To the Graduate Council:

I am submitting herewith a dissertation written by Julia Marlowe entitled "Joint Production in the Theory of Household Production." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Home Economics.

Roger M. Swagler, Major Professor

We have read this dissertation
and recommend its acceptance:

Accepted for the Council:

Vice Chancellor
Graduate Studies and Research

JOINT PRODUCTION IN THE THEORY OF HOUSEHOLD PRODUCTION

A Dissertation

Presented for the

Doctor of Philosophy

Degree

The University of Tennessee, Knoxville

Julia Marlowe

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ABSTRACT

Total time available to households must be divided among work in the market, work at home (home production) and leisure. Expanded labor force participation by family units, such as husbands taking second jobs or wives entering the labor force, puts pressure on home production and leisure time. Trends toward labor-saving appliances, eating away from home and elimination of some home production are examples of this phenomenon.

Another, less noted, alternative is joint production (performance of two or more home production tasks simultaneously). Under increasing time pressures, households may engage in increased amounts of joint production, even though certain additional costs are involved, such as increased stress levels and decreased product quality. However, these additional costs may be acceptable if they are less than the savings in time.

This analysis tested hypotheses relating to joint production through a model based on the Becker formulation of goods and time as inputs in the production of commodities (commodities represent the sources of consumer satisfaction, and are combinations of goods and time inputs). The model was developed to accommodate the complexities of joint production, and was used to identify a set of hypotheses about the degree to which households engaged in joint production.

The model was tested using a sample of 603 married respondents, interviewed by the Survey Research Center, University of Michigan. Respondents recorded the amount of time they spent in joint production.

Results showed that men worked more than twice as many hours per week as women and earned almost twice as much money per hour. Women devoted more time to joint production than men. There was no difference in educational level.

Regression equations showed that four variables had a significant effect upon joint production time: education, unearned income, hours worked in the market and number of children. Increases in the variables were associated with increased joint production.

Respondents with preschoolers did the most joint production and respondents without children or with teenagers did the least amount of joint production. Men devoted more time to joint production as they worked more hours in the market and had more children. Employed women without children devoted more time to joint production than nonemployed women without children. When comparing employed women with children to those not employed with children, there were no significant differences in the time devoted to joint production. One explanation is that the presence of children places such great demands upon female joint production that working in the market makes little difference.

This study supports the notion that increased labor force participation does increase the demand for joint production, especially when the individual has a high educational level. Because increased amounts of joint production have also been tied to increased stress, there may be an emerging need to help families deal with stress related to joint production.

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INTRODUCTION

I. STATEMENT OF THE PROBLEM

Because American society tends to be time oriented, it isn't surprising that the decreasing amount of time spent in home production should attract attention. Home production, or work in the home, contributes many goods and services which increase well-being of families. Home production is of particular concern today because of recent changes in time allocation as women increasingly become involved in the labor force. When more time is allocated to work in the market, less time is available for home production and leisure. Trends toward labor-saving appliances and eating away from home are examples. Numerous studies have been devoted to these trends, but a related phenomenon, the performance of simultaneous activities, has attracted little study. That is, one may conserve time by performing several home production tasks at the same time or in conjunction with leisure activities. The performance of simultaneous activities is joint production. Because time allocation patterns and demand for joint production are related, the purpose of this study was to develop a time allocation model for observing behavior when joint production occurs.

All individuals have the same time resources, yet often one hears that one individual has more time than another. When the word "time" is used, it usually refers to the value of what can be done with that time.

Thus, it is the opportunity cost of time which is important and is different for every individual.

In affluent societies, time has become increasingly valuable [29, 38, 40]. Affluence has enabled individuals to acquire many goods and services, but time must be allocated to the acquisition, enjoyment, and maintenance of those goods and services. An increase of goods and services therefore increases the demand for time. Given fixed supply, the price of time has increased as the demand for it has increased.

Because demand for time varies among individuals, time does not have the same value for everyone. Time itself may be used for working in the market, working at home or leisure activities [29]. The precise pattern of allocation will depend upon the individuals' own preferences and the price of time. The ultimate goal of individuals is to maximize their satisfaction, which requires the use of goods and services. These can be obtained directly by working in the home or indirectly by working in the market. In the latter case, the individual earns a wage and uses that money to purchase goods and services. In both instances, time is required.

II. CONTEMPORARY ECONOMIC THEORY

Contemporary economic theory views the household as both a consumption and production unit. The current theory is based on two recent developments, the first of which defines the source of consumer satisfaction as characteristics rather than goods themselves [26]. Thus, one derives satisfaction from beauty, warmth and softness rather than from a blanket. The second development is based on the idea that a

family combines goods and time to produce commodities which are sources of satisfaction. Goods are therefore inputs, instead of providing satisfaction directly. In this framework, the commodities (or outputs), rather than the inputs, bring satisfaction [4]. For example, a meal is an output which brings satisfaction and combines inputs of goods, such as food and equipment, with time.

This framework lends itself to an economic analysis of the family which is analogous to the analysis of a firm. A firm produces output by combining capital and labor in some given proportion. The firm uses a production function for a particular output which specifies the relationship of various inputs in the production process. The firm wishes to minimize cost and will use inputs in certain proportions to accomplish this. As the price of one input increases, the firm will adjust, given the production function, by using less of the more costly input and more of the relatively less expensive input.

Similarly, a family utilizes a household production function and combines goods and time in much the same way that a firm combines capital and labor. In the case of a family, the economic goal is to maximize satisfaction through commodities produced. A family will use time and goods inputs to achieve the maximum output at the lowest cost. Thus, as time becomes relatively more valuable, goods will be substituted in home production. The family behaves in an economic sense by using the lowest cost inputs to maximize output. Time which is not allocated to home production can then be used for working in the market or for leisure. If a commodity uses relatively more of the time input, it is said to be

a time-intensive commodity; if it uses more goods as inputs in relation to time, it is said to be a goods-intensive commodity [3].

III. WOMEN IN THE LABOR FORCE

Implications of the above theory on time allocation can be related to recent changes in consumption patterns of families in the United States. Such changes are observed in recent statistics on increased consumption of meals eaten away from home, increased consumption of goods-intensive items such as riding lawn mowers, and increased leisure activity expenditures [21, 39].

These changes are closely associated with labor force participation of women. Typically, women have been the primary producers of household activities; hence, changes related to home production time are more significant for women than for men [5, 21, 37]. Robinson states that "No activity has as clearly demarcated the sexual division of labor in our society as household care" [35, p. 183]. This fact has been documented by several studies showing that even when women work in the market, they still carry the bulk of home production [3, 42]. This has become increasingly important as more and more women have joined the labor force in recent years [11].

Blake states that "More women may need to work because of inflationary trends in the economy, high rates of divorce and the fact that their children leave school to support themselves at a later age than they did a generation ago" [5, p. 142]. Gronau has identified education as a factor influencing labor force participation, and women today are more educated than those in earlier generations [5, 18]. In

1967, the percentage of females finishing college was 9.9 percent; in 1975, it was 13.2 percent [21]. As educational levels of women increase, the opportunity to earn a higher wage increases and thus the price of time for home production rises. As wages in the market increase, the cost of not working becomes greater. This trend of increased market wages for women is expected to continue, especially for women in professional occupations [5].

Smaller families also are related to labor force participation among women. Children are typically a time-intensive commodity; consequently the more children one has, the more time which must be allocated to the care of those children. Some of this care may be done by others, but child care is expensive, and adds an additional cost of labor force participation. Thus, the smaller the number of children, the less expensive it is to work in the market.

Given that individuals allocate time in the manner which is most productive, women will go to work in the market if they can obtain more commodities by that indirect method rather than through direct production; conversely, women will work at home rather than enter the labor force when they are more productive in the former [10, 16, 17, 19]. Thus, changes in the opportunity cost of staying at home alters the economically efficient combination.

Assuming that as time allocation patterns change, a family retains a demand for certain commodities, the most economically feasible way to obtain these commodities will vary. In response to these changes, families may substitute within commodities or between commodities [15]. A change within a commodity will occur when an individual substitutes

inputs within a household production function. Substitution occurs between commodities when one commodity is substituted for another.

The relative price of inputs will change as the value of time increases or decreases. In other words, demand for a commodity or similar commodity may remain unchanged but the method of obtaining that commodity will have to change. Because many goods can be produced through direct as well as indirect production, an individual may substitute time for goods or goods for time. For example, an automobile may be cleaned by washing it at home using time directly, or indirectly by a purchased car wash, thereby spending more money, but less time. When an individual goes to work in the market, he/she may purchase more services and goods rather than produce them at home, reflecting a change in consumption and time allocation patterns. This alteration within the commodity is a substitution of inputs, but the output (commodity) remains the same.

Another change which may occur as a result of allocating more time to work in the market is the substitution between commodities. The demand for a commodity may be altered and another commodity substituted for the one produced before. Such instances can be found when the amount of time allocated for home production decreases, resulting in a decrease in certain commodities, often referred to as a lowering of home production standards.

Maintaining the satisfaction level with less home production time may be done by increasing efficiency in home production. To this end, more than one input may be produced with any given combination of inputs. In the case of time, the same time input would be used to

produce more than one commodity. Thus, joint production in the home emerges as analogous to the standard economic analysis of joint production by the firm.

IV. JOINT PRODUCTION

Joint home production occurs when two or more commodities are produced simultaneously. However, joint production also carries with it some associated costs. In producing more than one commodity with the same time input, the commodity produced may be of inferior quality to a similar one produced singly. For example, someone mowing a lawn while watching children may not do quite as good a job as would be obtained without joint production; similarly the children may not be as carefully watched if joint production is involved (e.g., if dinner is being prepared at the same time). Furthermore, the individual may experience increased stress from joint production as a result of concentration on more than one activity at the same time. Both these costs are mentioned in the literature [33, 50].

When less time is allocated to home production, there may be an increase of production-consumption as well as joint production. Production-consumption is defined as the production of a commodity while engaging in leisure activity at the same time. Reading as a leisure activity has decreased and one explanation may be that it is the type of activity which cannot easily be done while doing something else. By contrast, leisure activities such as watching television can be done in conjunction with home production such as meal preparation. Thus with an

increase in the value of home production time, there is a corresponding demand for joint production or production-consumption.[1]

Joint production is one area which has been neglected in the study of time allocation, primarily because of difficulties in measurement. Nevertheless, joint production may be very significant, especially with an increase in time devoted to work in the market by women. Changes in allocation of time have resulted in changes in both consumption patterns and the patterns of commodity production. When time is limited, it may be preferable to obtain two less desirable commodities through a joint production process rather than accept one preferred singly produced commodity. One might rather watch television while helping a child with homework than doing just one of the two, even though either commodity produced alone would be of better quality.

With single production, the question is how to combine inputs to produce a commodity? Thus one compares various inputs to select the least costly combination in producing a desired commodity. The analysis of singly produced commodities focuses on the rate of technical substitution or marginal rate of substitution among inputs. Equilibrium occurs when the ratio of the marginal productiveness of inputs in the production of a commodity equals the price ratio of those inputs. As

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[1]The term "joint production" has also been used in reference to the situation in which the individual gains satisfaction during the production of a commodity. The jointness refers to production of satisfaction simultaneously with the production of a commodity, rather than from producing two distinct commodities [34]. It is the latter case which this study addresses.

the marginal productivity of one input increases, one will increase use of that input, assuming no change in price.

Joint production is a more complex process. With joint production, an individual produces more than one output from common inputs. Thus, two questions are involved: what proportion of inputs will be used and what proportions of commodities will be produced? The rate at which one commodity must be sacrificed to obtain more of another commodity must be considered. Given a joint production process whereby one obtains two commodities from a single common input, equilibrium requires that the rate of product transformation must be equal to the marginal productivity of the common input in the production of one commodity to the marginal productivity of that same input in the production of the other commodity [24]. If the marginal productivity of an input is greater for one commodity than another, more of that commodity will be produced. Considering time as the common input, the marginal productivity of time may be so great in the production of one commodity that only one commodity is produced with that time. However, equilibrium may occur when more than one commodity is produced.

A change in the amount of time available for commodity production may cause a change in the marginal productivity of time. When there is a decrease in the amount of time available for home production, a person may shift from one single production to joint production. Looking at marginal productivity of inputs alone does not explain all the adjustments being made by the individual. Any model of the joint production case must explain such changes in time allocation.

This study employed a joint production model developed by the researcher. The model implied that certain factors would have an effect upon the demand for joint production or production-consumption, and resulted in the following research question: How will factors, such as education, market wage rate, gender and age of an individual, hours of market work, number and age of children, wealth and consumption technology (stock of capital), affect time allocated to joint production or production-consumption?

CHAPTER II

REVIEW OF LITERATURE

I. BACKGROUND AND SETTING

Although Richard Ely discussed home production as early as 1889, his analysis was minimal, and later analysts did not build on his beginnings [14]. The early home management literature was concerned with production, but concentrated on time allocated to particular tasks [33, 47, 48, 49]. Economic literature concerned with time allocation was limited to analysis of labor and leisure, with primary emphasis on time devoted to time working in the market [12].

According to Szalai, "We have no exact information as to when occurred the first quantitative study devoted to the period of the day spent off the job or the course of the entire day's activities" [42, p. 4]. In 1924 a time budget study was done by economic planners in the Soviet Union and was concerned with daily life of Moscow workers. At about the same time, five series of studies about use of time by farm women and farm homemakers were conducted by the Bureau of Home Economics, United States Department of Agriculture [42]:

> In most cases leisure time was considered to be that part of the day remaining after deducting the hours spent on the job or asleep, and attention was concentrated on the activities freely chosen during this part of the day, which agree with the concept of free-time or leisure [42, p. 4].

In 1930-1932, a time budget study was done on leisure and in 1939 Sorokin and Berger's book, Time Budgets on Human Behavior, popularized the

time-budget process as a method of investigation. "The actual spread of the time-budget technique got under way only after 1945 . . ." [42, p. 5]. The early time budget studies focused primarily on time in the market and leisure time. Ralph Borsodi, a sociologist concerned with economics, rigorously studied the economics of home production in his own home. He considered costs of materials and cost of labor to arrive at an economic value of home production [7]. However, only recently has there been much concern about the amount of time committed to home production, perhaps because the home management analyses were primarily descriptive and were not incorporated into economic analysis, and Borsodi's analysis was very limited [7, 33, 47, 48].

