THE DEMAND FOR NUTRITION: AN ECONOMIST'S PERSPECTIVE

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I. Introduction

This paper is an attempt to give an economic interpretation of the qualitative aspect of households' food consumption: nutrition. Optimal nutritional requirements to achieve good health are believed to be scientifically established. Nevertheless, behavior is often inconsistent with these requirements even when they are economically feasible and can be achieved at minimal costs (Stigler, 1945). The purpose of this discussion is to explain this inconsistency, or discrepancy, by some systematic behavior that relates the household's choice of diet to its socioeconomic characteristics. It should be noted that considering the diet as a choice variable is more relevant, but not only relevant, to households whose economic conditions permit them to produce nutritionally equivalent diets by different combinations of foods, and for whom food consumption is not just a means for survival.

Identifying and measuring the effects of some key household variables on the consumption of nutrients, rather than on the consumption of foods, can sharpen our view about related policy instruments. This is significant primarily because nutritionally better diets do not necessarily correlate with higher incomes and more expenditures on food (Berg, 1973).

This paper is primarily an empirical discussion. The intent is to measure the effects of household income, family size, and the homemaker's

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* I benefitted from comments by M. Grossman and C. Coate. However, neither they, nor the World Bank, of which I am a staff member, are responsible for the views expressed in this paper.

education on the consumption of 11 basic nutrients. These effects are discussed within the conceptual framework outlined in the next section, which is based on the theoretical works of Becker (1965), Lancaster (1966), and Grossman (1972, 1974), and on the empirical work of Michael (1972).

The data, which are described in the third section, pertain to home food consumption in the U.S. The specific effects of each variable on the household's diet, and the diet's nutritional health implications are discussed along with the statistical findings in Sections IV-VI.

This study should be considered a pilot study. The data available are insufficient to deal with all the hypotheses set forth. Nevertheless, the analytical framework is helpful in identifying potential biases in our estimates and in suggesting future data collection and research avenues.

II. Conceptual Framework

Food consumption behavior is largely a household phenomenon managed by the homemaker. Of the commodities that enhance the household welfare, the two most relevant to the homemaker's demand for her household's diet are: (a) gastronomic and aesthetic utility from food (GU) and (b) good health (GH) through nutrition. We consider the two to be normal commodities the demand for which increases with income. GH also has an investment dimension because of its lasting effect on human activity.

Two household production functions produce these commodities subject to the household's available resources. The first is a diet production function, the inputs in which are food, services of cooking and storage facilities, and shopping and preparation time. The second is a health production function, the inputs in which are medical care, exercise, housing, and a <u>balanced diet</u>, which is an output of the first function. 1/ The homemaker's education is considered a technological factor that enters the two functions. It can lead to a more efficient choice and use of food to obtain a given diet, and to better knowledge of the health effects of the diet. 2/

The forthcoming hypotheses and interpretation of the empirical results are based on two features of the production functions. The first is the jointness in producing GH and GU: while providing GU, the diet is also an input in GH. Furthermore, while beneficial in terms of one commodity, the diet can be detrimental in terms of the other. 3/ That is, an excessive diet satisfying GU can be harmful to health. On the other hand, a balanced, or otherwise required, diet can be disagreeable in taste. Rational behavior implies that while the marginal utility from one commodity, either GU or GH, may be negative, the <u>total</u> marginal utility from a unit of expenditures on a diet, as a joint input in the two commodites, is positive. Consequently, the opportunity cost of one commodity must include the utility loss or gain from the other commodity. For example, by using a new artificial sweetener that does not change his GU or his resources, the consumer may increase his welfare because the sweetener is believed to be superior to sugar for good health. In other words, the availability of this sweetener reduces the cost of a sweet meal, GU, in terms of health.

1/ A balanced diet is a scientifically defined optimal vector of nutrients required to provide energy, structural needs, and resistance to diseases.

2/ On the effect of education in production, see Welch (1970). For its specific effects on household consumption, see Michael (1972).

