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What do Agricultural Income and Productivity Measurements Really Mean?

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Abstract

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Statistical data on labour productivity and income in agriculture reveal large discrepancies between various EC member states, both with respect to their absolute levels and in relation to non-farm productivity and income in the respective countries. Insofar as they appear to reflect the failure of markets in allocating agricultural resources efficiently, and seem to be inconsistent with conventional wisdom concerning structural adjustment of agriculture, however, it can be seen that those data are misleading to a large extent. Based on a simple model of optimal time allocation between farm and non-farm activities of members of farm households, it is demonstrated that farm labour productivity and income must be different according to differences in the relation of farm to non-farm labour supply. The implications concerning international, interregional, intersectoral and intertemporal comparisons of income and productivity are discussed as well as the relevance of market failure in agriculture.

1. Empirical evidence

For several years Eurostat, the Statistical Office of the European Communities (1987) as well as the Commission of the European Community (CEC, 1986) have periodically published statistical data on the level and changes of real 'income' in agriculture of the member states of the EC. Eurostat, based on national accounts, estimates average "real agricultural income per annual work unit", whereas 'income' is measured either by net value added at factor costs (the so-called Indicator 1), by "net income from agricultural activity of family labour input" (Indicator 2), or by "net income from agricultural activity of family labour input" (Indicator 3) – all figures being deflated with the implicit price index of gross domestic product at market prices. Labour input is calculated in annual work units (AWU) which are equivalent to the labour input of

0169-5150/88/$03.50

TABLE 1

Level and changes of farm income per annual work unit (AWU) in EC-member states

	Belgium	Denmark	Federal Republic of Germany	Greece	France	Ireland	Italy	Luxembourg	Nether-lands	United Kingdom	EC=10
Real net value added at factor cost per AWU[a], EC-10 (1981/85)=100[b]											
1971/77	193.5	137.4	114.3	47.1	113.6	58.2	79.6	94.0	200.7	154.8	100.4
1977/81	186.8	143.1	101.6	55.1	102.4	59.1	85.5	97.5	194.0	135.9	97.4
1981/85	216.8	180.9	98.1	63.6	103.1	57.1	84.0	114.1	222.6	140.0	100.0
Real net value added (farm income) per AWU[a], EC-9 (1980/84)=100[c]											
1975/79[d]	158.0	166.8	96.8	-	89.4	72.9	46.4	110.6	188.7	111.5	81.4
1980/84[d]	182.5	184.3	89.0	-	99.9	81.1	71.4	120.3	201.0	103.9	100.0
Real gross domestic product per inhabitant[e], EC-10=100[c]											
1975	106	113	110	55	109	66	86	121	110	99	100
1984	105	116	115	54	109	67	87	123	101	96	100

[a]Annual work unit (AWU).

[b]Deflated by implicit prices index of GDP (1980=100), converted by constant exchange rates of 1980 (ECU), and based on national account (Eurostat).

[c]Deflated by implicit price index of GDP (1975/76), converted by constant exchange rates of 1975/76 (ECU), based on farm accounts (INLB).

[d]Financial resp. economic years.

[e]At prices and purchasing parities of 1980.

Sources: Eurostat (1986a, 1987), CEC (1986).

a person employed full-time for agricultural work in farming.[1] The Commission estimates 'agricultural income' per AWU in terms of "net value added at factor costs" by farming, deflated as well by the implicit price index of GDP, based on a survey of about 40 000 farms known as the *Information Network of Book Keeping* (INLB) seen as being representative for 2.7 million farms of the Community.[2]

Income indices of Eurostat (Indicator 1) and of INLB are presented in Table 1, in which original indices of average real income per AWU in various Community member states are rebased on average income per AWU of *all* member states (=100) in 1981/85 (Eurostat) and 1980/84 (INLB). In addition, real GDP per inhabitant in member states related to average GDP of the EC as a whole is represented.

Farm income data presented in Table 1 reveal large differences between various member states of the EC, especially in relation to the level of economic development of those countries as reflected by GDP per person. Whereas the Federal Republic of Germany is, next to Denmark, Luxembourg, Belgium, France and The Netherlands, the most economically developed member state, labour productivity in agriculture is extremely low in relation to GDP and to the productivity in the other countries mentioned. Furthermore, real farm income in Germany was declining in the long run relative to farm income in most other member countries, in spite of the fact that farm policy has been harmonized within the Community to a large extent since the early 60s. In the United Kingdom, farm income has been declining as well; however, its level is still relatively high as compared to GDP.

The fact that labour productivity in agriculture differs between countries is, of course, well-known to economists and has been subject to thorough economic analyses.[3] Those international dicrepancies in productivity are mainly explained by differences in the state and variation of economic development, stressing the fact that economic growth affects factor price relations and thereby forces agriculture to increase productivity in order to remunerate resources used in farm production accordingly.[4] Therefore, labour productivity in agriculture is expected to be more or less in accordance with labour productivity

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[1]The interpretation of those data of labour productivity in agriculture as "sectoral income indices" by Eurostat and the Commission presumably is due to the fact that they are not calculated at constant prices but are deflated by the implicit deflator of GDP. For more technical details see Eurostat (1987) and CEC (1986).

[2]In 1984, about 5.3 million farms had been counted within the EC (Eurostat, 1986b). Farms represented by INLB are so-called "full-time farms" exceeding a certain size in terms of the productive capacity (different between various member states). However, the definition of those full-time farms by Eurostat is to a large extent misleading because part-time farms are included as well.