II. DEVELOPMENT OF A TIME ALLOCATION MODEL

Basic Formulation

Recent analyses of time have focused on the time constraint, with a resulting emphasis on how total time is divided. In his discussion of the problem, Linder divided the use of time into five broad categories: free time, cultural time, personal time, work time, and leisure time [28]. He defined free time to be idle time when one is not doing anything, not even relaxing. In affluent societies, free time rarely ever exists. Cultural time was defined as time devoted to cultivating the mind or body, such as attending school. Linder used personal time to be time when one does home production and work time to be time working in the market. Leisure time was defined to be consumption time or time when one is directly getting satisfaction [28]. Linder's categories are not necessarily mutually exclusive, making precise measurement difficult.

However, Linder's work represented a broader perspective on time, moving away from the tendency to focus exclusively on market time. That perspective was shared by Becker, who noted that most individuals actually allocate most of their time to nonmarket activity. He emphasized the importance of time costs, developing the idea of commodities as combinations of goods and time. It is these commodities which provide satisfaction, according to Becker [4].

Time enters the analysis at two levels. First, time is required to obtain the goods inputs, either directly through home production or indirectly through work in the market. Secondly, consumption or enjoyment itself takes time [3, 28, 32]. Hence, commodities are outputs which are obtained by using inputs both of goods and time. It follows that both time costs and dollar costs are important [2, 4]. Becker defined the family not only as a consuming unit, but also a producing one.

Becker developed an economic model to analyze the family's use of time, where utility or satisfaction, U, is a function of commodities, Z_i. The family is subject to a budget and a time constraint. The utility function is:

$$U = U(Z_i, \ldots, Z_m), \qquad i = 1, \ldots, m$$

The commodity Z_i is produced:

$Z_i = F_i(x_i, T_i)$, where x_i represents a vector of goods inputs used in the production of Z_i, and T_i represents a vector of time inputs in production and consumption of Z_i. The budget constraint may be written:

$$\sum_{1}^{m} p_i x_i = I + V + N w,$$

where p_i is the market price of the x_ith good. N represents the hours spent at work in the market and w is earnings per unit of N. V symbolizes nonearned income.[1] The time constraint can be written as

$$\sum_{1}^{m} T_i = T_c + T - N,$$

where T_c is the time spent at consumption and T represents total time available.

The independent production functions can be written in the equivalent form:

$$T_i = h_i Z_i$$

$$X_i = x_i Z_i,$$

where h_i is the input of time per unit of Z_i and x_i is the good input per unit of Z_i. Becker stated that "The problem would appear to be to maximize the utility function subject to the multiple constraints and to the production relations" [4, p. 496].

The time and budget constraints can be combined "because time can be converted into goods by using less time at consumption and more at work" [4, p. 497]. Using $\bar{w}$ as the price of time gives the single constraint:

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[1] Notation is slightly different from Becker's so as to remain consistent throughout this review.

$$\sum_{1}^{m} p_i x_i + \sum_{1}^{m} T_i \bar{w} = V + T\bar{w}, \qquad i = 1, \ldots, m$$

Rewritten, the full constraint is:

$$\sum_{1}^{m} (p_i b_i + t_i \bar{w}) Z_i = V + T\bar{w}, \qquad i = 1, \ldots, m$$

> The full price of a unit of Z_i is the sum of the prices of the goods and of the time used per unit of Z. That is, the full price of consumption is the sum of the direct and indirect prices in the same way that the full cost of investing in human capital is the sum of direct and indirect costs [4, p. 497].

Human capital is important in producing commodities because human capital enters the production function through the time input. Human capital is manifest through improved human resources such as time, abilities, energy and health. The idea of a human resource constraint enters the analysis for both work in the market and work at home. Schultz stated that the family can be envisioned

> as a decision-making unit not only in maximizing its utility but also in determining the allocation of human time and of goods in the production activities of the household [40, p. 8].

The linkage between human capital and the time allocation concept is clear. Human time can be used to analyze work at home as well as work in the market [2, 3].

Time is the most easily measured human resource in terms of production and is the primary resource considered. Szalai said that productive human activity is now measured and paid largely by the clock rather than by the amount of output produced [42]. Time used for one activity must be taken from another; it follows that the cost of producing one activity or commodity must consider opportunity costs of

time. Thus, when one chooses to allocate time for consumption, the cost of that consumption is not only the price of the goods used, but also the value of time. Becker considered time costs for nonmarket activities as foregone earnings [2].

Extensions of the Basic Model

Becker emphasized the importance of nonmarket time, but he did not analyze its various components [4]. Mincer "First pointed out that, at least in the case of women, one should distinguish between work at home and leisure . . ." [31, p. 413]. Gronau disaggregated time outside the market into work in the home and leisure. He then developed an extension of Becker's model to analyze time allocation among leisure, home production, and work in the market [19].

Gronau used Becker's formulation of commodities and assumed a single-person household. He also assumed that goods produced at home are perfect substitutes for goods purchased in the market. Thus, in gaining utility from commodities, it does not matter whether goods are purchased in the market or produced at home:

$$U = f(Z, L)$$

$$Z = f(x)$$

$$x = x_m + x_h$$

$$x_h = f(H),$$

where x_m denotes expenditures in the market, x_h denotes goods produced in the home and H denotes time allocated to home production. Z is maximized subject to constraints. The budget constraint is written:

$$x_m = wN + V,$$

where N denotes time allocated to market work, w is the wage rate and V represents other sources of income. The time constraint is written:

$$L + H + N = T.$$

Two wage rates are important in this analysis. One is the wage an individual faces in the market, referred to in the literature as offered wage or real wage. The other is the value an individual places on his or her time, termed the asking wage or shadow price of time by some researchers and wage rate compensation by Gronau [19, 23]. How individuals choose to allocate time between work in the market, work at home and leisure was the focus of Gronau's model.

Gronau derived a graphic representation of time allocation between work in the market, work at home and leisure (Figure 1).

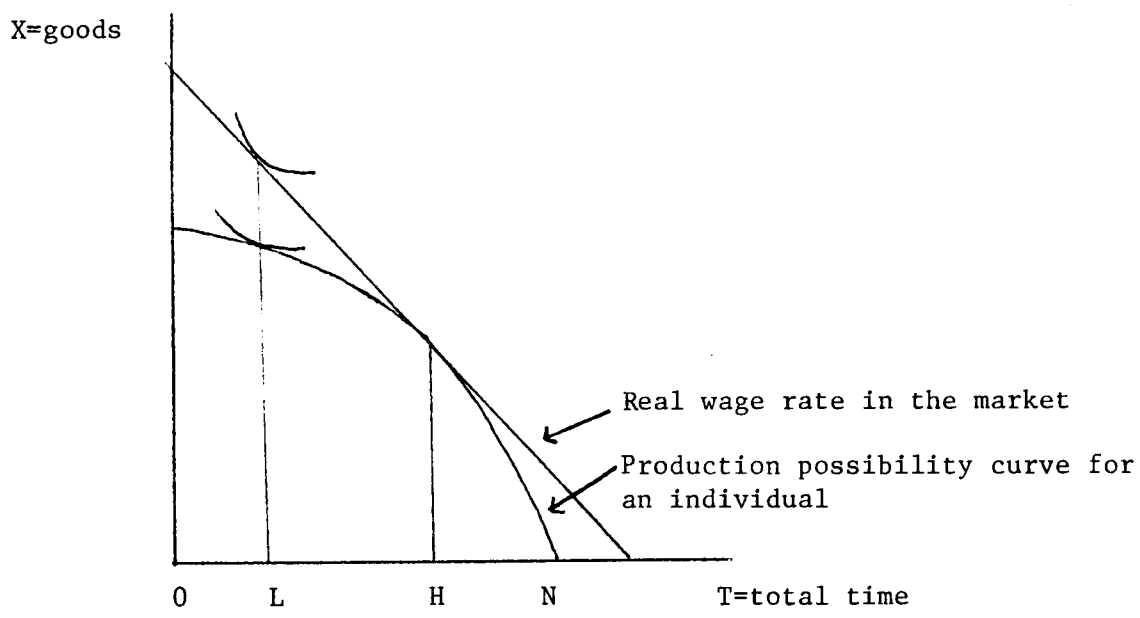

Figure 1. Graphic representation of time allocation between work in the market, work at home and leisure.

The production possibility curve is drawn concave to the origin because of diminishing marginal productivity. The real wage rate in the market is defined to be constant. An indifference curve divides time into work and leisure. Work is further divided into work at home and work in the market at the point where the real wage rate is tangent to the production possibility curve. At that equilibrium point, the ratio of the marginal product of home production to the marginal product of work in the market equals the real wage rate. In the above graph, the distance from O to L is the amount of leisure the individual would choose; the distance from L to H is the amount of home production time and the distance from H to N is the amount of time spent working in the market. Both Heckman and Gronau related an individual's equilibrium point to the decision of allocating time between work at home and work in the market. Heckman stated that "If a woman does not work, no offered wage matches her asking wage" [23, p. 679]. Gronau stated that an increase in the wage rate increases work in the market. That increase shifts the equilibrium point, followed by a decrease in both work at home and leisure [19].

Women typically earn less than men in the labor force and hence have a lower real wage rate. Thus, they have a lower opportunity cost than men [21]. Children also cause women to transfer time from either the market or leisure to home production. The amount of home production demanded is greater when children are present, especially when children are young [2, 15, 19, 40]. In addition, the "wife's entry into the labor force involves costs such as child care and housemaid services

which by far exceed the husband's cost of entry" 19, p. 1120 .[2] However, Gronau stated that we can expect further expansion in the labor supply of women if the increase in education and wages is associated with a decline in fertility.

In considering whether to work in the market, an individual must not only consider the real wage or offered wage, but also the value he/she places upon time and the costs associated with entry into the labor force. Market conditions do not always allow an individual to reach his or her equilibrium point.

> Studies in most of the highly developed countries show that significant proportions of women who work do not want to; also, among those women who are not working, typically half or more either do not want to be employed or want only part-time jobs. . . . In fact, the strongest preference among women appears to be for a part-time job. . . . [5, p. 144].

It appears that many women would achieve equilibrium with a part-time job and that oftentimes the optimal position cannot be achieved because part-time jobs are not available. Hence, women must either allocate more time to home production than is desirable or more time to working in the market than is desirable.

Extension with Environmental Variable

Another extension of the basic model of time allocation is the one developed by Robert Michael [30]. He focused on the manner in which an environmental variable may affect nonmarket production. Environmental variables include education, family size and age structure, and health,

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[2]Unless of course, the male is a single parent, in which case the analysis is the same as for women.

or more macro factors such as degree of political stability, level of hygiene and sanitation, rate of literacy and climate [30].

> The environmental variable is distinguished from the direct inputs by the fact that production of a commodity uses up some of the household's available time and market goods but does not, in general, affect the quantity of the environmental variable [30, p. 8].

Michael considered the family as a small firm which produces many commodities:

> The environmental variable affects production by influencing the conditions in which production takes place, the nature of the productive processes, or the effective quantities of the direct inputs of time and market goods [30, p. 8].

His model was used to determine the effect of the human capital variable on the productivity of the various production functions, on the relative prices of commodities, and on real full income. The household production function defines the functional relationship between the inputs (goods, time and human capital) and the output (commodities). Michael entered the environmental variable, E, into the production function:

$$Z_i = F(x_i, h_i; E).^3$$

The problem then was to predict what effects E has upon home production. To analyze the effect of human capital upon home production, the production function was differentiated with respect to the environmental variable while holding the other variables constant. This yielded the marginal product of E in the production of Z [27]:

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[3]Again, notation has been changed so as to be consistent.

$$\left(\frac{dZ_i}{dE}\right)_{x_i,\, h_i} = MP_i = \left(x_i \frac{\partial MP_{x_i}}{\partial E} + h_i \frac{\partial MP_{h_i}}{\partial E}\right).$$

Note that:

> the environmental variable may increase or decrease the productivity of the factors. If E has different effects on the various production functions, it will affect the relative prices of the commodities [27, p. 9].

Michael also used his model to analyze relative price effects:

> A change in E which affects nonmarket productivity may be evaluated as either a reduction in the cost of achieving a given output or as an increase in the output of commodities, holding the levels of the factors of production constant [30, p. 11].

Human capital,

> by altering the productivity of the factors of production and thereby affecting the relative efficiency of the production functions, could change the real income of the individual household and create income and substitution effects [30, p. 14].

Although Michael developed the model in terms of a general human capital variable, he tested the analysis using education as a proxy for the more inclusive ideal of human capital. His working hypothesis was: "education raises nonmarket productivity and thereby increases the household's real full income" [30, p. 17]. The impact of education was tied to the strong correlation between educational level and wage earned in the market.

Gronau also recognized that education may have an effect on household production and stated that education should be controlled in order to analyze time allocation between market and nonmarket work. Gronau stated that controlling for education, employed individuals had less leisure time than nonemployed individuals. Individuals who work in

the market also did home production so that their total work time was greater than the nonemployed [19]. If education was not controlled, then one might not be able to single out the effect. Because education can be assumed to be correlated with a higher wage and increased productivity in both market and nonmarket sectors, two factors enter into the time allocation decision. One factor is that the higher the wage rate, the more effect upon time allocation. The other factor is that increased productivity makes home production more efficient. Hence, as education increases, the incentive is toward work in the market.

III. EMPIRICAL STUDIES: FOCUS ON WOMEN

Home production analysis has concentrated on women, both because women do the bulk of home production and because they are more likely than men to be able to choose whether to work in the market or to allocate all their working time to home production. Robinson's 1965-1966 study showed that:

> While the employed woman was able to complete her housework in about half the time required by the housewife, this still represented a considerable encroachment on what could be free time for her [35, p. 183].