3/ For a related analytical discussion on jointness in home production and consumption, see Grossman (1974).

The second feature is that some relevant factors in the two household production functions are marginally substituted when their relative prices change. In the diet production function the homemaker can, while keeping constant the parameters in the utility function, substitute for her time input with time-saving and more sophisticated cooking and storage facilities, and with ready-made foods, for example, TV dinners and eating away from home, as well as by hiring cooks.

In the health production function, malnutrition and overnutrition can be marginally substituted by more medical attention and, in the case of overnutrition, also by exercise.

III. The Data and the Estimation Procedure

The data for this discussion were obtained from unpublished summary tables of the United States Department of Agriculture (U.S.D.A.) 1955 Household Food Consumption Survey which pertained to home diets only. 1/ These tables are particular in that they relate household food consumption to family size, income class, type of urbanization, region as well as to the homemaker's education.

The data comprise cell averages of weekly home consumption of 65 food items. The cells were established through the following classification. Each U.S. region, north and south, was broken down into three types of urbanization: urban, rural non-farm, and rural farm. Four income strata ($0-$1,999; $2,000-$3,999; $4,000-$5,999; and $6,000 and above) were specified for each of these. Each stratum was further subdivided into three levels of

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1/ 17 summary reports of this survey were published. The first is U.S.D.A. (1959).

homemaker's education - primary school, high school, and college. "Household size" was given for each of the above socio-economic strata, and was measured in terms of meals eaten at home; twenty-one meals home per week constituted one person.

The data thus provided a matrix of 65 food items by 72 observations. This matrix was linearly transformed into a matrix of 11 nutrients by 72 observations. 1/ These nutrients are: food energy, protein, fat, carbohydrates, calcium, iron, vitamin A, thiamin, riboflavin, niacin, and vitamin C. By means of a regression analysis household consumption of each of these nutrients was estimated as a function of family income, family size as defined, homemaker's education, type of urbanization and region. The various nutrients, income, and family size were used as continuous variables; the mid-point of each income group was used with the level of $8,000 for the highest group. Education, urbanization, and region were introduced by dummy variables. Urbanization and region were introduced primarily to approximate potential variations in food prices across regions and residential areas.

The estimated equations, one for each nutrient, are of a double logarithmic form, that is, the logarithmic transformations of the continuous

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1/ The transformation matrix consists of coefficients, each of which transforms a given quantity of each food item into a corresponding quantity of a particular nutrient. For the particular matrix used here see U.S.D.A. (1971). Whenever a specific food item could not be identified with a matching transformation vector, a substitute vector, transforming the closest food item, was selected. The distortion is minimal since the problem applied only to a few cases and the level of each nutrient is a linear function of all the food items.

variables were used. 1/ This form, which presumes constant elasticities and diminishing marginal propensities to consume, has a particular advantage in this context. Although the different nutrients are measured in different units, this form provides dimensionless coefficients - elasticities - permitting comparisons of the relative effects of the socioeconomic variables on the consumption of various nutrients. Although there is jointness in consumption of nutrients, each of the equations was estimated separately because nutrients are not consumed in fixed proportions, since, across households, they come from different foods.

The estimated equations are reported in table 1. The relatively high multiple coefficients of variation (R^2s) result from the use of grouped data. 2/

IV. The Effect of Income

A change in the household's income affects the household's derived demand for foods as well as the way the household's diet is produced. Because GH and GU have been assumed normal commodities an increase in household income is assumed to increase the demand for the two of them. Nonetheless, since the two are jointly produced, the demand for a balanced diet may actually decrease. This postulate follows from two assertions. 3/ First, GU can be enhanced only

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1/ Explicitly:
$\text{Log } N_{ij} = A_i + a_{1i} \log \text{income}_j + a_{2i} \text{ Log } (F \cdot \text{size}_j) + a_{3i} \text{ south}_j \ (=1) + a_{4i} \text{ rural farm}_j \ (=1) + a_{5i} \text{ rural non-farm}_j \ (=1) + a_{6i} \text{ high-school}_j \ (=1) + a_{7i} \text{ college}_j \ (=1) + U_{ij}.$ $(i = 1 \ldots 11, \ j = 1 \ldots 72)$

2/ Johnson (72, 2nd ed.) and Theil (71).