[3]A few agricultural economists who have analysed international productivity from different points of view: Clark (1957), Denison (1967) and Hayami and Ruttan (1985).

[4]See especially Schultz (1945, 1953) and Schmitt (1972).

TABLE 2

Labour productivity in agriculture as a percentage of total labour productivity in OECD-countries[a]

	1960-67	1968-73	1974-79	1980-82	1960-82
OECD-countries	30.5	33.1	38.2	35.7	33.1
All EC-member states	43.0	44.7	46.1	44.9	44.1
Belgium	78.9	86.9	79.4	76.7	80.0
Denmark	35.2	-	61.7	69.9	-
F.R. of Germany	40.3	40.0	40.0	40.0	40.1
Greece	40.7	40.9	47.0	53.5	43.2
France	44.4	48.5	50.5	48.2	46.8
Italy	41.5	39.7	44.7	45.9	42.1
Netherlands	90.4	93.5	85.4	73.5	86.3
United Kingdom	71.4	81.3	85.4	76.9	78.8
Spain	54.5	41.9	41.2	36.9	46.8
Portugal	51.3	52.5	60.6	-	-
United States	49.2	63.0	76.9	77.1	60.8
Australia	108.9	92.5	88.1	76.0	97.6
Canada	47.7	52.0	62.7	70.3	54.3
Sweden	48.4	52.5	64.5	57.1	53.4
Japan	39.8	37.7	42.1	36.0	39.5
New-Zealand	-	110.0[b]	88.3	76.0	-

[a]Agricultural GDP (at market prices) per civilian employed person in agriculture as percentage of GDP per civilian employed person in the whole economy.
[b]1973.
Source: OECD (1984, pp. 36, 58).

in the non-farm sector, reflecting the level of economic development. However, Table 1 reveals that there are large differences in agricultural productivity between countries of very similar levels of economic development and, as a consequence, in relation to overall labour productivity. This is also demonstrated by Table 2, in which an intersectoral comparison of labour productivity between main OECD countries is provided by measuring value added per person employed in agriculture as a percentage of value added per person employed in the whole economy of these countries.[5] Again, labour productivity in agriculture differs to an extremely large extent between various countries within and outside of the European Community. Whereas the intersectoral productivity gap (1960–1982) is more than 50% for all EC member states and Japan, it is only about 40% for Sweden, Canada and the United States, less than 20% in The United Kingdom, Belgium, and The Netherlands, and almost zero for Australia.

[5]Labour productivity measured by agricultural GDP at market prices per person employed in agriculture as estimated by OECD is, of course, less exact than labour productivity estimated by Eurostat, especially due to differences in labour input and output of forestry, fishing, and hunting being included in OECD estimates.

International discrepancies in intersectoral differences of labour productivity between agriculture and other sectors of the economy have been analysed by Colin Clark (1957, pp. 521–564), J.R. Bellerby (1956) and Marc Latil (1956) extensively in the 50s. However, as Clark had to admit that "it is clear ... that no immediate deduction can be drawn from the data" (p. 524), these authors did not find a convincing explanation of those differences.[6] Bellerby and Latil, especially, used mainly those arguments which have been put forward, in particular by Schultz (1945), in order to explain intersectoral productivity and income discrepancies of agriculture prevailing within many countries, although Clark already had warned by "noticing that the relative income of agriculture is by no means always so low as might be supposed" (p. 522). Therefore Schultz, by stressing the fact that "to equate the forces and counterforces affecting the supply and demand of farm products, what is constantly required is a redistribution of the labor force with relatively fewer workers engaged in agriculture as the economy develops" (p. 82), pointed out that "the migration of workers out of agriculture has been hindered considerably by social arrangements, customs, and laws..., and by Federal and state agency rulings and requirements which in many agricultural areas keep farm people from economic opportunities otherwise open to them" (p. 97). Finally, he added (p. 201) that "the movement of people from farms is at best difficult... Present social-security legislation also hinders the movement of people ... lack of knowledge, poor health, and insufficient funds to change residence are in themselves major obstacles to migration. They are greatest in farming areas where migration is needed most."

Whereas Schultz was obviously emphasizing both market failure and non-market failure as the main sources of intersectoral income and productivity disparities of agriculture[7], almost a whole generation of agricultural economists has been engaged in generating various hypotheses which, in detail and more theoretically founded, might explain failures of markets to adjust resource allocations in agriculture in accordance with economic equilibrium theory. In this context, imperfections of non-farm product and labour markets have been brought to the fore (Giersch, 1961). The theory of fixed assets in agriculture has been suggested by Johnson (1958), and Cochrane (1958) has put forward his theory of the "agricultural treadmill" as another explanation

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[6]For a more extensive discussion see Schmitt (1988a). Clark (1957, p. 524), however, pointed out that "in any case that there is a most important qualification ... if agriculture is being considered. In agriculture marginal returns are almost certain to be below average returns", whereas "in manufacture and transport it may be even the case that marginal returns are above average returns." Such differences may not explain international differences in intersectoral productivity discrepancies, however; see Fig. 2 in this article.