Robinson's work was based on a sample of approximately 2,000 respondents. Data were gathered through a time budget method. Two methods were used: the yesterday approach and the tomorrow approach. The yesterday approach relied on respondents' recollection of what was done the day before receiving the questionnaire, whereas the tomorrow approach consisted of

respondents listing what they did with their time on the day after they received the questionnaire [36].

More than fifty years ago, home economists studied the length of a woman's work week and found it to be between 42 and 49 hours [27]. Walker's recent studies showed that the work week has lengthened for many individuals because many employed women must work 66-75 hours a week when they combine market work and household duties [43, 44]. Walker's study consisted of a total sample of 1,400 families in upstate New York. Data were collected on amount of time allocated to work in the home, using both the yesterday and the tomorrow approach [44, 46]. Walker stated that the technology of the 1970's has not greatly increased leisure time because, with larger homes to care for and more foods to choose from, home production tasks have expanded [43, 44]. This hypothesis is consistent with Linder's thesis that our affluence has brought us a more complicated society which places great demands upon our time [29].

IV. VALUE OF HOME PRODUCTION

Several researchers have attempted to estimate the value of home production. In addition to defining a shift from home production to market work, Gronau developed a model to estimate household productivity, emphasizing the output of home production. He discussed the role home output plays in comparison with other material resources. Gronau's work focused on the measurement of productivity and the total home output, whereas most studies focused on labor inputs going into home production [18]. Gronau found:

> that the value of home production associated with the work at home of United States' wives in 1973 exceeded 60 percent of the family's money income before taxes, and 70 percent of the family's money income after taxes [18, p. 2].

However, home production is not included in the United States' gross national product. In his Principles of Economics, Marshall suggested that household production not be included in the GNP because it is difficult to estimate the value of that contribution [14]. It is also difficult to distinguish home production from leisure in many cases [45]. However, two problems result when home production is not considered in the gross national product. Comparisons between communities may be askew if one has more working women than the other, and

> as housewives . . . buy more commodities and services rather than via home production, the range of goods not normally paid for decrease [14, p. 12].

Hence, national income figures tend to exaggerate the increase in economic welfare [14]. One concern for the study of home production value is that inconsistencies exist in current philosophy. For instance:

> If a woman is employed as a domestic worker, the value of her household work is included in totaling the GNP, . . . but if that woman marries her employer, the value of her work is no longer included, even though her household work may not change [14, p. 12].

Attempts at estimating the value of home production have produced various figures. In the 1930's, Borsodi estimated the value of home production to be about 30 percent greater than the gross national product [8]. Galbraith stated that:

> The value of the services of housewives has been calculated, somewhat impressionistically, at roughly one fourth of the total GNP. The average housewife has been estimated (at 1970 wage rates for equivalent employments) to do about $257 worth of work a week or some $13,364 a year [13, p. 79].

A more recent source (1976) stated that the value of home production is over one third of the gross national product [22].

Arvey and Begalla set a wage rate for a full-time homemaker in 1968 at approximately $740 per month based on the kinds of tasks done in the home. They divided home production into a series of tasks performed and priced those specific occupational tasks in the market, in terms of a wage for each task grouping [1]. In order to arrive at an estimate of the value of home production, Walker and Gauger did a study of families in New York, and used hourly wage rates of workers in Syracuse who performed similar services to those the housewife performs [45]. Even though wage rates might vary greatly between individuals and region of the country, the important point is not the exact dollar figure, but the fact that the contribution of home production is significant.

Another recognized way of valuing home production is by using the concept of foregone earnings. Foregone earnings are computed by multiplying the number of hours one spent in home production by the wage rate the individual would have been earning if he/she had spent that time working in the market. Hence the value of home production is equal to the amount of dollars an individual foregoes by not working in the market. This method of valuing home production was used by Gronau [19].

V. KEY VARIABLES IN HOME PRODUCTION TIME USE STUDIES

Specific studies on time allocation and home production have focused on specific variables which were thought to affect time allocated to home production. Most researchers included similar variables, namely:

employment status, income, education, number and ages of children, marital status, age and size of house or apartment.

Employment Status

If a person works in the market, he/she will have less time for leisure and home production. Recent studies found that employment of women greatly affected the amount of time they spent on home production, but had almost no effect on men's time allocation toward home production [35, 44]. Gronau found this effect so strong that he confined his study to women. His model predicted that as labor force participation of women increased, time allocated to home production decreased [19]. Walker and Robinson both found that employment status of women was the most significant factor affecting her time for home production. Walker found that employed homemakers used 5.3 hours per day in household production and that full-time homemakers used 8 hours per day on the average. She also found that since 1927 there has been a decrease of 30 minutes per day in food preparation and clean up, but an increase of greater than 30 minutes for marketing, record keeping and management [44]. She found that:

> the husband's contribution to household work time is related to his hours of employment, although his contribution did not correlate with employment of his wife, the number of his children, or the age of the youngest child [44, p. 8].

Income

Robinson did not find family income "associated in any systematic way with housework" [35, p. 69]. This is consistent with Gronau's finding that home production was not affected by changes in unearned

income [19]. However, Gronau found that an increase in the wife's market wage rate increased her work in the market and decreased both her work at home and leisure time. The husband's wage had no effect on wife's home production [19].

Education

As noted, education was the focus of Michael's work, with education treated as a human capital variable. He found that the higher the education, the greater the productivity at home [30]. Education has not been analyzed as directly by other researchers, but it has been included as an important variable in determining time allocation for home production. Gronau stated that home production increased with education, but at a lower rate than market productivity [19]. Robinson found that, for women, higher education was associated with less home production, especially cooking. But for men, higher education was correlated with more home production. However, men did a small amount of total home production. Robinson also found that better educated individuals put their leisure time to more active uses and watched less television [35].

Number and Age of Children

Children have been viewed as one of the most likely variables to affect time allocated to home production. Ghez and Becker considered the family life cycle to be an important determinant and the stages of the family life cycle are defined primarily in terms of children [15]. Schultz stated that the most important cost of home production associated with children during the early years is the price of the mother's time. He further contended that there is substitution between quality and

quantity of children. He stated that as income increases quality is substituted for quantity [40]. This means that families would have fewer children but spend more time and dollars on each child.

Gronau found that home production is affected only slightly by the wife's employment in the market when the family does not have young children. However, when the family has young children, the loss of home production when the wife joins the labor force almost equals her increase in dollar earnings. Gronau further demonstrated that children caused their mother to transfer time away from leisure and market work to home productivity [19].

Walker posed the hypothesis that time used for household work by the homemaker was related to both the total number of children and their ages. She found, using 1967-1968 data, that home production time increased when young children were present and as the number of children increased. Her data also showed that women were more likely to work in the market if their children were older [43]. Gronau said this occurs because the market wage rate is less than the value of home production time when children are present, because young children require great amounts of home production time [19]. Walker also found that children contributed only a small amount of time to home production for the family; thus they added more work for the mother rather than helping her. Children ages 6-11 contributed 30 minutes and teenagers contributed one hour per day to home production activities [44]. This is consistent with the contemporary view that children are consumption rather than capital [40].

Robinson found that age of children was more significant than the number of children in predicting the amount of child care produced. The age of the parent was also a predictor, because it reflects the age of the children; marital status was a predictor because it is correlated with having children present. However, the number of children, not the age of children, increases the amount of home production. Note the distinction; child care is just one type of home production. Robinson found that number and age of children clearly affect household and family care, but only for women. However, men spent more time with children as the children got older. Children also had an effect upon amount of time allocated to sleep, in that women with children slept less. Employed women with children worked 15 minutes less in the market than employed women without children. Thus, children had an effect upon time allocated to working in the market [35]. An interesting note was that:

> Women with more children did more of the "core" housework of cooking and cleaning, but spent no more on other house-related duties than women with fewer children [35, p. 65].

Overall, parenthood had more impact upon time allocation than marital status, but did not have as much effect as employment status [35].

Marital Status

Major studies have shown that marital status had less effect than sex, employment status and parenthood [35, 44]. Marital status was associated with more home production, probably due to the greater likelihood of children being present [35, 44]. Gronau found that married people had less leisure time than unmarried people because of

marriage and the existence of children [19]. However, considering that men do very little home production, it is understandable that being married would add some home production activities to the wife's schedule, even without children present.

Age and Gender

Gender was the most significant variable in determining the amount of home production time. The roles are defined to a significant degree, with women doing over 80 percent of home production. Even when women are employed, they do the bulk of home production. Also the variables which affect time allocated to home production, namely, number and age of children and employment status, affected women's time allocation, not men's [35, 44].

Age was significant for both men and women, but much more so for women. For women, age is associated with the age of children and at certain ages women would be more likely to work in the market. Thus, age may be interacting with employment status or age of children [35, 44].

Outside Help

Walker's study showed that little home production was done by anyone outside the family or by commercial services [44]. And Robinson found that when outside help was used, it did not have much effect unless there was full-time outside help [35].

> Even those few women who enjoyed the luxury of outside household help appeared to spend just about as much time doing housework as those without help [35, p. 30].

Robinson also did not find a difference in home production time due to household appliances; women spent as much time doing some form of home production, whether or not they had labor-saving devices [35].

VI. JOINT PRODUCTION

The idea of a production function existing for a family is now widely accepted.[4] However, joint production has received only slight attention in household production functions [16, 34]. Joint production is defined to mean production of more than one output with a specific combination of inputs. Joint production has been recognized by researchers, however none of those researchers investigated it because of the difficulties in measurement [4, 19, 30]. Thus the models developed by Becker, Michael and Gronau contain the assumption that there is no joint production [19, 30].

Pollak and Wachter stated that the household production function approach is not useful in the joint production case. However, they viewed joint production as production-consumption [34]. In this sense, joint production means one doing both home production and consumption in the same activity. In assessing the value of home production, Borsodi realized that more than one activity could be done simultaneously. He also recognized production-consumption and suggested that one could socialize tasks to make them more enjoyable. For example, a couple could wash dishes together; hence enjoying each other's company and conversation

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[4]Various studies of time allocation have used the household production function approach [3, 6, 10, 15, 16, 17, 20, 25, 28, 30, 34].

while doing home production [9]. It is recognized that many home production tasks are also pleasurable [4, 35]. In that case, time is both an input and an output [34]. As a result, Pollak and Wachter suggested avoidance of commodity prices when joint production is present. They did no empirical testing; furthermore, they did not consider the case of two or more commodities obtained with a specific set of inputs, unless it was the production-consumption situation.

Grossman defined joint production to be the use of one input to produce simultaneously more than one commodity. Thus, his analysis was similar to the by-product analysis in microeconomic theory of the firm. For example, a by-product of smoking is poor health. Grossman developed a model but did no empirical testing [16].

Steidl did not use an economic model, but did empirical testing of joint production in household work. Data collected in 1952 on time-use by homemakers were used and tasks were analyzed in blocks which signified joint production. "In more than 85 percent of all blocks, homemakers reported only one activity and allocated about 80 percent of their time to them" [41, p. 20]. The remaining time was presumably devoted to joint production. "The proportion of time for singly reported activities did not vary appreciably with the type of homemaker" [41, p. 11]. Full-time homemakers did define more blocks than employed homemakers. Steidl's study did not specifically identify variables which affected joint production.

The idea that joint production has certain costs associated with it over and above the costs of production of a single commodity has been identified [33, 50]. If there were no extra cost, joint production would

always occur since more is preferred to less. A 1959 study analyzed satisfaction of home production with employed homemakers and found that employed homemakers did experience greater time pressures and showed slightly less satisfaction with their own situation [33].

> There was evidence, however, that outside employment influenced the way housework was done. Forty-four percent indicated changes . . . such as "Now I keep three machines going . . . ! [33, p. 26].

An implication of that study was that more joint production may occur when homemakers were employed outside the home and also that employed homemakers may experience more stress in the form of time pressures.

A recent study on the quality of child care showed that when joint production occurred there was some decline in quality of child care. An experimental design was used and observation was made in two situations. The first situation was a 10-minute period where mothers were left alone in a room with their children. The second situation was the same as the first, except that the mothers were given a task to do during that time. The quality of child care was determined to decline in the second situation; hence, quality of child care decreased when joint production occurred [50]. This decrease was a cost associated with joint production.

Home production literature mentions types of activities which have been decreasing or increasing in frequency. Perhaps those activities which can be produced jointly or produced in conjunction with consumption are the ones which are increasing. Leisure activities which can be done in conjunction with home production may be chosen so that more home production can be done. For example, there has been a decrease in

reading and an increase in television viewing [35]. In view of the above, joint production within the household may be occurring with greater frequency than in the past.

CHAPTER III

THEORETICAL FORMULATIONS AND PROCEDURES

I. A JOINT PRODUCTION MODEL

A model of joint production must relate the production of at least two commodities using the same input or inputs. Utility (satisfaction) is a function of commodities which are jointly produced, those which are singly produced and consumed or leisure time. The following model was developed with utility defined as a function of four commodities: Z_1, Z_2, Z_3 and Z_4, and consumption time, L. In the model Z_1 and Z_2 are commodities which are produced using both goods inputs, x_i, and time inputs, h_i, where i = 1, 2, 3.

(1) $U = U(Z_1, Z_2, Z_3, Z_4, L)$

(2) $Z_1 = f(x_1, h_1)$

(3) $Z_2 = g(x_2, h_2)$

(4) $Z_3, Z_4 = F(x_3, h_3)$

Equation (4) was rewritten in the following form for ease in mathematical formulation:

(4.1) $F(Z_3, Z_4, x_3, h_3) \geq 0.$

A family faces both time and budget constraints. The budget constraint was written as follows:

(5) $V + Nw \geq p_1x_1 + p_2x_2 + p_3x_3$

where p is the price of each goods input, N is time spent working in the market, w is the market wage rate and V is nonearned income.[1] The time constraint was written as follows:

$$(6) \quad T \geq N + L + H,$$

where T represents total time, L is the time devoted to leisure activities and H is the time devoted to home production in the production of Z's. In this model, only four commodities can be produced with the amount of H. If all four commodities are produced, then:

$$(6.1) \quad H = h_1 + h_2 + h_3.$$

Thus equation (6) becomes:

$$(6.2) \quad T \geq N + L + (h_1 + h_2 + h_3).$$

It was assumed that Z_3 is a substitute for Z_1, and Z_4 is a substitute for Z_2. An individual would produce either Z_1 or Z_2 or produce jointly Z_3 and Z_4 during a given time period. That is, the individual would do either joint production or production of a single commodity at one time, but not both. Z_1 and Z_2 are preferred to Z_3 and Z_4 because, as noted earlier, the latter have the negative features (lower quality and stress) associated with joint production.