3/ On the income effect in household joint production, see Grossman (1974, pp. 13-18).

Table 1

REGRESSION COEFFICIENTS WITH HOME CONSUMPTION OF NUTRIENTS AS DEPENDENT VARIABLES

(t Statistic in Parentheses)

Dependent Variable (Nutrient)	Income	Family Size	North-Urban Elem. School (Intercept)	Region South	Urbanization		Education		Adjusted R^2	F
					Rural Non-Farm	Rural-Farm	High School	College		
Calcium	.0901 (4.2103)	.8191 (6.7919)	8.8167	-.1379 (-0.5070)	.2633 (6.3293)	.0886 (2.6448)	.1998 (4.9333)	.1234 (3.7281)	.839	54
Carbo-hydrates	.0085 (0.6250)	.9135 (11.8791)	7.8833	.0579 (3.3276)	.2657 (9.9887)	.1489 (6.9906)	.0486 (1.5837)	.0308 (1.4597)	.920	118
Fat	.0836 (5.9714)	.7749 (9.7841)	6.6646	-.0641 (-3.5810)	.2227 (8.1575)	.0622 (2.8273)	.1361 (5.1165)	.0790 (3.6406)	.907	100
Food Energy	.0520 (4.3697)	.8139 (12.2760)	9.9059	.0011 (.0000)	.2420 (10.4310)	.0973 (5.2032)	.0911 (4.0310)	.0531 (2.8703)	.929	159
Iron	.0580 (2.8431)	.6380 (5.6261)	5.1646	.0000 (.0020)	.1954 (4.9343)	.0196 (0.6106)	.0410 (1.0622)	.0034 (0.1072)	.763	39
Niacin	.0493 (3.1006)	.7300 (8.1747)	5.0505	.0433 (2.1436)	.2226 (7.2039)	.0544 (2.1847)	.0213 (0.7076)	.0004 (0.0163)	.870	69
Protein	.0823 (6.6910)	.6985 (10.0939)	6.5586	-.0449 (-2.8782)	.2372 (9.9247)	.0476 (2.4792)	.0991 (4.2716)	.0559 (2.9421)	.923	124
Riboflavin	.0865 (5.0291)	.6843 (7.0474)	3.0082	-.0441 (-2.0137)	.2335 (6.9701)	.0351 (1.3048)	.1203 (3.6902)	.0680 (2.5564)	.858	63
Thiamin	.0291 (2.1716)	.7742 (10.2543)	2.9019	.1185 (6.9706)	.2690 (10.3462)	.0961 (4.5981)	-.0183 (-0.7233)	-0.0150 (-0.7246)	.923	122
Vitamin A	.1542 (6.9459)	.5130 (4.1073)	10.7470	-.1310 (4.6454)	.0229 (0.5313)	-0.0030 (-0.0864)	.1852 (4.4095)	.1279 (3.7289)	.743	30
Vitamin C	.1710 (7.0954)	.3299 (2.4601)	6.3651	.0010 (.0000)	.1011 (2.1556)	-.0313 (-0.8258)	.1377 (3.0197)	.1270 (3.3867)	.697	21

by food consumption, while GH can also be enhanced by other inputs. Second, an increase in food consumption to enhance GU may lead to an unbalanced diet which the consumer may try to offset by other inputs in GH, medical care and, in particular, exercise.