[7]'Market failure' conventionally defined as deviations from resource allocation by perfect markets (Pareto optimum), are very difficult to operationalize. Therefore an operational definition and quantification of market failure seems to be almost impossible ('Nirvana-approach').

of relative low returns in agriculture. Furthermore, somewhat as a variation of Cochrane's treadmill, more recently Bartling (1984) has suggested that due to barriers to exit out of agriculture, competition between farmers will be of a ruinous nature, similar to competition resulting from a natural monopoly[8]. However, essentially, all such hypotheses are more or less in accordance with the theory of relatively low opportunity costs of farm labour due to insufficient qualification for non-farm occupations, rather high (interregional) transaction costs, high age of farm population, risk involved in mobility or non-farm occupations (unemployment), institutional barriers to entry to non-agricultural markets, and non-economic factors such as strong preferences for farming, etc.

However, convincing as such a theory of low opportunity costs of farm labour might be, three questions are hard to answer by this theory. First: Are factors affecting low opportunity costs only relevant as far as the farm population is concerned? Second: If low opportunity costs of farm labour really matter, why are such extreme differences in agricultural productivity and income relative to non-farm productivity and income to be observed between various countries and regions as Tables 1 and 2 reveal? Third: Why, in periods of strong economic growth and overemployment as in the 60s and in many countries, are intersectoral income and productivity gaps still prevailing to such an extent? It seems unavoidable to look for another explanation of such international and intersectoral divergencies of productivity and income in agriculture.

2. Another theoretical view of resource allocation in agriculture

Farm households versus farm firms

Let me start by quoting Eurostat (1987, p. 50), which in explaining different "levels of agricultural income in the Community Member States" says that "in analysing the disparity in agricultural incomes between the Member States, non-agricultural income should be taken into account, given that it is an important element in total income of agricultural households." Eurostat adds that "the 1983 agricultural structures survey shows that the proportion of holders with some other gainful activity differs markedly from one member state to another... In the FR of Germany and Greece, something like 40% of farmers have some other gainful activity, compared with only 19% in The Netherlands and Luxembourg... Gross value added at market prices in agriculture per AWU is normally much higher in farms with no other gainful activity... In other words, the efficiency of labour input in gainful agricultural activity is much higher on farms with no gainful activities".

Of course, it is well known that small farms all over the world supplement

[8]For a more extensive discussion of such 'theories' see Hathaway (1963, pp. 83ff).

their low farm income by income from such non-farm activities. There is nothing new in such a statement, and it is also well known that (labour) productivity of full-time farms is in most cases above productivity of part-time farms because this is a precondition for part-time farming. Perhaps Eurostat presumably might have a more systematic coherence in mind, perhaps in a sense that high non-farm productivity of farm labour might necessarily be connected with small farm productivity as an outcome of rational decisions of 'farmers'?[9]

In order to elaborate such a hypothesis in terms of neoclassical economic theory, it seems necessary to refer to the farm household as the central decision-making unit with respect to optimal allocation of resources available to the farm household instead of the farm firm (holding). The traditional view of agricultural economists and statisticians has focused on the farm as the decision-making institution[10] in accordance with (micro-)economic theory being applied to the (non-farm) firm as the relevant institutional setting[11]. By defining the farm household as the relevant decision-making unit in agriculture, we are resuming, of course, ideas which have first been put forward by the Russian agricultural economist Alexander Chayanov in 1923. His ideas, for a long time almost completely neglected by agricultural economists[12], have been rediscovered and theoretically reformulated by Chihiro Nakajima (1986). His pioneering analyses have been stimulated, of course, by Gary S. Becker's (1965) seminal New Household Economics.[13]

The question to be answered first refers to the problem of optimal allocation of resources being available to farm households. In an economy characterized by division of labour between various economic activities, a farm household has three different choices with respect to an efficient allocation of such resources. First, resources may be devoted to farming solely in order to maximize utility (profit) of the farm family (household). Such a decision is called Option

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[9]However, the last sentence of Eurostat quoted above, according to which "the efficiency ... in gainful agricultural activity is much higher on farms with no other gainful activity", might be interpreted in terms of an inferior rationality of factor use in farming by part-time farmers.

[10]Most official agricultural statistics are based on the farm as a firm concept, excluding off-farm activities of farm households, a concept which is consistent with statistical methods used in non-farm sectors, but which is inconsistent with agriculture, as will be shown.

[11]This traditional view by agricultural economists of the farm as a firm maximizing its profits by a corresponding allocation of resources in farming is founded by the German economist Albrecht Thaer (1810) who postulated (p. 3) that the "most perfect agriculture" is an agriculture "not aiming toward the maximum of production but toward maximizing its profit." See Taylor and Taylor (1952).

[12]Chayanov's theory of the family farm has been discussed by agricultural economists in the 20s, especially in German-speaking countries and Japan due to German and Japanese translations of his book. Even the English edition of his (revised) book in 1966 has not resulted in an extensive discussion by agricultural economists. See Schmitt (1988b).

[13]For a more detailed presentation and discussion of the present state of the theory of (farm) household economics see Gebauer (1988).