Utility is maximized subject to the time and budget constraints and the production functions. For maximization, the following equation is formulated from equations (1) through (6.2).

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[1] Relative prices of goods were not crucial to this analysis. It was assumed that price of x_1 equals price of x_2 equals price of x_3.

$$(7)\quad \phi = U[f(x_1, h_1), g(x_2, h_2), F(x_3, h_3), L] + \lambda_1[V + Nw - (x_1 + x_2 + x_3)] + \lambda_2[T - N - L - (h_1 + h_2 + h_3)].$$

Equilibrium conditions, defined by partial derivatives, are as follows:

$$(7.1)\quad \frac{\partial \phi}{\partial x_1} = \frac{\partial U}{\partial Z_1}\frac{\partial f}{\partial x_1} - \lambda_1 \leq 0$$

$$(7.2)\quad \frac{\partial \phi}{\partial x_2} = \frac{\partial U}{\partial Z_2}\frac{\partial g}{\partial x_2} - \lambda_1 \leq 0$$

$$(7.3)\quad \frac{\partial \phi}{\partial x_3} = \left(\frac{\partial U}{\partial Z_3} + \frac{\partial U}{\partial Z_4}\right)\frac{\partial F}{\partial x_3} - \lambda_1 \leq 0$$

$$(7.4)\quad \frac{\partial \phi}{\partial h_1} = \frac{\partial U}{\partial Z_1}\frac{\partial f}{\partial h_1} - \lambda_2 \leq 0$$

$$(7.5)\quad \frac{\partial \phi}{\partial h_2} = \frac{\partial U}{\partial Z_2}\frac{\partial g}{\partial h_2} - \lambda_2 \leq 0$$

$$(7.6)\quad \frac{\partial \phi}{\partial h_3} = \left(\frac{\partial U}{\partial Z_3} + \frac{\partial U}{\partial Z_4}\right)\frac{\partial F}{\partial h_3} - \lambda_2 \leq 0$$

$$(7.7)\quad \frac{\partial \phi}{\partial N} = \lambda_1 w - \lambda_2 \leq 0$$

$$(7.8)\quad \frac{\partial \phi}{\partial L} = \frac{\partial U}{\partial L} - \lambda_2 \leq 0$$

λ_1 and λ_2 solutions are as follows:

$$(8)\quad \lambda_1 \geq \text{maximum}\left\{\frac{\partial U}{\partial Z_1}\frac{\partial f}{\partial x_1}, \frac{\partial U}{\partial Z_2}\frac{\partial g}{\partial x_2}, \left(\frac{\partial U}{\partial Z_3} + \frac{\partial U}{\partial Z_4}\right)\frac{\partial F}{\partial x_3}\right\}$$

$$(9) \qquad \lambda_2 \geq \text{maximum} \left\{ \frac{\partial U}{\partial Z_1} \frac{\partial f}{\partial h_1}, \frac{\partial U}{\partial Z_2} \frac{\partial g}{\partial h_2}, \left(\frac{\partial U}{\partial Z_3} + \frac{\partial U}{\partial Z_4} \right) \frac{\partial F}{\partial h_3}, \frac{\partial U}{\partial L}, w \lambda_1 \right\}$$

If the price of producing Z_1 plus the price of producing Z_2 is less than or equal to the price of jointly producing (Z_3, Z_4), then one would always produce Z_1 and Z_2 singly, because the commodities produced singly are preferred. However, prices are not always equal. More time is required to produce Z_1 and Z_2 singly than is required to produce Z_3 and Z_4 jointly. Thus, Z_1 and Z_2 possess greater time costs relative to Z_3 and Z_4. Certain factors, such as employment status and market wage rate may cause time costs to increase or decrease. As time becomes more and more expensive, there will be some point where an individual shifts from single production of Z_1 or Z_2 to joint production of Z_3 and Z_4. If the ratio of marginal utilities to price is greater for (Z_3, Z_4) than for Z_1 plus Z_2, then one will choose to do joint production. The following relationship indicates that situation:

$$(10) \qquad \frac{MU_{Z_3,\, Z_4}}{P_{Z_3,\, Z_4}} > \frac{MU_{Z_1}}{P_{Z_1}} + \frac{MU_{Z_2}}{P_{Z_2}}$$

Using the market wage rate as the shadow price of time, then as w increases, the cost of producing all commodities increases. However, the increase is greater for Z_1 and Z_2 because of their greater time costs. When these costs become greater, the ratios of marginal utilities of Z_1 and Z_2 to their respective prices become smaller and one would shift from production of them to the jointly-produced commodities, as is shown in equation (10).

II. IMPLICATIONS OF THE MODEL

Individuals will shift from time-intensive commodities to goods-intensive commodities as w increases. This is consistent with previous models [4, 19]. The following equation is derived from equations (7.1), (7.4) and (7.7):

$$(9.1)\quad \lambda_2 = \lambda_1 w = w\left[\frac{1}{p}\left(\frac{\partial U}{\partial Z_1}\frac{\partial f}{\partial x_1}\right)\right] = \frac{\partial U}{\partial Z_1}\frac{\partial f}{\partial h_1}\ .$$

As market wage increases, the value of productivity of goods inputs, x_1, in the production of Z_1 will increase and become greater than the value of productivity of time, h_1. The same is true for the other commodities in the model. Hence, one will substitute x for h in the production of commodities.

A shift from single production to joint production is also implied by the model. Consider equation (9); as w increases, $w\lambda_1$ increases, and one or more other terms in the equation must decrease. Hence, the following relationship comes from equation (9):

$$(9.2)\quad \frac{\partial U}{\partial Z_1}\frac{\partial f}{\partial h_1} \gtreqless \left(\frac{\partial U}{\partial Z_3} + \frac{\partial U}{\partial Z_4}\right)\frac{\partial F}{\partial h_3} = \lambda_2 = \lambda_1 w$$

Hours Worked in the Market

Market wage rate may increase due to a variety of factors. If individuals obtain more education or experience, they may be able to find employment paying a higher wage than before. Obviously, someone

working earns more than someone unemployed.[2] Someone working full time usually earns a higher wage than someone working only part time. Also, someone who works overtime in addition to full time generally receives a higher average wage rate than one who does not work overtime. Thus, in some cases a higher wage rate is associated with more time allocated to working in the market.

Given that $T = N + L + H$, an increase in N must be accompanied by a decrease in L and/or H. However, goods inputs are not always available or desirable to compensate for decreased time available for home production. In order to produce certain commodities with less time, an individual may shift to joint production. For example, assume an individual only had one hour to devote to home production. In this case, total time available for home production, H, equals one hour. Furthermore, assume that the production of Z_1 requires one hour; the production of Z_2 requires one hour; and the production of Z_3 and Z_4 produced jointly requires one hour. Thus, one can use that hour to produce either Z_1 or Z_2 or (Z_3, Z_4), but not all four commodities. The individual may very well choose to obtain both Z_3 and Z_4 rather than only one of the commodities produced singly. In other words, an individual could have two commodities which are less desirable individually, but be better off by virtue of having two commodities instead of only one.

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[2] An exception may occur when one has few skills and can earn more on welfare, but that is not the typical case.

The relationships between utility and the time input are represented in the graph below (Figure 2). The curves represent quantities of the commodities which can be produced. Assume the production of (Z_3, Z_4) gives a curve on which marginal utility declines more rapidly than it does for Z_1 or Z_2.

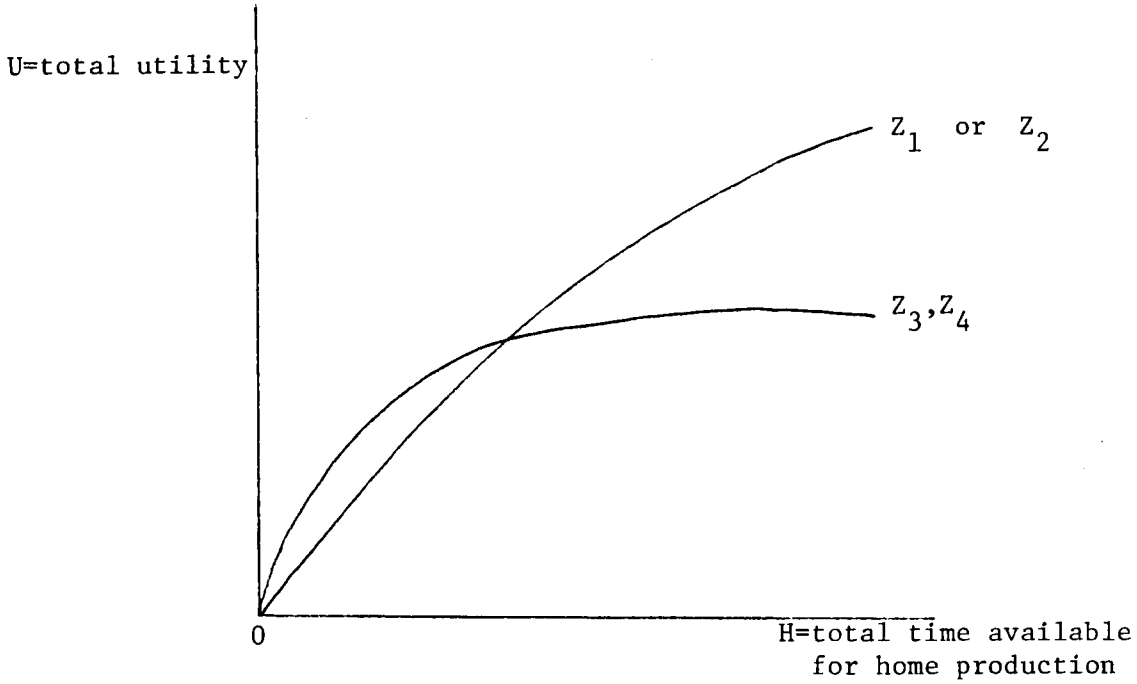

Figure 2. Relationships between utility and time input.

When the amount of H is small, the individual would be better off to produce (Z_3, Z_4) because total utility would be greater for (Z_3, Z_4) than for Z_1 or Z_2. As H becomes greater, production of a single commodity becomes preferable to a substitute commodity obtained through joint production. When one has a large amount of time to devote to the home production of commodities, production will be in favor of the

commodities produced singly. If one does not have much time to devote to home production, quality standards may be lowered so that more commodities are obtained with the small amount of home production time.

Market Wage Rate

As stated earlier, less time will be allocated to home production when the market wage rate increases. There is an inverse relationship between market wage rate and amount of time devoted to home production, but a direct relationship between market wage rate and amount of time devoted to joint home production. As market wage rate increased, it was expected that the amount of time allocated to work in the market would increase. Hence, employed individuals were expected to allocate less time to home production than unemployed individuals, but more time to joint production.

Education

Education increases productivity in the market and a more educated individual generally earns a higher wage. Michael also found that education increased productivity in the home, reflecting greater efficiency in the production of commodities [30]. Someone with a higher education may be better able to produce satisfactory commodities through a joint production process. Thus there are two directional effects of education upon home production. The first is that increased education is correlated with more work in the market and a decrease in home production. The second effect is that increased education increases the amount of joint production. Hence, education was expected to be

inversely related to the amount of home production time, but directly related to the amount of joint production time.

Gender

Women tend to earn a lower market wage than men; therefore, being female was expected to be correlated with more home production time. Even if w were large, women were expected to allocate more time to H than men, based on previous findings of time allocation studies [35, 44]. It was expected that women would engage in more joint production than men because they do so much more home production.

Number of Children

As the number of children increase there is a greater need for home production and also a need for joint production. However, an increase in the number of children also decreases the likelihood of market work, because of the costs associated with going to work as well as the increased demand for home production. Hence, there is a bi-directional effect upon time allocated to joint production, that being a shift toward less market work which is away from joint production and a shift toward more joint production as a result of the increased demand for all home production, especially child care which must often be done in conjunction with other activities.

Unearned Income

Unearned income, V, of the individual was defined as the family's total income and other monetary assets minus the individual's market earnings. The greater the unearned income, the more ability the family

has to purchase goods in the market. Thus, home production time was expected to decrease as V increases. However, Gronau and Robinson did not find any significant effect of V upon H [19, 35]. Also, as V increases for the family, there may be a decrease in N because the family has dollars from other sources. If N decreased, one would have more time for home production and a decrease in joint production would be expected.

Size of House

A particular form of wealth, size of house, was also expected to be significant, in that the larger the house the more home production is required. If more home production is required, it was expected that more joint production would be demanded in this case, because more home production required is not directly tied to amount of time available for home production. For example, one with a large home would need more home production time to maintain the house, but one would also need more money to pay for the house. Hence, the individual may choose to work in the market and compensate for lost home production time by doing more joint production.

Consumption Technology

Because commodities are combinations of goods and time inputs, an increase in the goods input may enable one to produce more output, with less time input. If one owns many time-saving appliances, he/she may be able to perform many home production tasks within a short time period, hence engage in more joint production. Also, time-saving appliances

cost money; in order to acquire the money, one may have to increase the amount of time worked in the market so that more time-saving appliances would indirectly lead to less home production time and encourage joint production.

III. EMPIRICAL TESTING OF MODEL IMPLICATIONS

Data Collection and Sample

Implications of the joint production model were tested by using time-budget data gathered by the Survey Research Center, Institute for Social Research, Ann Arbor, Michigan. A national probability sample consisting of 1,519 respondents and 887 spouses, drawn from 37 states within the United States was surveyed by interviewers for the Survey Research Center. Respondents consisted of both males and females and thus, were not necessarily the head of the household. Each respondent was interviewed four times: October-November 1975, February 1976, May 1976, and September 1976. The first interview was a personal contact in the respondents' homes; the successive interviews were conducted over the telephone.