On the production side, an increase in real income provides the household with more market goods, which are inputs in the household's diet. The homemaker's potential time input, however, remains fixed. This leads to an increase in the relative value of the homemaking time. 1/ Consequently, as income rises, the family's diet production process will use more substitutes for the homemaker's time, particularly when the higher income comes from an increase in the homemaker's wage rate and in her labor force participation. These substitutes can take the form of either more ready-made convenience foods, improved household cooking and storage facilities, eating more in restaurants, hiring a cook, or a combination of these. 2/ On the average, this means less fresh foods and self-prepared household diets. The effect of such diets on GH is an empirical issue, concerning the effects on the diet of non-fresh foods, preservatives in convenience foods, and the absence of the homemaker's quality control in the case of a cook or eating away from home. There is little reason to presume that these effects will improve the quality of the household's diet. Hence, we can assume that because of the changes induced in the demand for foods and the way the household's diet is produced, an increased income is likely to have, on the average, an adverse nutritional effect on good health in a high income country like the U.S..

1/ Becker (1965).

2/ Note that some elements, like dining out, have positive income elasticities that are also derived from higher demand for entertainment. Given some indivisibilities associated with hiring cooks, the substitution for these is likely to occur at relatively high incomes.

The estimated income coefficients, which are income elasticities indicating the sensitivity of the various nutrients to change in income, are positive except for the coefficient for carbohydrates. Hence, income has an overall positive, although differential, effect on the household's consumption of nutrients. The estimates suggest the following descending order of sensitivity of nutrients to income: (i) vitamin C, (ii) vitamin A, (iii) calcium, (iv) riboflavin, (v) fats, (vi) proteins, (vii) iron, (viii) food energy, (ix) niacin, (x) thiamin, and (xi) carbohydrates. 1/

The rate of increase in the home consumption of nutrients is far less than proportional to the rate of increase in income. Vitamin A, the nutrient most sensitive to income, has an income elasticity of only .17, that is, a 10% increase in income brings about a 1.7% increase in the level of consumption of vitamin A. On the other hand, carbohydrates are insensitive to changes in income, and tend to show a negative income elasticity that is carbohydrates may be "inferior" nutrient; i.e., that as income increases, the consumption of this nutrient decreases. 2/

The theoretical considerations and the fact that the data pertain only to home diets suggest that our estimates on the effect of income on the demand for nutrients may be downwardly biased. As incomes rise households may actually consume more nutrients than our estimates suggest - but in coffee

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1/ When a linear form is applied to estimate these equations, carbohydrates tend to have a negative income elasticity, though still insignificant statistically. A similar procedure based on the 1965 survey, produced similar results. The rank correlation between the order above and the corresponding order for the 1965 data is .85, which implies relatively consistent income coefficients over time. Part of the difference between the two rankings can be attributed to the absence of information on education in the 1965 data.

2/ Ibid.

shops and restaurants. This follows from the assertions that as income is rising (a) households will consume more foods away from home and (b) the demand for GU and entertainment associated with restaurants increases. 1/ How food consumption away from home may affect the consumption of specific nutrients cannot be established on the basis of the available data; this remains an empirical question.

The estimated differentials in consumption of nutrients by region and urbanization seem in line with the estimated income elasticities rather than just with regional and residential differences in prices, of foods in particular. Northern households consume more than Southern households of most nutrients except for carbohydrates, niacin, and thiamin, which have the lowest income elasticities. While probably also reflecting some regional price differentials, these results are consistent with higher mean incomes in the North than in the South. 2/

The urbanization dummy variables, in particular, were expected to approximate potential variations in food prices. Indeed, non-urban households consume at least the same levels of vitamin A, vitamin C, and iron as urban households, and consume more of the other nutrients than the urban household. This differential in consumption may be explained by lower food prices in non-urban areas. For this reason, however, the lower levels of

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1/ These assertions are supported by Michael's findings (1972, p. 37) that the income elasticity for expenditures on food away from home is higher than the elasticity for expenditures on food at home.