1. Second, resources might be transferred totally to non-farm activities by terminating farming simultaneously (Option 2), which is reflected in the decreasing number of farms over time. Third, the farm family's resources might be devoted both to farming and to non-farm activities (Option 3). The degree of intra-household division of resource use to farm and non-farm activities might differ between various farm households, and alter in the course of time. This is statistically reflected in the number of part-time farms, their share in the total number of farms, and relative changes over time as well as their specific characteristics as farm households according to the relative importance of non-farm activities.[14]

In Fig. 1, factors determining those different options are demonstrated with respect to allocation of time (for labour and leisure) available to farm households. In Fig. 1A, optimal allocation of labour time TA is analysed basically. Given the agricultural income possibility curve of a farm household Y^L representing realizable farm income by allocating labour input in farming only, the farm household achieves an income level of Y_1^L, where the income possibility curve approaches indifference curve I_2. Corresponding labour input (time) of the household spent for farming is TA_1^L whereas $T - TA_1^L$ represents leisure time.

However, allocation of time would be different if non-farm use of labour is taken into account. Given the budget-curve Y^{NL} representing the income possibility of non-farm labour input and determined by the wage-rate in the non-farm sector (representing opportunity costs of farm labour as well as of leisure), the allocation of labour time of all family members in those non-farm activities would result in labour time for those activities TA_2^{NL} and income Y_2^{NL}. But only lower utility (I_1) could be achieved as compared to the use of labour in farming only (the situation mentioned before). In other words, Option 2 is less efficient than Option 1. However, a combination of farm and non-farm activities (Option 3) would result in still higher utility (I_3) and higher income (Y_3^{NL+L}) as compared to Option 1, and even less total labour time spent (TA_3^{NL+L}) as compared to Option 2 (TA_2^{NL}). The optimal allocation of time by part-time farming is achieved if TA_3^L is spent for farming and $TA_3^{NL+L} - TA_3^L$ ($= TA_3^{NL}$) is spent for non-farm activities. In other words, farming will be expanded until farm marginal labour productivity is equal to marginal labour productivity of non-farm activity which is equal to the wage-rate (see also Fig. 2).

We therefore come to the conclusion that part-time farming is more efficient than full-time farming, as is quitting farming in favour of a non-farm job for all members of the farm household, provided that marginal productivity of farming at a certain point of the agricultural production function falls short of

[14]For a proposal concerning statistical classification of farms according to socio-economic characteristics see Gebauer (1987).

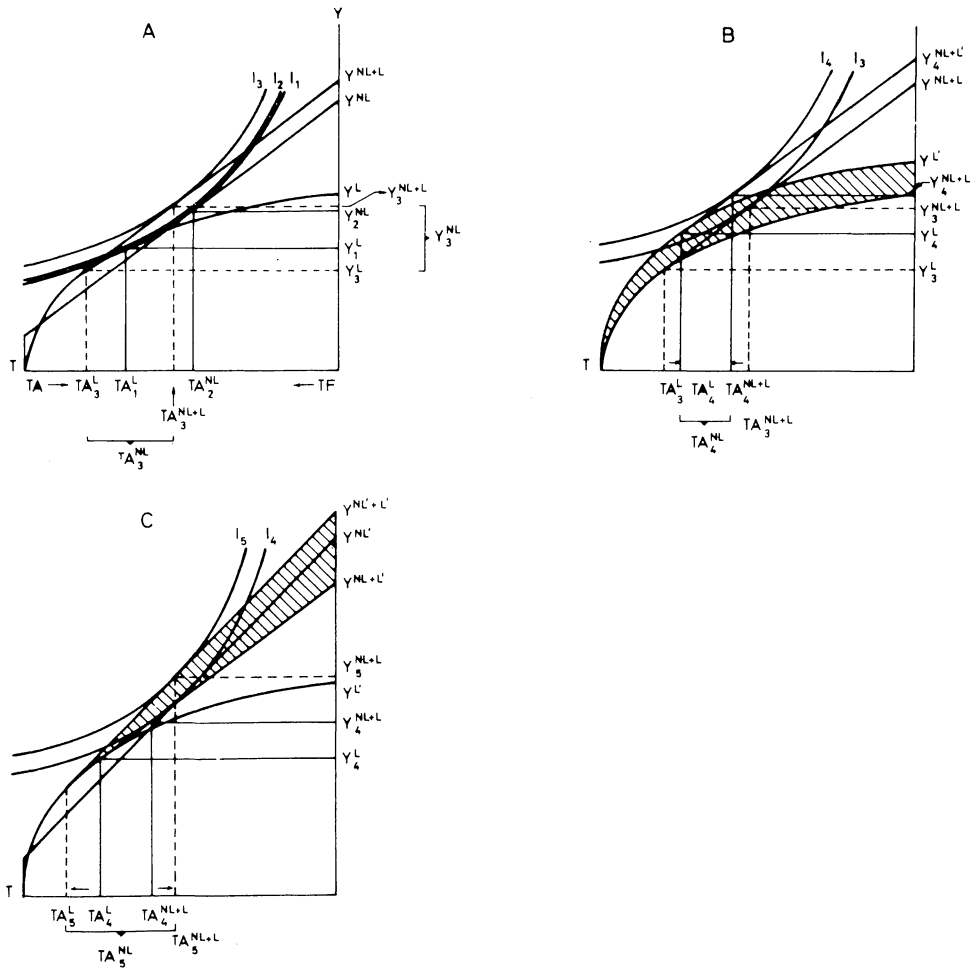

Fig. 1. (A) Optimal allocation of time in farm households: farm income and non-farm wage rate as given. (B) Changes in allocation of time by increasing farm income due to rises of farm prices and/or farm productivity. (C) Changes in allocation of time by increasing farm income and increasing non-farm wage rate. Symbols: Y income possibility curve of: Y^{NL} non-farm income, Y^{L} farm income, Y^{NL+L} total non-farm and farm income; I indifference curve; T total time available for labour and leisure; TA labour time, TF leisure time; TA^{NL} labour time for non-farm activities, TA^{L} labour time for farm activities, TA^{NL+L} labour time for non-farm and farm activities.