Respondents were asked specific questions relating to demographic information and life satisfaction. Each respondent was asked to fill out a time diary during each interview. The "yesterday approach" was used to gather data on time allocation. Respondents filled out a diary of time use for the day preceding the day of the interview. This method was used in the 1965-1966 study conducted by the Survey Research Center (SRC) and has been tested for validity. A series of small-scale validity studies was conducted applying direct (TV cameras) and indirect (beepers

that went off at random intervals to signal respondents to write down what they were doing) observational methods for comparison with diary entries over the same period [35, p. 10]. Reliability tests were also conducted by comparing time-diary figures to a sample city and to Szalai's multinational study. "The correlation across the 96 categories of time use, between the Jackson (sample city) and national time-use aggregates, as measured by Yule's Y, was .95" [35, p. 10]. There was also strong correspondence with the multinational study [35].

In the first column of the time diary, beside the appropriate time, respondents listed their primary activities. In another column called "doing anything else" they listed any activities they were doing simultaneously with the primary activity. Those activities were coded by SRC as secondary activities. A secondary activity was one which was done in conjunction with another activity. The amount of time devoted to secondary activities was used as a measure of the time allocated to joint production or production-consumption in this study. Secondary activities were not coded for spouses; thus, only respondents were used in this analysis.

The data were also filtered on the basis of marital status; only married respondents were used in this study. Thus, the sample used consisted of 603 married respondents: 290 males and 313 females. Only married respondents were included because a married individual has greater latitude in the decision whether or not to work in the market. Hence, a single individual generally must work in the market whether he/she is more productive in the market or not, whereas a married respondent could possibly rely on income earned by his/her spouse.

Data Analysis

Data were collected for one Saturday, one Sunday and two weekdays, so as to have a fairly representative sample of how Americans use time. Total time allocated to nonmarket activities was averaged over the four days. Nonmarket time was all time not allocated to working in the market and was computed for each day by subtracting the number of minutes spent working in the market from 1440 (total number of minutes in a day). Total time allocated to secondary activities was also averaged over all four days. Because time use varies greatly from weekday to weekend, average secondary time for the two weekdays and for the wekend days was also computed. Thus, there were four dependent variables: average total nonmarket time, average total secondary time, average weekday secondary time and average weekend secondary time.

Simple linear regressions were used to test for relationships of the dependent variables with time allocated to nonmarket activities and to secondary activities (joint production). The independent variables were: education level, hours worked per week in the market, unearned income, size of house, consumption technology, market wage rate, number and ages of children.

Education was reported as the highest number of years the respondent completed in school. Work in the market was reported in three ways: hours worked per week, minutes worked on the day of the time diary and employment status (no market work, work less than twenty hours per week and work twenty hours or more per week). Hours worked per week was used as the independent variable in the regression equations. Minutes worked in the market on the diary day were used to compute nonmarket time that

day. Employment status was used as an independent variable for the analysis of variance tests.

Unearned income was all income which was not earned by the respondent working in the market, and was computed by adding the monthly salary of the respondent's spouse plus any monthly income from dividends, interest earnings and any other source of unearned income. Size of house was reported as the number of square feet in the house. Consumption technology referred to a stock of goods inputs which affect the amount of time devoted to home production, such as lawn mowers and household appliances. Consumption technology was approximated by totaling the number of certain capital possessions owned by the respondents.

Respondents listed their salary earned the previous week; market wage rate per hour was computed by dividing weekly salary by the number of hours worked per week in the market. Number of children was the total number of children under eighteen years of age, living in the household. Ages of respondents' children were coded as children less than five years of age, five through twelve years of age, or thirteen through seventeen years of age.

Because of missing data for some of the independent variables, simple linear regressions were used. Time allocated to home production varies greatly between males and females, so regressions were computed separately for males and females. A regression equation which included the four most significant variables was also analyzed. In addition to regression analyses, a t-test was used to see if there were any statistical differences between male and female respondents' educational

level, hours worked per week, market wage rate and average total secondary time.

One-way analysis of variance was used to test the effects of children's ages upon the amount of time devoted to secondary activity. This test was used for the entire sample and for females in the sample. Respondents were divided into eight groups by the researcher. Each respondent was placed in one of the following groups: respondents with no children, those with only children less than five years of age, those with only children ages thirteen through seventeen, those with children less than five and children five through twelve, those with children less than five and children thirteen through seventeen, those with children five through seventeen and those with children in all three age groups.

Children have been shown to be a significant factor in allocating time to home production by females [35, 44]. Therefore, to determine the effect of work in the market upon joint production for females, data were controlled for the presence of children. One-way analysis of variance was done for employment status and secondary time, including only those female respondents with no children. The analysis was repeated including only those with children under twelve years of age. Each analysis of variance was done separately with the three ways of computing secondary time. Simple linear regression equations were also compared for hours worked in the market per week and secondary time with females controlled for the presence of children (no children, children less than five, and children five through twelve).

A $p < 0.10$ level was used for all the analyses. It was suspected that joint production was underrepresented in these data because many individuals might not have recalled their secondary activities from the previous day. The underrepresentation, to the extent it occurs, causes biased coefficients.

CHAPTER IV

RESULTS

I. STATISTICAL FINDINGS

Descriptive statistics for the sample are given in Table I. Sample size did not always equal 603 because of missing data for some variables. Four variables (education, hours worked per week, market wage earned per hour and average total secondary time) were examined according to sex of the respondent (Table II). Both male and females had a mean education level of slightly more than high school. On the average, men worked more than twice as many hours per week in the market as women and earned almost twice as much money per hour. Women devoted more time to secondary activities (joint home production) than men.

A t-test was used to analyze differences between males and females for selected variables (Table III). There was no statistical difference in educational level between men and women. However, there were differences between males and females for hours worked per week, wage earned per hour and average total secondary time. Standard deviations were greater for men than for women, indicating a wider range of values (Table II). An F test revealed that the variances were different between males and females for education and wage per hour, so a separate variance estimate was used in the t-test to determine if there were differences in education and wage per hour. An F test showed variances to be the same between males and females for hours worked per week and

TABLE I

DESCRIPTIVE STATISTICS: MARRIED RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976, BOTH MALES AND FEMALES

Variable	Mean	Standard Deviation	Range	Sample Size
Educational Level, Years	12.4	2.96	0-17.0	602
Square Feet in House	1770.7	1428.50	420.0-9995.0	324
Hours Worked/Week	26.0	23.03	0-98	596
Number of Children in Household	1.3	1.46	0-6	603
Unearned Income	$1076.78	1360.54	$1.00-$12,595	459
Consumption Technology	13.9	3.16	1-25	603
Market Wage/Hour	$5.43	4.35	$.51-$32.99	287
Average Total Secondary Time, Minutes/Day	397.9	147.58	50.2-1004.2	603
Average Weekend Secondary Time, Minutes/Day	427.56	188.88	0-1022.0	603
Average Weekday Secondary Time, Minutes/Day	372.3	190.09	0-1140.0	603
Average Total Nonmarket Time, Minutes/Day	1229.2	242.03	510.0-1440.0	603

TABLE II

DESCRIPTIVE STATISTICS OF SELECTED VARIABLES: MARRIED RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976

Variable	Mean	Standard Deviation	Sample Size
Education; Number of Years			
M	12.6	3.38	289
F	12.2	2.49	313
Hours Worked Per Week in Market			
M	37.2	21.27	287
F	15.6	19.45	309
Wage/Hour			
M	$6.73	4.80	174
F	$3.43	2.48	113
Average Total Secondary Time, Minutes			
M	380.6	150.90	290
F	413.9	142.81	313

TABLE III

SUMMARY OF t-TEST FOR SIGNIFICANT DIFFERENCES BETWEEN MALES AND FEMALES: MARRIED RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976

Variable	t-Values	Degrees of Freedom[a]	Probability
Education Level	1.59	527	.113
Hours Worked Per Week	12.91	594	.000
Wage/Hour	7.64	273	.000
Average Total Secondary Time	-2.79	601	.005

[a]For education level and wage/hour, a separate variance estimate was used so that degrees of freedom were slightly less than would have been if a pooled variance estimate had been used.

average total secondary time. A pooled variance estimate was used in obtaining a t value for those two variables (Table III).

Simple linear regressions were computed using various dependent variables, including average total nonmarket time and average secondary time. For the latter, three measures were used: average total, average weekend and average weekday. Analyses were done using the entire sample and then with males and females separately. Results for each independent variable are discussed below. Significance was set at the $p < 0.10$ level.

Education

Education emerged as the most significant variable for joint production time. For average total secondary time, education was significant with both males and females (Table IV). Individuals having higher levels of education spent more time doing two activities simultaneously than did those with less education. The same was true for weekend time (Table V). However, when weekday secondary time was the dependent variable, education was significant for males only (Table VI). The same was true for nonmarket time (Table VII). In this case however, males with higher levels of education spent less time in nonmarket activity than those with lower levels of education. None of the regression equations explained more than 5 percent of the variation.

Hours Worked Per Week in the Market

Respondents' number of hours worked in the market per week was a significant variable for all four dependent variables for males. As males worked more hours in the market, they also allocated more time to secondary activities (Tables IV-VI). The relationship was just the

TABLE IV

REGRESSION RESULTS FOR AVERAGE TOTAL SECONDARY TIME: MARRIED RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976 (STANDARD ERRORS IN PARENTHESES)

Variable	Sample Size	Constant	Slope	R^2 $[\bar{R}^2]$	F	Significance	Standard Error Estimate
Education							
Males	289	257.86 (33.457)	9.79 (2.574)	0.0480 [0.0447]	14.470	0.000	(147.700)
Females	313	316.01 (39.916)	8.05 (3.214)	0.0198 [0.0166]	6.266	0.013	(141.622)
Hours Worked Per Week							
Males	287	304.22 (17.183)	2.08 (0.401)	0.0861 [0.0828]	26.857	0.000	(144.427)
Females	309	406.95 (10.393)	0.43 (0.418)	0.0035 [0.0025]	1.078	0.301	(142.568)
Unearned Income							
Males	207	381.59 (12.593)	0.00 (0.008)	0.0017 [0.0000]	0.349	0.280	(153.701)
Females	252	393.65 (12.294)	0.02 (0.007)	0.0305 [0.0267]	7.870	0.005	(141.641)

TABLE IV (CONTINUED)

Variable	Sample Size	Constant	Slope	R^2 [$\overline{R^2}$]	F	Significance	Standard Error Estimate
Number of Children							
Males	290	370.99 (11.549)	7.50 (5.815)	0.0057 [0.0022]	1.663	0.099	(150.723)
Females	313	403.99 (11.086)	7.51 (5.766)	0.0054 [0.0022]	1.695	0.194	(142.653)
Square Feet in House							
Males	183	352.86 (17.206)	0.01 (0.007)	0.0081 [0.0026]	1.478	0.112	(148.760)
Females	141	421.38 (18.588)	-0.00 (0.008)	0.0003 [0.0000]	0.043	0.835	(134.454)
Consumption Technology							
Males	290	377.29 (49.942)	0.23 (2.839)	0.0000 [0.0000]	0.006	0.467	(151.156)
Females	313	379.61 (35.866)	2.49 (2.533)	0.0031 [0.0000]	0.964	0.327	(142.820)
Wage Earned Per Hour							
Males	174	428.29 (18.665)	-3.04 (2.260)	0.0104 [0.0046]	1.808	0.090	(142.621)
Females	113	427.07 (24.925)	-1.74 (5.895)	0.0008 [0.0000]	0.087	0.769	(154.848)

TABLE V

REGRESSION RESULTS FOR AVERAGE WEEKEND SECONDARY TIME: MARRIED RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976 (STANDARD ERRORS IN PARENTHESES)

Variable	Sample Size	Constant	Slope	R^2 [$\bar{R}^2$]	F	Significance	Standard Error Estimate
Education							
Males	289	299.60 (43.915)	9.32 (3.378)	0.0259 [0.0225]	7.631	0.003	(193.870)
Females	313	285.60 (50.582)	12.53 (4.073)	0.0295 [0.0264]	9.457	0.002	(179.467)
Hours Worked Per Week							
Males	287	347.28 (22.954)	1.85 (0.536)	0.0401 [0.0367]	11.906	0.000	(192.928)
Females	309	432.14 (13.309)	0.37 (0.535)	0.0016 [0.0000]	0.486	0.487	(182.576)
Unearned Income							
Males	207	414.28 (16.628)	-0.00 (0.011)	0.0000 [0.0000]	0.000	0.446	(202.945)
Females	252	420.77 (15.606)	0.02 (0.008)	0.0167 [0.0128]	4.254	0.040	(179.789)

TABLE V (CONTINUED)

Variable	Sample Size	Constant	Slope	R^2 [$\bar{R}^2$]	F	Significance	Standard Error Estimate
Number of Children							
Males	290	408.22 (15.014)	6.34 (7.560)	0.0024 [0.0000]	0.693	0.201	(195.951)
Females	313	429.99 (14.142)	6.06 (7.356)	0.0022 [0.0000]	0.679	0.411	(181.978)
Square Feet in House							
Males	183	394.67 (22.463)	0.00 (0.010)	0.0001 [0.0000]	0.018	0.457	(194.211)
Females	141	454.72 (24.427)	-0.00 (0.011)	0.0004 [0.0000]	0.063	0.802	(172.692)
Consumption Technology							
Males	290	431.37 (53.132)	-1.07 (3.684)	0.0003 [0.0000]	0.086	0.386	(196.162)
Females	313	384.35 (45.643)	3.89 (3.223)	0.0047 [0.0015]	1.469	0.229	(181.751)
Wage Earned Per Hour							
Males	174	455.99 (24.448)	-1.55 (2.960)	0.0016 [0.0000]	0.276	0.300	(186.81)
Females	113	443.11 (30.538)	0.08 (7.223)	0.0000 [0.0000]	0.000	0.992	(189.719)

TABLE VI

REGRESSION RESULTS FOR AVERAGE WEEKDAY SECONDARY TIME: MARRIED RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976
(STANDARD ERRORS IN PARENTHESES)