2/ This may follow statistically from the apparently higher proportions of Northern relative to Southern households in the higher income (and education) ranges within each income category.

consumption of rural-farm households compared to rural non-farm households is puzzling. While this may reflect problems of recalling the household's food consumption in a farm setting, it may also reflect the lower levels of income and education of the rural-farm population. 1/

The estimated income effect suggests that higher incomes reduce the consequences of deficiencies in vitamin C, vitamin A, calcium, riboflavin and proteins. On the other hand, higher incomes increase the consequences of higher fat intakes. Overall, however, as predicted, the results imply that as income increases, the demand for a balanced diet decreases. The estimates indicate that the US Recommended Daily Allowances (RDA) for various nutrients are met, at least on the average, at minimal levels of income. Hence, higher incomes lead to overconsumption of all the nutrients, except for carbohydrates. While not storing excess vitamins, man's body does deposit excess proteins and food energy in the form of fats which are accumulated in addition to the higher direct intakes of fats. Thus, unless offset by exercise, higher incomes may lead, on the average, to obesity.

The suggested negative effect of higher incomes on GH - through nutrition - is consistent with the general findings (Fuchs, 1965) that higher incomes have a negative effect on health in the U.S., and that demand for medical care increases with income (Michael, 1972). The specific links among income, good health, nutrition, and medical care need closer scrutiny using improved data.

1/ The statistical argument made in the previous footnote applies here also for farm vis-a-vis non-farm households in the rural areas. This may be a result of oversampling the rural population, see USDA (1955).

The conclusion about the effect of income on the household's diet can be put in a wider, macro context. Poorer countries may prove to have more healthy diets than the prevailing diet in the U.S. (Christakis, _et al_ 1965). Leverton (1968) observed a decrease in the average quality of the U.S. diet between 1955 and 1965. Berg (1973, pp. 40-49) found ample evidence of how other commodities compete with the balanced diet in the process of economic growth.

V. The Effect of Household Size

The size of the family is one of the basic determinants of the household's demand for food. 1/ Controlling for other household endowments, income in particular, the household can satisfy a larger family's demand for food by changing food production and consumption patterns in a fashion similar to its response to a reduction in income.

Considering good health of household members as a commodity which has no substitues and assuming that the homemaker does not discriminate among household members, we can expect that in a relatively high income setting such as in the U.S., the homemaker will sacrifice primarily GU — tastier and more expensive foods — and other household commodities to equalize the consumption of nutrients by all household members and to provide some basic diet. Consequently, we can expect larger households to have a higher demand for nutrients, but the increase may be less than proportional to the increment in household size due to the reduced demand per capita for GU. On

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1/ Additional consideration should be given to the family's age and sex composition, on which we do not have data.

the production side, we can expect larger families to eat at home more because of scale economies, which imply lower per capita costs in producing a home diet. 1/

Except for calcium and carbohydrates, the estimated coefficients on household size of all the other nutrients have values between zero and one and differ statistically from these values. Calcium and carbohydrates have values which do not differ statistically from the value of one at a 95 level of statistical significance. That is, except for the consumption of these two nutrients, consumption of the others increases with household size, as measured, but the increase is proportionately less than the increase in size. Consumption of calcium and carbohydrates appears to increase almost proportionately to the increments in household size. These findings mean that, controlling for other things, a larger household increases the total consumption of <u>all</u> nutrients, and that, except for carbohydrates and calcium, per capita levels of other nutrients fall.

It is noteworthy that these estimated coefficients may also reflect the relationship between household size and its composition and that they may be downward biased. As opposed to one- or two-member households, larger households in a representative sample reflect the presence of children, whose consumption levels are smaller than those of adults. This may explain, in part, the less than proportionate increase in consumption with household size. 2/ The estimated coefficients are downwardly biased if indeed larger

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1/ Michael (1972).

2/ The evidence that consumption of calcium, which is usually associated with milk consumption, increases proportionately with family size supports the above assertion that the presence of children is reflected in the results.

families eat at home more than smaller families, and therefore are defined in this survey as relatively larger than a simple count would imply.