marginal productivity in non-farming (the industrial wage-rate exceeds marginal productivity in farming). It further follows that variations in (marginal) productivity in farming and/or non-farm activities (wage-rate) change the optimal division of time between farm and non-farm activities (and, most often,

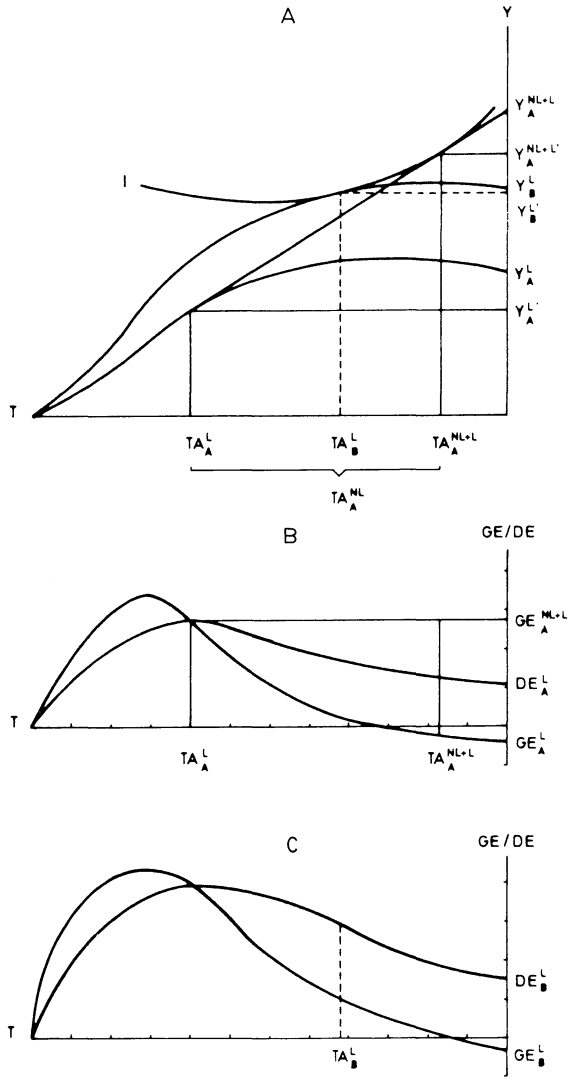

Fig. 2. (A) Optimal allocation of time in part-time farm A and full-time farm B (without complementary off-farm activities). (B) Marginal and average productivity of labour in part-time farm A. (C) Marginal and average productivity of labour in full-time farm B. Symbols (see also Fig. 1): GE^{L} marginal product of farming, DE^{L} average product of farming, GE^{NL} marginal product of off-farm activity, DE^{NL} average product of off-farm activity.

leisure time). In other words, the superiority in efficiency of full-time farming versus part-time farming or non-farm activities of household members depends on the relative size of marginal productivity of farm to non-farm labour

input.[15,16] This is elaborated in Figs. 1B and 1C. In Fig. 1B the implication of rising productivity in farming due to technological innovations and/or higher producer prices is shown. The agricultural income possibility curve increases to $Y^{L'}$, farm labour input rises to TA_4^L, whereas non-farm labour input declines to TA_4^{NL} as does total labour time (from TA_3^{NL+L} to TA_4^{NL+L}). Total income rises to Y_4^{NL+L}, providing higher utility at I_4 instead of I_3. The reverse will happen, of course, if value productivity in agriculture declines, due perhaps to lower farm prices. Allocation of time in farm activities will decline, and labour input in non-farm activities will rise.[17]

In Fig. 1C, rising productivity in farming is accompanied by rising wage rates, represented in the change of the non-agricultural budget-line to $Y^{NL'}$. In such a case, labour input in agriculture is reduced from TA_4^L to TA_5^L, whereas labour time spent for non-farming is expanded from TA_4^{NL} to TA_5^{NL}, and total labour input would rise from TA_4^{NL+L} to TA_5^{NL+L}. Leisure would be reduced accordingly. Total utility will, of course, increase to I_5 as will happen with respect to total income (Y_5^{NL+L}).

The conclusions of these theoretical deductions are: (1) Given a certain farm size structure, reflected by the agricultural income possibility curve Y^L, and a given wage rate (Y^{NL}), Option 3 (part-time farming) is the more dominant the higher the wage rate and/or the smaller the production capacity (farm size) as measured in monetary terms. (2) Rising wage rates relative to the increase in (marginal) productivity in agriculture will make part-time farming (Option 3) the superior allocation of farm labour, being reflected in a rising share of part-time farming in agriculture. If the reverse happens (rising farm productivity relative to wage rates), Option 1 (full-time farming) will be the most efficient allocation for full-time farms already in existence. Part-time farms will reallocate off-farm use of labour to farming. Part-time farming will therefore decline relatively. This reasoning leads to the further conclusion (3) that, given a rather 'favourable' farm structure in terms of productivity in agriculture relative to the industrial wage rate, structural changes will be in fa-

[15]The agricultural income possibility curves in Figs. 1 and 2 are assumed to be determined by a non-linear production function, the conventional assumption of factor use in agriculture. Whether this assumption is a realistic one is, of course, a question of empirical evidence which cannot be decided here.