Variable	Sample Size	Constant	Slope	R^2 [$\bar{R}^2$]	F	Significance	Standard Error Estimate
Education							
Males	289	217.18 (42.751)	10.39 (3.289)	0.0336 [0.0302]	9.978	0.001	(188.729)
Females	313	360.68 (52.557)	2.85 (4.232)	0.0015 [0.0000]	0.452	0.502	(186.473)
Hours Worked Per Week							
Males	287	263.65 (21.918)	2.32 (0.512)	0.0670 [0.0637]	20.466	0.000	(184.223)
Females	309	389.77 (13.590)	0.34 (0.546)	0.0012 [0.0000]	0.381	0.537	(186.419)
Unearned Income							
Males	207	348.03 (15.880)	0.01 (0.010)	0.0053 [0.0004]	1.092	0.149	(193.818)
Females	252	373.29 (16.123)	0.02 (0.009)	0.0167 [0.0128]	4.248	0.040	(185.753)

TABLE VI (CONTINUED)

Variable	Sample Size	Constant	Slope	R^2 [$\bar{R}^2$]	F	Significance	Standard Error Estimate
Number of Children							
Males	290	337.32 (14.655)	7.98 (7.378)	0.0040 [0.0005]	1.157	0.140	(191.262)
Females	313	381.05 (14.454)	10.81 (7.518)	0.0066 [0.0034]	2.066	0.152	(185.991)
Square Feet in House							
Males	183	316.60 (22.886)	0.02 (0.010)	0.0166 [0.0112]	3.055	0.041	(197.866)
Females	141	392.19 (24.466)	-0.00 (0.011)	0.0001 [0.0000]	0.008	0.926	(176.978)
Consumption Technology							
Males	290	329.48 (51.899)	1.28 (3.599)	0.0004 [0.0000]	0.115	0.361	(191.608)
Females	313	378.51 (46.852)	1.22 (3.308)	0.0004 [0.0000]	0.137	0.713	(186.568)
Wage Earned Per Hour							
Males	174	392.66 (26.210)	-2.64 (3.174)	0.0040 [0.0000]	0.691	0.203	(200.275)
Females	113	411.07 (32.023)	-3.55 (7.574)	0.0020 [0.0000]	0.220	0.640	(198.949)

TABLE VII

REGRESSION RESULTS FOR AVERAGE NONMARKET TIME: MARRIED RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976
(STANDARD ERRORS IN PARENTHESES)

Variable	Sample Size	Constant	Slope	R^2 [$\bar{R}^2$]	F	Significance	Standard Error Estimate
Education							
Males	289	1277.05 (33.712)	-4.60 (2.593)	0.0109 [0.0075]	3.163	0.038	(148.825)
Females	313	1381.50 (33.669)	-2.61 (2.711)	0.0030 [0.0000]	0.926	0.336	(119.458)
Hours Worked Per Week							
Males	287	1394.06 (13.142)	-4.73 (0.307)	0.4541 [0.4522]	237.074	0.000	(110.460)
Females	309	1421.35 (5.740)	-4.65 (0.231)	0.5699 [0.5686]	406.770	0.000	(78.743)
Unearned Income							
Males	207	1229.91 (12.090)	-0.00 (0.008)	0.0020 [0.0000]	0.411	0.260	(147.553)
Females	252	1336.88 (10.425)	0.01 (0.006)	0.0095 [0.0055]	2.395	0.123	(120.107)

TABLE VII (CONTINUED)

Variable	Sample Size	Constant	Slope	R^2 $[\bar{R}^2]$	F	Significance	Standard Error Estimate
Number of Children							
Males	290	1259.54 (10.856)	-31.28 (5.466)	0.1021 [0.0989]	32.748	0.000	(141.677)
Females	313	1348.39 (9.297)	1.02 (4.835)	0.0001 [0.0000]	0.044	0.833	(119.627)
Square Feet in House							
Males	183	1241.99 (15.633)	-0.01 (0.007)	0.0077 [0.0077]	1.405	0.119	(135.159)
Females	141	1362.60 (15.324)	0.00 (0.007)	0.0003 [0.0000]	0.046	0.830	(110.845)
Consumption Technology							
Males	290	1292.38 (40.259)	-5.17 (2.791)	0.0118 [0.0084]	3.439	0.033	(148.634)
Females	313	1337.01 (30.035)	0.92 (2.121)	0.0006 [0.0000]	0.190	0.664	(119.600)
Wage Earned Per Hour							
Males	174	1139.60 (16.203)	5.30 (1.962)	0.0407 [0.0351]	7.297	0.004	(123.808)
Males	113	1262.99 (18.655)	-1.83 (4.412)	0.0016 [0.0000]	0.172	0.679	(115.894)

reverse for nonmarket time; when males worked more hours in the market they had less nonmarket time (Table VII).

Hours worked in the market per week was not a significant variable with secondary time for females (Tables IV-VI). However, the variable was significant for nonmarket time; increased hours worked in the market were associated with less nonmarket time (Table VII). Because nonmarket time was computed as total amount of time in the day (1440 minutes) minus time allocated to work in the market on that day, there was a high amount of the variation explained by the regression equation. None of the regression equations explained more than 1 percent of the variation.

Unearned Income

Unearned income (all income not earned in the market by the respondent) was a significant variable for all secondary time use with females (Tables IV-VI). Higher unearned income was associated with more secondary time. Unearned income was not significant with secondary time use for males (Tables IV-VI).

For nonmarket time, unearned income was not significant for either males or females. None of the regression equations explained more than 3 percent of the variation.

Number of Children

For average total secondary time, the respondents' number of children was a significant variable when only males were included in the analysis (Table IV). The presence of more children was associated with more joint production time by males. The number of children was not a

significant variable when only females were included in the analysis (Table IV). For weekend secondary time or for weekday secondary time, the number of children was not significant with either males or females (Tables V-VI). None of the regression equations explained more than 2 percent of the variation.

The number of children was significant for nonmarket time use with males (Table VII). In this equation, more children were associated with less nonmarket time for males. Ten percent of the variation was explained by the regression equation. The number of children was not significant for nonmarket time with females (Table VII).

Size of House

With average total secondary time and average weekend secondary time, size of house was not significant for either males or females (Tables IV-V). However, with average weekday secondary time, the size of house was significant for males; larger houses were associated with more secondary time. None of the regression equations explained more than 2 percent of the variation (Table VI). Size of house was not a significant variable with weekday secondary time for females (Table VI). Nonmarket time use was not associated with size of house for either males or females (Table VII).

Consumption Technology

Consumption technology, a proxy for the availability of time-saving appliances, was not a significant variable for any secondary time (Tables IV-VI). For nonmarket time use, consumption technology was significant with males but not females (Table VII). More appliances were

associated with less nonmarket time for males. None of the regression equations explained more than 2 percent of the variation.

Wage Rate Earned Per Hour

With average total secondary time, market wage rate was significant for males, but not females (Table IV). As males earned more money per hour, they allocated less time to secondary activities. With both weekend and weekday secondary time, wage rate was not significant for either males or females (Tables V-VI). However, wage rate was significant for males with nonmarket time; higher wages were associated with more nonmarket time (Table VII). Wage rate was not significant with nonmarket time for females (Table VII).

Regression with Four Variables

A regression equation including four of the independent variables (education, hours worked per week in the market, unearned income and the respondents' number of children) was analyzed also.[1] Results showed that the model was significant for all secondary time and for nonmarket time. However, there was variation among the models in terms of predictor variables.

In the model for males' average total secondary time, education and hours worked in the market added significantly to the model; the number of children and unearned income did not (Table VIII). Thirteen percent

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[1]Nonlinear possibilities were also checked but there was not a better fit than with the linear equations.

TABLE VIII

REGRESSION RESULTS FOR AVERAGE TOTAL SECONDARY TIME WITH FOUR INDEPENDENT VARIABLES: MARRIED RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976
(STANDARD ERRORS IN PARENTHESES)

Sex	Sample Size	Constant	Coefficient[a] β_1	β_2	β_3	β_4	R^2 [$\bar{R}^2$]	F	Significance	Standard Error Estimate
Males	206	220.01	7.028	2.320	0.003	-6.044	0.1467	8.637	.000	142.886
		(40.643)	(3.118)	(0.506)	(0.008)	(7.144)	[0.1297]			
Individual F[b]			5.082	21.037	0.123	0.716				
Females	250	297.40	6.936	0.486	0.016	6.221	0.0549	3.560	.008	141.028
		(46.043)	(3.870)	(0.480)	(0.007)	(6.374)	[0.0395]			
Individual F[c]			3.212	1.028	5.230	0.952				

[a] β_1 = Coefficient, Education.

β_2 = Coefficient, Hours Worked Per Week in Market.

β_3 = Coefficient, Unearned Income.

β_4 = Coefficient, Number of Children.

[b] Education and Hours Worked Per Week were significant in the model.

[c] Education and Unearned Income were significant in the model.

of the variation was explained with this model, using $\bar{R}^2$ rather than R^2.[2] The simple linear regression showed education, hours worked in the market and number of children to be significant, but the R^2 was lower than in the four-variable model (Table IV, page 56). In the model for females' average total secondary time, education and unearned income were significant, but hours worked per week and the number of children did not add significantly to explanatory power (Table VIII). Under 6 percent of the variation was explained by the model. Results of simple linear regressions identified the same predictor variables but explained less of the variation (Table IV, page 56).

Results from the model for males' average weekend time were the same as for males' average total secondary time; education and hours worked per week were the only two significant independent variables (Table IX). Eight percent of the variation was explained by the model. Results were consistent with the simple linear regressions, but there was improvement in the amount of variation explained (Table V, page 58). For females' average weekend secondary time, only education added significantly to the model (Table IX). Four percent of the variation was explained by the model. Simple linear regression also identified unearned income as significant and explained 2 percent of the variation (Table V, page 58).

Hours worked in the market was the only variable that added significantly to the model for males' average weekday secondary time

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[2] In order that more accurate comparisons could be made, $\bar{R}^2$ was computed for all the regression equations.

TABLE IX

REGRESSION RESULTS FOR AVERAGE WEEKEND SECONDARY TIME WITH FOUR INDEPENDENT VARIABLES: MARRIED RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976
(STANDARD ERRORS IN PARENTHESES)

Sex	Sample Size	Constant	Coefficient[a] β_1	β_2	β_3	β_4	R^2 [$\bar{R}^2$]	F	Significance	Standard Error Estimate
Males	206	242.585	8.513	2.008	-0.003	-4.687	0.0759	4.129	.003	196.971
		(56.026)	(4.298)	(0.697)	(0.010)	(9.848)	[0.0575]			
Individual F[b]			3.924	8.288	0.118	0.227				
Females	250	288.985	10.799	0.261	0.013	2.285	0.0386	2.462	.046	179.072
		(58.568)	(4.923)	(0.610)	(0.009)	(8.109)	[0.0229]			
Individual F[c]			4.812	0.183	2.034	0.794				

[a] β_1 = Coefficient, Education.

β_2 = Coefficient, Hours Worked Per Week in Market.

β_3 = Coefficient, Unearned Income.

β_4 = Coefficient, Number of Children.

[b] Education and Hours Worked Per Week were significant in the model.

[c] Only Education was significant in the model.

(Table X). Twelve percent of the variation was explained by the model. With the simple linear regression models, education, as well as hours worked in the market, was also significant; however, under 4 percent of the variation was explained in the model with education (Table VI, page 60). For females' average weekday time, unearned income was the only variable that added significantly to the model (Table X). Under 4 percent of the variation was explained by the model. This result was consistent with the simple linear model which explained 2 percent of the variation (Table VI, page 60).

In the model for nonmarket time, hours worked per week was a significant variable for both males and females. In addition, the respondents' number of children was also significant for males (Table XI). Forty-nine percent of the variation was explained for males' nonmarket time and 61 percent for females' nonmarket time. The simple linear models showed education to be significant for males' nonmarket time (Table VII, page 62).

Ages of Children

Results of the one-way analysis of variance test showed that children's ages were significant with average total secondary time and average nonmarket time, when the entire sample was included (Table XII). When the analysis included only females, children's ages were significant for all time use except weekday secondary time (Table XIII).

All groups had more time allocated to joint production for weekends than for weekdays (Tables XIV-XV). The highest amount of time devoted to secondary activities occurred with the respondents who had children

TABLE X

REGRESSION RESULTS FOR AVERAGE WEEKDAY SECONDARY TIME WITH FOUR INDEPENDENT VARIABLES: MARRIED RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976
(STANDARD ERRORS IN PAREHTNESES)

Sex	Sample Size	Constant	Coefficient[a] β_1	β_2	β_3	β_4	R^2 [$\bar{R}^2$]	F	Significance	Standard Error Estimate
Males	206	186.706	6.028	2.741	0.008	-7.428	0.1169	6.652	.000	183.064
		(52.071)	(3.994)	(0.648)	(0.010)	(9.153)	[0.0993]			
Individual F[b]			2.278	17.874	0.774	0.659				
Females	250	320.829	2.247	0.619	0.017	12.459	0.0319	2.018	.093	185.868
		(60.676)	(5.099)	(0.632)	(0.009)	(8.400)	[0.0161]			
Individual F[c]			0.194	0.958	3.586	2.200				

[a] β_1 = Coefficient, Education.

β_2 = Coefficient, Hours Worked Per Week in Market.

β_3 = Coefficient, Unearned Income.

β_4 = Coefficient, Number of Children.

[b] Only Hours Worked Per Week was significant in this model.

[c] Only Unearned Income was significant in this model.

TABLE XI

REGRESSION RESULTS FOR AVERAGE NONMARKET TIME WITH FOUR INDEPENDENT VARIABLES: MARRIED RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976

Sex	Sample Size	Constant	Coefficient[a] β_1	β_2	β_3	β_4	R^2 [$\bar{R}^2$]	F	Significance	Standard Error Estimate
Males	206	1389.92	0.754	-4.487	-0.004	-10.532	0.4890	48.095	.000	106.417
		(30.269)	(2.322)	(0.377)	0.006	(5.321)	[0.4788]			
Individual F[b]			0.105	141.838	0.527	3.919				
Females	250	1418.59	0.757	-4.975	0.002	-3.248	0.6142	97.505	.000	75.624
		(24.687)	(2.075)	(0.257)	0.004	(3.418)	[0.6079]			
Individual F[c]			0.133	373.379	0.310	0.903				

[a] β_1 = Coefficient, Education.