This evidence - that with household income constant consumption of all nutrients increases with family size - indicates that the household foregoes as its size increases other goods, including possibly more expensive and tastier diets for some basic diet. Moreover, the household does not substitute some nutrients for others. This seems to indicate that the household "protects" its health by foregoing other commodities, including GU. It may also forego some of the entertainment and leisure associated with eating away from home.

The differentials in the per capita decrease in consumption of the various nutrients is of interest. The nutrients subject to the largest decrease are vitamin C, protein, vitamin A, and iron, which have the highest income elasticities. Carbohydrates, food energy, and calcium do not decrease on a per capita basis. Thus, the consequences of an increase in family size are similar to those of a reduction in household income. This means that, controlling for other things, larger households may have a healthier diet than smaller households.

VI. The Effect of the Homemaker's Education

The homemaker's education may affect the household's diet by changing preferences and by augmenting the household's resources. Changes in preferences may result from more knowledge about the health consequences of various food consumption patterns, and therefore, more educated homemakers may opt for a balanced diet more than the less educated homemaker would.

Education is known to increase women's wages, their labor force participation (Mincer, 1962) as well as their efficiency in home production (Michael, 1962). Without the knowledge of the homemaker's specific types of training, it is not clear, however, which of the two activities, market work or home work, is augmented more by education. On the basis of observations that more educated women can command higher wages and participate more in the labor force, we can expect them to spend less time, relatively to less educated, doing work at home. 1/ Therefore, we can expect families of more educated homemakers to eat more ready made foods, to eat away from home more, and possibly to employ cooks. 2/

On the other hand, easier access to information and more efficiency in household activities of the more educated homemaker can mean better knowledge of nutrional values of food and of cooking practices. This suggests that more educated homemakers can provide their households -- for any level of expenditure on foods - with a better diet, ceteris paribus, in terms of a balanced diet. There is some intuitive appeal to the assumption that homemaker's education is of more value in the production of GH than to the production of GU. This assumption follows the notion that more knowledge is required to produce a balanced diet and good health than to produce gastronomic utility.

1/ The distinction between time of work at home and leisure time is complicated. To the degree that this distinction is possible, Gronau (1973) asserts that women usually trade between work at home and childcare, and labor force participation; that is leisure time remains relatively constant.

2/ In general, we can expect that the higher the homemaker's market wage, the more she will resort to cook's services than to ready-made foods at home. The implication of this on the household's diet is an empirical issue.

Hence, the effects of homemaker's education are opposing. More educated homemakers are expected to have more real resources and less time for home production, <u>ceteris paribus</u>, inducing a negative effect on the household's balanced diet, similar to the effect of higher income; at the same time they may have a higher preference for a balanced diet for good health.

The estimated coefficients on education measure the percentage differential in level of intakes of any of the nutrients between households where the homemakers have primary education and those where the homemakers have high school or college education. For example, according to the estimates, households with a homemaker who has a high school education consume, on the average, 19.98 percent more of vitamin A than households with a homemaker who has primary education. Households with college educated homemakers consume only 12.34 percent more vitamin A than households with primary school educated homemakers.

Except for the consumption of thiamin, niacin, iron, and carbohydrates, which appear statistically insensitive to variation in the homemaker's education, the consumption patterns of the other nutrients are similar to that of vitamin A. Households with high school educated homemakers consume more of these nutrients, on the average, than other households including those with college educated homemakers. Thus, education, as measured, exhibits a nonlinear effect, bringing about an increase in consumption of vitamin A, vitamin C, riboflavin, protein, fat, and calcium with high school education, and about a drop beyond this level of education. All in all, the nutrients that are sensitive to variation in income are also sensitive to variations in education.

The evidence that, controlling for household income, education exhibits an effect similar to income supports the hypothesis that more educated mothers are more efficient buyers of foods. Furthermore, the findings and this conclusion may be understated if high school and college educated homemakers induce their families to eat more away from home, a fact unaccounted for in our data.