[16]Figure 1 demonstrates very clearly that Option 2 is only relevant if wage-rate exceeds marginal labour productivity in agriculture. Therefore, the question arises why non-farm entrepreneurs do not start farming to a large extent. Although statistics available do not reveal the extent of mobility of non-farm labour into agriculture by starting new farming, in many countries, such as Germany, the inflow into agriculture by non-farmers is legally restricted. In other countries, such as the United Kingdom and the United States, it is known that, very often, farms are bought by non-farmers to be managed as part-time farms, very often a method to save taxes in addition.

[17]Of course, reallocation of labour due to declining (real) farm prices will take time. Such time-lags in intersectoral adjustment of resource use may explain diverging supply elasticities vis-à-vis rising versus declining farm prices.

vour of full-time farms (farm structure will be stabilized), whereas under the opposite structural and economic conditions, part-time farming will grow and structural adjustment will be accelerated due to a relative decline of full-time farming.

Our conclusions based on the theory of optimal allocation of time by farm households lead to an explanation of the direction and speed of adjustment of agriculture, as defined by different farm sizes and socio-economic types of farms as full- and part-time farms. This is analysed in more detail elsewhere with respect to agriculture in EC member states (Schmitt and Gebauer, 1987). It is shown that overall economic and agricultural conditions, especially with respect to the existing farm size structure prevailing in Germany, have resulted in the dominance of part-time farming, whereas in The Netherlands those conditions are quite the opposite, and agriculture has been adjusted by a relative growth of full-time farms. Other countries, such as England, France, Belgium and Denmark have shown an 'intermediate' strategy of structural adjustment somewhere between those extremes. England and France, however, tended more to the strategy to be observed in Germany, whereas the other countries mentioned are more in line with the structural adjustment observed in The Netherlands.[18] There is, however, still another country – Japan – where structural adjustment of agriculture has resulted in an almost total dominance of part-time farms. In 1909, only 29.9% of farms have been part-time farms. In 1985, the share of part-time farms has risen to 85.5% (Andermann and Schmitt, 1988).

3. Implications on income and productivity in agriculture

The theory of optimal allocation of time by farm households applied to explain the prevailing level and changes of structural adjustment in agriculture is nothing more than a reformulated theory of opportunity costs of labour input for farming, being extended to farm households instead of farms only. The farm household is, therefore, seen as the relevant decision unit instead of the farm, as traditional agricultural economics presumes.

We will now extend our analysis to the implications of theoretical findings discussed above, with respect to conventional measurements of farm income and productivity of resources used in agriculture presented at the beginning. We will summarize and discuss those implications as follows.

(1) First, and in more general terms, it seems to be quite clear that statistical data concerning income of farms, income distribution within agriculture (between farms of different classes of size or socio-economic types of farms), between agriculture and non-agricultural sectors, and between farms of different

[18]Unfortunately, official statistics, representing socio-economic structure of agriculture by registering off-farm activities of all members of the farm households, are very poor and incomplete. As far as statistical information in the EC is concerned, see Schmitt and Gebauer (1987).

regions or countries as well as over time are misleading if that statistical information is restricted to income generated by resource use in farming only, and, therefore, neglects resource use of the farm family (household) outside farming. Income figures presented by Eurostat and INLB, as well as similar statistical sources of member states and other countries, based on individual farm or national accounts (OECD) are relying on resource allocation restricted to the farm holding. They are therefore subject to a more or less heavy bias depending on the share of farm household labour used outside agriculture. Therefore, the effective income situation of agriculture can be measured correctly only by taking into account total household income[19] if those income figures are used for intertemporal, intersectoral, interregional, or international comparisons. Corresponding reflections are, of course, relevant for agricultural productivity measurements.

(2) We next specify those propositions concerning the measurement of agricultural income and productivity by referring to Fig. 2. There, two different farms are considered, farm B as a full-time farm in the strict sense (all members of the farm households are engaged in farming), whereas farm A represents a part-time farm. The income capacity of A (Y_A^L) is smaller than that of B (Y_L^B) due to less productive land resources (or smaller farm size and/or lower productivity of land) available to farm A. In order to achieve the same utility (indifference curve I) members of household A combine agricultural with non-agricultural employment Y_A^{NL+L}, which is optimal if time T available is allocated to farming at TA_A^L and to non-farm activities at TA_A^{NL}, so that total labour time is TA_A^{NL+L}. In farm B, total labour input (in farming) is TA_B^L, which is greater in agricultural labour input, but less in total labour input, than farm A[20]. Accordingly, total income achieved in farm A ($Y_A^{NL+L''}$) is higher than income of farm B ($Y_B^{L''}$). The lower parts of Fig. 2 show marginal and average productivity of labour in both farms.

It is seen that (a) in farm A marginal and average product of labour input in farming (at TA_A^L) equals marginal product of non-farm use of labour (wage rate) as has been already shown with respect to Fig. 1. In farm B, however, marginal labour productivity is less than average productivity (at than TA_B^L). By relating total (farm and non-farm) labour input of household A to total farm output, as is done by OECD statistics mentioned above, marginal farm product and average farm product (at TA_A^{NL+L}) are less than for farm B.