β_2 = Coefficient, Hours Worked Per Week in Market.

β_3 = Coefficient, Unearned Income.

β_4 = Coefficient, Number of Children.

[b] Hours Worked Per Week and Number of Children were significant in this model.

[c] Only Hours Worked Per Week was significant in this model.

TABLE XII

ANALYSIS OF VARIANCE: DEPENDENT VARIABLES BY AGES OF CHILDREN; MARRIED RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976, BOTH MALES AND FEMALES

Dependent Variable	Degree of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Average Total Secondary Time	7	314,962.19	44,994.60	2.0934	.0424
	593	12,745,570.54	21,493.37		
Average Weekend Secondary Time	7	409,200.52	58,457.22	1.6459	.1198
	593	21,061,203.05	35,516.36		
Average Weekday Secondary Time	7	324,198.37	46,314.05	1.2897	.2528
	593	21,294,394.44	35,909.60		
Average Nonmarket Time	7	39,057.02	56,579.57	2.5731	.0128
	593	13,039,294.55	21,988.69		

TABLE XIII

ANALYSIS OF VARIANCE: DEPENDENT VARIABLES BY AGES OF CHILDREN; MARRIED RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976, FEMALES ONLY

Dependent Variable	Degree of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Average Total Secondary Time	7	242,045.32	34,577.90	1.7178	0.1043
	304	6,119,162.13	20,128.82		
Average Weekend Secondary Time	7	469,854.18	67,122.03	2.0712	0.0464
	304	9,851,590.67	32,406.55		
Average Weekday Secondary Time	7	212,117.45	30,302.49	.8684	0.5318
	304	10,608,276.28	34,895.65		
Average Nonmarket Time	7	182,061.31	26,008.76	1,8523	0.0771
	304	4,268,583.47	14,041.39		

TABLE XIV

DEPENDENT VARIABLES BY RESPONDENTS' CHILDRENS' AGES: MARRIED RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976, BOTH MALES AND FEMALES

Group[a]	Sample Size	Average Total Secondary Time		Average Weekend Secondary Time		Average Weekday Secondary Time		Average Total Nonmarket Time	
		Means	Standard Deviation	Means	Standard Deviation	Means	Standard Deviation	Means	Standard Deviation
1	264	379.4	148.55	409.8	189.63	352.2	192.69	1312.2	142.57
2	77	445.7	143.11	480.9	188.36	413.0	192.15	1284.7	144.99
3	56	382.6	139.30	408.5	180.20	366.9	181.11	1260.7	139.76
4	50	417.3	170.40	444.4	192.50	390.3	211.84	1257.7	147.95
5	58	411.4	141.37	458.1	188.47	364.7	171.38	1271.0	161.08
6	2	349.1	272.09	443.8	224.51	254.5	319.61	1440.0	0.00
7	87	398.6	134.88	414.0	189.18	393.7	180.72	1256.6	167.25
8	7	413.5	139.97	440.4	159.82	386.6	149.96	1262.1	103.69

[a]1 = No children; 2 = children less than 5 only; 3 = children 5-12 only; 4 = children 13-17 only; 5 = children less than 5 and 5-12; 6 = children less than 5 and 13-17; 7 = children 5-12 and 13-17; 8 = children in all three age groups.

TABLE XV

DEPENDENT VARIABLES BY RESPONDENTS' CHILDRENS' AGES: MARRIED RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976, FEMALES ONLY

Group[a]	Sample Size	Average Total Secondary Time		Average Weekend Secondary Time		Average Weekday Secondary Time		Average Total Nonmarket Time	
		Means	Standard Deviation	Means	Standard Deviation	Means	Standard Deviation	Means	Standard Deviation
1	128	394.6	147.97	415.8	181.17	377.4	190.57	1349.8	119.99
2	40	471.9	136.48	514.0	183.25	437.0	184.05	1381.1	108.86
3	32	415.3	126.43	440.6	186.15	390.0	153.12	1318.1	116.50
4	32	444.6	182.28	479.7	203.55	409.5	230.35	1308.2	114.79
5	29	412.2	113.75	452.3	163.74	372.2	156.82	1385.3	114.18
6	2	349.1	272.09	443.8	224.51	254.5	319.61	1440.0	0.00
7	45	453.3	113.75	388.9	158.83	423.0	180.31	1349.7	131.09
8	4	414.0	164.14	476.3	186.11	430.4	165.29	1323.8	95.71

[a]1 = No children; 2 = children less than 5 only; 3 = children 5-12 only; 4 = children 13-17 only; 5 = children less than 5 and 5-12; 6 = children less than 5 and 13-17; 7 = children 5-12 and 13-17; 8 = children in all three age groups.

less than five years of age, only. Respondents without children and those with teenagers allocated the least time to secondary activities.

Market Work Controlled for Presence of Children

Results of both simple linear regressions and one-way analysis of variance showed that market work was a significant factor with average total secondary time use and average weekend secondary time use for females who had no children (Tables XVI-XVIII). Women who worked more hours in the market allocated more time to joint production. Employment status was not significant with average weekday secondary time variable for women without children (Tables XVIII-XIX).

When the analysis included women with children less than five, employment status was not significant for any secondary time use (Tables XVI, XVII, XIX and XX). Results of simple linear regressions with females having children five through twelve years of age showed that market work was significant for average total secondary time and average weekday time, but not for average weekend time (Tables XVI and XIX).

Women who had children consistently allocated more time to secondary activities than women who had no children (Tables XXI-XXIII and XXIV-XXVI). Women who worked twenty hours or more per week in the market allocated more time to joint production than women who did not work in the market (Tables XXI-XXIII and XXIV-XXV). The only exception was average weekday secondary time, when the sample included women with children twelve years of age or younger (Table XXVI).

TABLE XVI

REGRESSION RESULTS FOR AVERAGE TOTAL SECONDARY TIME WITH HOURS WORKED PER WEEK, SEGMENTED FOR AGES OF CHILDREN; MARRIED FEMALE RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976
(STANDARD ERRORS IN PARENTHESES)

Group	Sample Size	Constant	Slope	R^2	F	Significance	Standard Error Estimate
No Children	127	380.12 (16.628)	1.026 (0.707)	.0166	2.110	.075	(147.853)
Children Under 5	40	465.15 (25.750)	0.66 (1.342)	.0064	0.245	.312	(137.823)
Children 5-12	32	379.58 (33.081)	1.41 (0.975)	.0650	2.086	.080	(124.277)

TABLE XVII

REGRESSION RESULTS FOR AVERAGE WEEKEND SECONDARY TIME WITH HOURS WORKED PER WEEK, SEGMENTED FOR AGES OF CHILDREN; MARRIED FEMALE RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976
(STANDARD ERRORS IN PAREHTHESES)

Group	Sample Size	Constant	Slope	R^2	F	Significance	Standard Error Estimate
No Children	127	400.34 (20.382)	1.12 (0.866)	.0132	1.672	.099	(181.240)
Children Under 5	40	519.84 (34.639)	-0.57 (1.805)	.0026	0.099	.377	(185.398)
Children 5-12	32	416.61 (50.028)	0.95 (1.474)	.0135	0.411	.263	(187.941)

TABLE XVIII

ANALYSIS OF VARIANCE: WORK IN MARKET UPON SECONDARY TIME USE; MARRIED FEMALES WITH NO CHILDREN FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976

Dependent Variable	Degree of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Average Total Secondary Time	2	133,064.38	66,532.19	3.1411	.0467
	125	2,647,626.23	21,181.01		
Average Weekend Secondary Time	2	211,482.70	105,741.35	3.3404	.0386
	125	3,956,878.60	31,655.03		
Average Weekday Secondary Time	2	76,522.13	38,261.07	1.0544	.3515
	125	4,535,717.99	36,285.74		

TABLE XIX

REGRESSION RESULTS FOR AVERAGE WEEKDAY SECONDARY TIME WITH HOURS WORKED PER WEEK, SEGMENTED FOR AGES OF CHILDREN; MARRIED FEMALE RESPONDENTS FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976
(STANDARD ERRORS IN PARENTHESES)

Group	Sample Size	Constant	Slope	R^2	F	Significance	Standard Error Estimate
No Children	127	363.68 (21.508)	0.96 (0.914)	.0087	1.097	.149	(191.252)
Children Under 5	40	420.35 (34.468)	1.62 (1.796)	.0211	0.819	.186	(184.484)
Children 5-12	32	342.62 (39.783)	1.87 (1.172)	.0781	2.541	.061	(149.453)

TABLE XX

ANALYSIS OF VARIANCE: WORK IN MARKET UPON SECONDARY TIME USE; MARRIED FEMALES WITH CHILDREN TWELVE YEARS OF AGE OR YOUNGER; NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976

Dependent Variable	Degree of Freedom	Sum of Squares	Mean Squares	F Ratio	F Probability
Average Total Secondary Time	2	7,456.05	3,728.02	.2267	.7974
	149	2,449,748.35	16,441.26		
Average Weekend Secondary Time	2	28,271.32	14,135.66	.4475	.6401
	149	4,707,018.50	31,590.73		
Average Weekday Secondary Time	2	3,930.12	1,965.06	.0652	.9369
	149	4,487,477.22	30,117.30		

TABLE XXI

AVERAGE TOTAL SECONDARY TIME USE BY WORK CATEGORY: MEANS AND STANDARD DEVIATIONS; MARRIED FEMALES WITH NO CHILDREN FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976

Group	Sample Size	Mean	Standard Deviation
No Work in the Market	72	384.0	141.19
Work Less Than 20 Hrs./Week	8	297.5	130.99
Work 20 Hrs. or More/Week	48	426.7	153.82

TABLE XXII

AVERAGE WEEKEND SECONDARY TIME USE BY WORK CATEGORY: MEANS AND STANDARD DEVIATIONS; MARRIED FEMALES WITH NO CHILDREN FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976

Group	Sample Size	Mean	Standard Deviation
No Work in the Market	72	405.6	177.07
Work Less than 20 Hrs./Week	8	284.6	144.51
Work 20 Hrs. or More/Week	48	453.0	183.62

TABLE XXIII

AVERAGE WEEKDAY SECONDARY TIME USE BY WORK CATEGORY: MEANS AND STANDARD DEVIATIONS; MARRIED FEMALES WITH NO CHILDREN FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976

Group	Sample Size	Mean	Standard Deviation
No Work in the Market	72	367.4	185.09
Work Less Than 20 Hrs./Week	8	310.4	186.37
Work 20 Hrs. or More/Week	48	403.8	198.95

TABLE XXIV

AVERAGE TOTAL SECONDARY TIME USE BY WORK CATEGORY: MEANS AND STANDARD DEVIATIONS; MARRIED FEMALES WITH CHILDREN TWELVE YEARS OR YOUNGER, FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976

Group	Sample Size	Mean	Standard Deviation
No Work in the Market	87	423.3	126.34
Work Less Than 20 Hrs./Week	13	403.6	141.82
Work 20 Hrs. or More/Week	52	430.2	128.01

TABLE XXV

AVERAGE WEEKEND SECONDARY TIME USE BY WORK CATEGORY: MEANS AND STANDARD DEVIATIONS; MARRIED FEMALES WITH CHILDREN TWELVE YEARS OR YOUNGER, FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976

Group	Sample Size	Mean	Standard Deviation
No Work in the Market	87	448.0	170.86
Work Less Than 20 Hrs./Week	13	406.0	191.48
Work 20 Hrs. or More/Week	52	458.1	185.58

TABLE XXVI

AVERAGE WEEKDAY SECONDARY TIME USE BY WORK CATEGORY: MEANS AND STANDARD DEVIATIONS; MARRIED FEMALES WITH CHILDREN TWELVE YEARS OR YOUNGER, FROM NATIONAL PROBABILITY SAMPLE OF AMERICANS' TIME USE, 1975-1976

Group	Sample Size	Mean	Standard Deviation
No Work in the Market	87	412.4	178.33
Work Less Than 20 Hrs./Week	13	401.3	178.72
Work 20 Hrs. or More/Week	52	402.4	163.85

II. SUMMARY

Four key variables were associated with males' allocation of time to secondary activities. These variables were: education, hours worked in the market per week, number of children and market wage rate per hour. Education and unearned income were associated with females' allocation of time to secondary activities. Hours worked in the market was also a significant variable when the females had no children. Increases in each of these variables were associated with higher levels of joint production. In the case of nonmarket time, higher levels of education and hours worked in the market were associated with less nonmarket time for females, but with a decrease in nonmarket time for males. Women did more joint production than men and devoted more time to nonmarket activity than men did. Women with children less than five years old did the most joint production, and more joint production occurred on weekends than on weekdays.

CHAPTER V

SUMMARY AND CONCLUSIONS

I. SUMMARY

Total time available to households must be divided among work in the market, work at home, and leisure. Any increase in one category must be offset by an equal decrease in others. Expanded labor force participation by members of family units puts pressure on home production and leisure time.

Previous studies concerned with home production have shown that as time became more valuable, the amount of time devoted to home production decreased. As a result, the family generally produced fewer goods and services at home. Often, families substitute purchased goods from the market for home-produced goods.

Another alternative to the dilemma of less home production time is to simply do without certain kinds of home production. However, another alternative exists; one can increase the amount of joint home production. Hence, as the amount of time allocated to home production is decreased, the amount of time spent on joint home production would increase. This study focused on the amount of time devoted to joint home production.

A model, based on the Becker formulation of goods and time as inputs into the production of commodities, was developed to accommodate the complexities of joint production. With singly produced goods, one selects the least costly input combination in producing a desired output.

In the case of joint production, an individual produces more than one output from common inputs; thus, in addition to input combinations, the proportions of commodities to be produced must be considered.

The model was used to identify a set of hypotheses about the degree to which households engaged in joint production. Several variables were identified to be associated with the demand for joint production time. These are discussed individually in the following section.