It seems that while the income effect is derived from a higher demand for gastronomic utility, the education effect is derived from higher demand for health. This conclusion is based on observing the effect of education at the college level, the effect of education on consumption of specific nutrients, and the comparison of the results with other findings on the effect of education on home food consumption and the demand for medical care.

The reversal in the effect of education at the college level may result from either one or a combination of a non-monotonic income effect not traced before, and the fact that college educated homemakers may find it worthwhile for their families to eat away from home more often. If, in fact, this reversal is due to a nonlinear income effect, the reversal should have occurred for nutrients that have the lowest income elasticities. This, however, is not the case. The statistical difference in household consumption of nutrients between college educated and high school educated homemakers is highest (in a descending order) for calcium, fat, riboflavin, proteins, vitamin A, and food energy - nutrients that do not have the lowest income elasticities.

Given that the RDA requirements are met, on the average, at low levels of education, less consumption of at least some of nutrients is consistent with a higher demand for health. Less food energy, fat, and protein have a positive health effect where overnutrition is more prevalent than malnutrition.

We cannot study with these data the degree to which the reversal in the consumption of nutrients is because college educated homemakers induce their families to eat away from home. Attempting to explore this point, we ran a set of regressions similar to the one reported, but replaced the education variables with a dummy variable indicating whether the homemaker was employed. 1/ This variable did not yield statistically significant coefficients. At face value such results indicate that the household's consumption of nutrients is unaffected by the homemaker's employment. However, a more refined study using information on employment along with at least information on the homemaker's wages and working time is needed.

The emerging conclusion of the positive effect of education on GH via nutrition can be supported by the findings of others. Michael (1972) argued that because home food consumption is a necessity, having an income elasticity between zero and one, education has a negative effect on the demand for home food consumption. He proves this point by showing that <u>expenditures</u> on home food consumption decline as the level of the (homemaker's) education increases. The results here, however, show that education has an overall positive effect on the <u>quantities</u> of nutrients consumed that are derived from home food consumption. The apparent inconsistency in the results can be

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1/ U.S.D.A. (1959) Report Number 15. Although based on the same sample, the two variables - education and employment - could not be introduced together because the data were obtained from different summary tables.

resolved by the observation that "... the amount of formal schooling of the wife affects, for example, her knowledge of nutrition and her willingness to buy inexpensive but highly nutritive cuts ...." (Burk, 1968, p. 133). Hence, while more educated homemakers may spend less on home food consumption, they manage to gain more in terms of nutrients. Clearly, education affects the consumption of nutrients through lower information cost and more along the lines suggested by F. Welch (1970) of the effect of education in production.

Given the joint production of the two commodities, GH and GU, if the overall positive effect of education on consumption of nutrients could have been derived from a higher demand for GU - with a detrimental effect on health - one should expect a higher compensating demand for medical care and exercise with more education. Michael (1972) found no effect of education on the demand for medical care. Assuming that more educated people have a higher demand for medical care as an input per se to good health, Michael's finding implies that more educated people may need less medical care. One possible explanation for this phenomenon is that more educated people have better diets as inputs in their health status. 1/ The effect of education on exercise is yet to be studied.

The results thus seem to lead to the conclusion that one way education helps to produce GH in the U.S. is via nutrition. 2/ However, further analysis with more sophisticated data is required.

1/ More educated people may also be paying higher prices for a given "quantity-quality" of medical care, implying an upward bias in Michael's results.

2/ For the positive effect of Education on GH, see Auster, Levenson and Sarachek (1969).

VII. Conclusion

The findings reported in this paper are consistent with some prior, but unmeasured, notions about the effects of household income, household size, and the homemaker's education on the consumption of nutrients. They show some systematic behavior concerning consumption of nutrients that can be linked to some general conceptual framework dealing with the demand for nutrition.

Nevertheless, the discussion has been tentative and suggestive. It suggests that a meaningful discussion should be based on survey data that also include household expenditures on food at home and away from it, health-related expenditures and practices, patterns of food production at home, the homemaker's labor force participation, as well as on the household's sources of income.

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