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[19]For a more detailed discussion see Gebauer and Schmitt (1987).

[20]It is assumed that B's household members are not engaged in off-farm occupational activities, as it would be the case at the same wage rate being relevant for A. This assumption of lower opportunity costs for labour in B may be based on higher transaction costs, institutional restrictions of flexibility of labour due to minimum time requirements, non-availability of off-farm jobs, or insufficient qualification of B's labour for off-farm employment as compared to A. For a more detailed discussion see Cogan (1981), Singh et al. (1986) and Gebauer (1988).

Furthermore (b), it is seen that average productivity of labour in household A allocated only to farming (at TA_A^L) is less than in full-time farm B. Therefore, by referring farm output only to labour input used for farming, as is done by Eurostat and INLB statistics mentioned before, average labour productivity in part-time farm must be below average productivity in full-time farms, due to rational decisions by members of farm households. "Efficiency of labour input in gainful agricultural activity" as Eurostat (p. 50) states, "is much higher on farms with no other gainful activity"; of course, this is due to rationality of choices in resource allocation and not to irrational decisions.

It follows (c) that interregional and even more, international comparisons of (average) labour productivity (income) in agriculture, by neglecting the impact (different importance) of off-farm employment of farm household members in official statistics of agriculture, are misleading. This is also true as far as intersectoral comparisons of labour productivity between agriculture and other sectors of an economy are concerned, provided that part-time farming plays a definite role in agriculture.

Finally, even intertemporal comparisons of productivity (income) of agriculture are misleading, given that the share of off-farm employment of farm population changes over time due to changing economic conditions for agriculture, such as the industrial wage rate, producer prices, and technological innovations (productivity) in farming.

(3) Our theoretical consideration of pure comparative- statistic nature are based so far on conventional assumptions such as full information, and especially on unrestricted (intersectoral) flexibility of labour. However, as Schultz (1945, p. 97) has already observed, restrictions on mobility of labour are widespread in various economies. Barriers of entry to the labour market due to institutional provisions concerning minimum (or maximum) daily, weekly or yearly labour time, age, sex, race, and qualification of employment outside agriculture are not specifically relevant for farm population in search of off-farm employment. Some of those restrictions of intersectoral mobility of farm labour might to a large extent be overcome by intra-familial division of labour time, so that some members of the household are engaged fully in off-farm activities whereas others are fully occupied in farming.

However, quite often this intrafamilial division of labour is restricted as well, especially if the labour capacity of the family is reduced due to the size and composition of the family changing over time according to the life-cycle of the farm family, as described so extensively by Chayanov (1923). For instance, elder farmers and their spouses are prevented from finding off-farm employment although marginal productivity in farming is low in relation to industrial wage rates. In other cases, optimal labour time available for such off-farm employment according to a (rather high) marginal productivity in agriculture (see farm B in Fig. 2) falls short with respect to minimum labour-time provi-

sions outside agriculture. In still other cases, family members engaged in non-farm activities subject to provisions fixing maximum labour time prefer to work longer. Such preferences are very often satisfied by additional work done on farms.[21] In all such cases, it is quite obvious that opportunity costs of labour (leisure) used in farming are rather low compared to industrial wage rates. Given those low opportunity costs, marginal productivity of marginal labour use in farming might and can be rather low before those family members will cease farming. However, labour is still used efficiently in farming although (marginal) productivity might be rather low.

Such a statement stresses the fact in addition to what has already explained above, that marginal as well as average labour productivity and corresponding income of farming might be even lower than under the assumption of full flexibility of labour (Fig. 2). In addition, this reasoning may also demonstrate that part-time farming seems to be a rather persistent type of land-use due, not to some ideological commitments (preferences) of farmers to agriculture, as many agricultural economists and sociologists presume, but simply to rational decision making.

(4) Until now, we have used the terms 'productivity' and 'income' exchangeably. This is done also by Eurostat and INLB in interpreting net value added of agriculture (per AWU) as 'farm income'. However, those figures do represent a measurement of (average) productivity of labour used in agriculture according to conventional definitions of productivity.[22] It is clear that labour productivity in agriculture, including even productivity of non-farm labour input of the farm family, is quite different from total income received by the farm family simply because additional income (besides income due to the productive use of resources) is achieved, such as transfer payments within the prevailing system of social security, etc. The question arises, therefore, whether and to what degree such income, in addition to value added as the measurement of output used in estimation of productivity may affect productivity of resource use in agriculture.[23] If we assume, for simplicity, that agriculture receives transfer payments linked to the volume of output (for instance as compensation for positive external technological effects of farming) then of course (net) value added at factor costs (or at market prices) is smaller than what is reflected by the income possibility curve of Figs. 1 and 2. In terms of Fig. 1B, value added is represented by Y^L, and the true income possibility curve including transfer payments by $Y^{L''}$. Labour input in agriculture (TA_4^L) will, of course, be higher than without such payments (TA_3^L), and off-farm labour use-smaller (TA_4^{NL+L} instead of TA_3^{NL}). As a consequence of such an income-sup-

[21] See Footnote 20 and references cited.

[22] See, among others, National Research Council (1979).

