussion openers and the participants for their comments and questions.

On the question of subsidies in agriculture in the United States and the EEC countries he said that this mistake cannot be afforded by developing countries. In his opinion, in the process of farm planning too much attention was given to the size of the farm but too little to other factors influencing farming. He agreed that the volume of production was important but prices were also created by supply and demand.

Professor Tweeten also thanked the participants for their comments and questions. He stressed that the reasons for subsidies in the United States and the EEC were different. In his opinion many factors influenced the efficiency of farming, size was only one of them and many others should be taken into account. However net farm income was the most important measure of the effectiveness of farming.

Participants in the discussion included James Akinwumi, Philip M. Raup, Aidan Power, John Strak and Toman Von Roogen.