[23] See also Schmitt and Tangermann (1982).

porting farm policy, average and marginal productivity (value added) of labour in agriculture would be smaller as compared to opportunity costs of labour (wage rate), although average and marginal income of labour would be higher. This effect of non-market failure on (suboptimal) resource allocation demonstrates, therefore, that international and intersectoral comparisons of productivity of agricultural resource use might be misleading, if such divergences in productivity are interpreted as corresponding to differences in farm income. They are also misleading if productivity in agriculture is measured by conventional methods in order to demonstrate international and intersectoral discrepancies in efficiency of resource use in agriculture as long as the effects of income-supporting measures on resource allocation are neglected.

(5) In order to measure such intersectoral income disparities between agriculture and "comparable non-agricultural professions" (according, for instance, to the German Agricultural Law of 1955) some statistical sources, such as the *Agricultural Report* of the German government estimate gross total income per farm household (Bundesregierung, 1987, pp. 27ff) including off-farm income. However, off-farm income is restricted to the farmer and his wife. Off-farm income of other members of the farm household is excluded, despite the fact that net value added of farms very often is the result of labour input of those persons as well.[24] The (unofficial) justification of such a restriction is that such off-farm income of other family members does not contribute to the growth of the farm by cofinancing of investments. It is obvious that this argument confounds generation and utilization of income. As far as measurement of the "social situation of people engaged in agriculture" as required by the German Agricultural Law is concerned, only total income of the farm household is to be seen as relevant without respect to utilization of such income in- or outside the farm. Again, agricultural income statistics restricted only to income generated or related to farm activities of household members, based on farm or national accounts, are misleading if used for purposes of an international comparison of agricultural income as well as productivity.

Conclusions

It has been demonstrated that international, interregional, and intersectoral as well as even intertemporal comparisons of agricultural productivity and income based on conventional measurements being used by statisticians and economists are misleading. The main reason for such an assessment has to be seen in the fact that agriculture differs between various countries, regions,

[24]Whereas agricultural value added of full-time farms in Germany (1984/85) reported by the *Agrarbericht* (Bundesregierung, 1986) was DM 31,400, "total farm family income" as measured by that *Agrarbericht* was DM 34,500; total income of all family members reported by the German Central Statistical Office was DM 65,500 (Schüler, 1984).

points of time, and vis-à-vis other sectors of an economy with respect to the extent of off-farm allocation of resources (labour) owned by the farm family. Off-farm use of resources is mainly determined by prevailing economic conditions (industrial wage rate and agricultural terms of trade), and farm structure. Economic conditions do, of course, change over time and are different between countries. Therefore, the degree of structural adjustment of agriculture, its speed, and especially its socio-economic configuration are different as well. By 'socio-economic configuration' of the structure of agriculture, in this context part-time farming versus full-time farming is meant, referring to the allocation of all labour available to the farm household in farming (full-time farm) or to a certain extent outside the farm (part-time farm).

What can and should be done in order to eliminate the impact of differing socio-economic configurations of farm structure on productivity and income to be measured statistically and used for international and intersectoral comparisons? As far as 'farm income' is concerned, it is quite obvious that total (net) income achieved by all resources available to the farm household has to be registered. Of course, various groups of farm households could be differentiated according to various farm groups of different farm sizes, regional localization, and socio-economic configuration such as part-time and full-time 'farms', in order to demonstrate income distribution between agriculture and other sectors as well as within the farm sector, and factors affecting prevailing income distribution. If, however, intertemporal, inter- and intrasectoral, international or interregional differences in efficiency of factor use in 'agriculture' has to be estimated, two different approaches which are not exclusive, could be used. First, measurements of total or partial productivity in agriculture in a strict sense might be restricted to those (full-time) farms using total labour input of all household members for activities in farming only. If, however, those productivity measurements are done by referring only to labour input in farming without any regard to whether and to what extent labour of family members is used for off-farm activities as well, comparisons of productivity between farms are subject to misinterpretation in terms of inefficiencies as long as the extent of off-farm employment of household members is not registered numerically. Therefore, second, it seems to be appropriate to register this output (value added) generated by all resources (labour) owned by farm households and to relate this output to such resources (labour). This approach is appropriate especially as far as intersectoral comparisons of productivity are concerned, although it is quite clear that there are difficult problems of estimation of off-farm output involved.

Finally, some important implications of the assessment concerning resource allocation in agriculture should be mentioned. First, the hypothesis of market failure in agriculture based on imperfections of labour markets vis-à-vis farm population, and used as a justification of government interventions, seems to be challenged and should be reconsidered by taking into account the fact that

reallocation of resources in agriculture to a large extent is done by intrafamilial division of labour between farm and non-agricultural activities. In this context, various farm-policy measures directed towards steering and mitigating social hardships of adjustment of agriculture should be reconsidered as well. In more general terms, the role of agriculture in a market-oriented economy has perhaps once more to be discussed and classified. Given the superiority of family farms, their great stability as well as flexibility vis-à-vis changes in economic conditions — which have been already admired by Chayanov despite the predictions of doom by Karl Marx — may be explained by these types of adjustment being only open to farm families.[25] Second, more specific implications of socio-economic configurations of structural adjustment should be analysed. For instance, agricultural economists very often assume that supply of agricultural products is more elastic vis-à-vis rising than declining farm prices. It might be that time-lags in necessary resource adjustment due to declining versus rising farm prices explains such differences in supply elasticities being in line with the theoretical model presented above.

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[25]See among others Newby (1987).

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