The model was tested using a sample of 603 married respondents, interviewed by the Survey Research Center, University of Michigan. Respondents recorded the amount of time they spent doing secondary activities. A secondary activity was defined to be any activity which was performed while someone was also doing a primary activity. Secondary activity time represented joint production time in this study. Respondents were interviewed on two weekend days and two weekdays. The amount of time allocated to secondary activities was the dependent variable and was computed three ways: average total secondary time, average weekend secondary time and average weekday secondary time.

Nonmarket time was defined to be the amount of time one did not work in the market and was the total amount of time available for home production and leisure. For some of the regression analyses, nonmarket time was used as the dependent variable. Including nonmarket time insured that this study would be comparable with previous studies dealing with home production time use. In addition, analysis of variance and a t-test were used for certain variables.

II. CONCLUSIONS

Overview

Women performed more joint production than men did. This was expected because women do much more home production than men [19, 35, 44]. However, more independent variables were significant for males' joint production time than for females' joint production time. Thus, the model was a better predictor of joint production time for males than for females. One explanation is that women, especially those with young children, perform so much joint production as part of their routine that changes in the variables have little effect upon the amount of time allocated to joint production. Conclusions for each independent variable are discussed below.

Education

Females. Previous studies of time allocation to home production found that women with higher levels of education performed less home production than women with lower levels of education [19, 30, 35]. Increased education increases productivity in the home so that less time is needed to perform certain home production tasks and leads to an increase in hours worked in the market. Results of this study did not show education to be a significant factor for females' nonmarket time allocation. In this study, nonmarket time included home production time and leisure time, so that if only home production were analyzed, the results might have been different.

It was expected that if there were less time for home production, there would be an increase in the amount of time devoted to joint production, because of the need to perform many home production tasks in a short period of time. This hypothesis was supported by the data; women with higher levels of education performed more joint production than women with lower levels of education. Education was significant for average total secondary time and average weekend time, but not for average weekday time.

More of the variation was explained by the model for weekend secondary time than for weekday time, which may indicate less randomization in time allocation patterns for weekend activities. Women with higher levels of education are more apt to work in the market and do more joint production on weekends than women who do not work in the market. However, when weekdays are considered, the amount of joint production is not different for women who work and those who do not. Employed women may not do much joint production during the week because they leave many tasks to the weekend. Unemployed women may not do much joint production during the week because they have more home production time and do not need to engage in joint production. Hence, the differences among women with regards to joint production time are great during weekends but not during weekdays.

Males. Previous studies showed that education was the only variable associated with more home production by males [35, 44]. Robinson found that the relationship of education to the amount of time devoted to home production with males was the reverse of that for

females. Males with higher levels of education performed more home production than males with lower levels of education [35].

The study presented here showed that education was significant for males' nonmarket time. However, males with more education devoted less time to nonmarket activity. Because nonmarket activity was defined to be total time available for home production and leisure, men with higher educational levels had less nonmarket time. This is rational, given that men with higher educational levels have more job opportunities. These results were not necessarily inconsistent with previous findings. Even though men with higher levels of education had less nonmarket time than men with lower levels of education, it is not possible to say whether they spent that time on home production or leisure because no distinction was made between the two in the analyses.

In terms of joint production, men with higher educational levels performed more joint production than men with lower educational levels in all of the analyses. This was consistent with previous studies. Carrying that analysis further, men with higher levels of education help more by increasing the amount of joint production they do.

Hours Worked in the Market

Several researchers had found that employment of women was a significant factor in determining the amount of time spent on home production [19, 35, 44]. In all of those studies, more time worked in the market was associated with less home production time. The analysis presented here is consistent with previous studies; however, home production time was not separated from leisure time.

The relationship of hours worked in the market to time allocated to joint production was not as expected. The variable was significant in all analyses when men were included, but never significant for women. Men who worked more hours in the market devoted more time to joint production than men who worked fewer hours in the market. Thus, the hypothesis that increased hours worked in the market places increased demand upon joint production was supported. However, hours worked in the market was not a significant factor for females' joint production. One explanation is that women must devote much time to joint production whether they work in the market or not, especially when young children are present in the household.

For this reason, hours worked in the market were analyzed after controlling for the presence of children. The analyses showed that more hours worked in the market were associated with more joint production when the respondents did not have children or had only teenagers. It is women with small children who must necessarily do much joint production, because young children require almost constant attention. That could explain why hours worked in the market were not associated with joint production time for women with young children. As with education, results were not significant for weekday time, indicating no differences in joint production time between employed and unemployed women during weekday time.

When women were analyzed in terms of those who worked versus those who do not work, employed women performed more joint production than nonemployed women, when the women either had no children or had teenage children. With those subsets, the hypothesis, increased work in the

market would increase the demand for joint production, was supported. The analysis did not show employment to be associated with increased demand for joint production when women had young children. Again, the reason may be that young children necessitate much joint production; hence, employment has no discernable effect.

Another reason for hours worked in the market not being associated with joint production is that an individual may not have a choice as to how many hours are devoted to the market. For example, if a person is most efficient working fifteen hours a week in the market, but is only given a choice of either not working or working forty hours per week, then the person cannot allocate time effectively either way. Because women do more home production, this choice of market hours may be very important. Literature does indicate that many women would work only part time if given the choice [13].

Unearned Income

Unearned income was defined as all income which the respondent did not earn; thus unearned income included wages of the spouse and other family income such as dividends and interest earnings. Robinson and Gronau did not find family income or the husband's wage rate to have any effect upon the wife's home production [19, 35]. Results of this study were consistent with previous findings; unearned income was not associated with nonmarket time. However, unearned income did have an effect upon joint production performed by females. Higher unearned income was associated with more joint production time for females, but not for males. A woman may have a high unearned income because her spouse earns a high

wage in the market. Husbands who earn a high wage tend to have a high educational level and tend to marry women with high educational levels. Hence, education may indirectly have an effect in this case. Also, the higher the unearned income, the more ability the family has to purchase time-saving appliances which lead to a decrease in home production time, but also may allow more joint production.

Number of Children

It was expected that respondents with more children would engage in more home production and more joint production than respondents with fewer or no children. Walker and Robinson found that when the number of children increased, the amount of time devoted to home production increased [35, 43]. In this study, the number of children was not a significant variable for females' nonmarket time, but was significant for males' nonmarket time. Male respondents with more children devoted less time to nonmarket activity than male respondents with fewer or no children. This is reasonable because as a man has more children, he generally spends more hours working in the market and fewer hours at home in order to earn more money to support the larger family.

As the number of children increased, the amount of time devoted to joint production increased for males but not for females. As surmised before, presence of children would suggest that there is a necessity for joint production. Typically, women do the bulk of child care [13, 14, 35], and the presence of even one child causes the mother to engage in joint production much of the time, so that the presence of additional children does not add significantly to joint production time. Also, the

average number of children in this study was 1.3 and there were not great differences in family size. The small range in family size may be one reason the number of children was not significant for females with either nonmarket or joint production time.

For males, an increase in the number of children also increased the amount of time devoted to joint production. One explanation is that when there are none or only a few children, men let women do most all the home production, but as the number of children increases, men must then begin to help more with child care and other home production; hence, engage in more joint production.

Ages of Children

Robinson found that ages of children had an effect upon home production, especially as it related to hours worked in the market. Women with young children worked in the market less than women with older children and hence spent more time in home production [35]. However, when men were analyzed, more home production time was associated with men having older children than men with younger children [35].

The study presented here found that there were differences, attributed to children's ages, in the amount of nonmarket time for the entire sample and for females only. In terms of joint production, children's ages were a significant variable for average total secondary time for men. For women, children's ages were a significant variable for average weekend secondary time. As was expected, females with children less than five years of age did the most joint production and allocated more time to nonmarket activities than other females. More

joint production occurred on weekends than during weekdays, possibly because more family members are present for greater time spans on the weekends and more activities are being performed.

Size of House

Wealth had been included in previous analyses of home production time, but had not been a significant variable [19]. Size of house was used as a measure of wealth in this study on the supposition that larger houses would be associated with greater wealth. For that reason and for the fact that a large house would require more care, it was expected that the larger the house, the more joint production would be done. The analysis did not support this hypothesis; size of house was not associated with amount of time devoted to home production or to joint production. There was one exception to this; men with larger houses performed more joint production on weekdays.

Overall, it is concluded that size of house is not a significant factor in the allocation of time to joint production. Persons with larger houses may exercise other alternatives regarding home production, such as investing in more labor-saving appliances, hiring others to help clean or simply eliminating some home production tasks. Perhaps men with larger houses did more joint production on weekdays because they were helping their wives who were employed in the market. However, on the weekends when both spouses are home, men might not see that their help is needed.

Consumption Technology

Consumption technology was used as an estimate for the presence of labor-saving appliances. It was computed by adding the number of appliances a family had. The expectation was that such appliances would enable one to perform more joint production or production-consumption. Results of this study did not support the hypothesis and consumption technology was not associated with joint production. This may be because the presence of major appliances is highly prevalent among families. A family tends to own such appliances whether both adults work or not in the market, have few or many children, no matter what education levels and so on. Thus, the presence of appliances has no marked effect upon joint production time.

However, owning more appliances was associated with less nonmarket time for males. A probable explanation is that owning more appliances means a greater dollar expenditure and would be associated with higher market earnings, more time worked in the market and consequently less nonmarket time.

Market Wage Rate

Women in this sample earned less than half what men earned, a fact which is consistent with previous research [11]. Gronau found that an increase in the wife's market wage rate increased her work in the market and decreased both her work at home and leisure time. He also found that the husband's wage had no effect on the wife's home production [19]. It was expected that higher wages would be associated with more joint production but less nonmarket time for both men and women. This study

showed no association between market wage rate and nonmarket time or joint production when only females were included in the sample. However, when men alone were included in the sample, increased wages were associated with more nonmarket and joint production time. Again, the reason may be that because women perform much more home production than men, market wage rate makes little difference as to the amount of home production and joint production which is done. Also, the wage rate that is earned in the market may not be what the individual would choose to earn. The model allows for an individual to define the most efficient allocation of time among work in the market, work at home and leisure by placing a value upon time. In actuality, individuals, especially women, may not have much choice over the wage they can earn in the market. In this sample, there was much more variation in wage rates for men than for women. The standard deviation was 4.8 for men and 2.5 for women, which provides a basis for concluding that in the case of women, they may simply have to take whatever wage they are offered.

III. IMPLICATIONS

Results of this study supported the hypothesis that increased labor force participation does increase the demand for joint production, especially when the individual has a high educational level. However, when women are concerned, the increased demand for joint production, as a result of increased market work, is significant when children are either not present or are teenagers. The researcher concludes that with women's educational levels increasing and more women entering the labor force, along with the corresponding decrease in family size, there will

be less time allocated to home production, but more time allocated to joint production.

This analysis only considered the case of married individuals, assuming that when married, one has more choice as to whether or not one works in the market. Also, a spouse may do some of the home production, freeing the individual from some of the tasks. In the case of single-parent households, there is home production which has to be done, and the parent often has no one else to perform home production tasks. Furthermore, the single-parent oftentimes has no one else to support the family. For that reason, single parents may not have much choice but to work in the market, and consequently allocate more time to joint production than married individuals.

Increased amount of joint production has also been tied to increased stress [33, 50]. Hence there may be an emerging need to help families deal with additional stress related to joint production as a result from decreasing amounts of time available for home production.

Home management literature which focused on performing more than one task within the same time period may be even more useful today than in the past [41]. An effort to update this type of literature could be advantageous in helping families cope with the need for increased joint production.

IV. LIMITATIONS

Reporting of time use is very difficult and certainly not precise. The yesterday approach was used for gathering data used in this study. Respondents listed the activities which they did the day before they

were interviewed. Naturally, no one is going to remember exactly what he or she did and the exact length of time for all activities the previous day. Alternative approaches used in gathering time use data are the tomorrow approach (where one lists activities and time use the day after the interview) and direct observation, both of which are more expensive than the yesterday approach, and neither has been shown to be significantly more reliable. The tomorrow approach and direct observation may cause the respondent to be more conscious of what he or she is doing and hence not behave in a typical manner.

It is also suspected that there was an under reporting of secondary activities. Walker found that respondents infrequently identified secondary activities [46]. Much of what one does may not be done consciously, especially when having to recall yesterday's activities. For instance, one may be mowing the lawn while supervising children at play and merely report the mowing. Child care is difficult to identify as home production, because if the children are young, child care is being performed constantly.

Joint production was addressed in this study on an individual basis, rather than observing how an entire family allocated time to joint production. Hence, the relationship of what the wife and husband and children do was not analyzed. As societal attitudes toward male and female roles change, there may be corresponding changes in family time allocation patterns. Total time devoted to joint production was the dependent variable in this study and specific types of activities were not investigated. Thus, the types of activities which lend themselves to joint production were not identified. Home production time and

leisure time were treated together as nonmarket time, which added another restriction to the study.

Another limitation of this study was that part-time workers were included with full-time workers. The Survey Research Center grouped respondents into three employment categories: those that did not work those that worked less than twenty hours per week, and those that worked twenty hours or more in the market. Data were collected in 1975 and 1976; since that time labor force participation by women has increased [11]. As a result of that phenomenon, more joint production may currently be performed than in 1976.

V. SUGGESTIONS FOR FURTHER STUDY

Future studies of home production should include joint production, as it has been shown to be another alternative along with substituting goods for time and with eliminating certain home production tasks. Research concerned with an entire family's time allocation patterns could identify the effects of joint production in a different perspective. The amount of joint production performed by women may depend upon the amount the husband and children do, as well as the available time the woman has.

The fact that wage rate was associated with time allocation for males but not for females, signifies that there are differences between males' and females' reaction to what they are earning in the market. Future study, focusing on wage rates, might identify why there are differences. As market earnings by women increase, these differences between men and women may be diminished.

Research focusing on types of activities as well as time use would identify which tasks are typically done in conjunction with others, and could provide insight into changes which are occurring because of increased pressure to perform joint production. In addition, future research aimed at developing a more sophisticated way of recording time use would be extremely helpful for all subsequent studies of time use. Research specifically aimed at designing an instrument to measure joint production time is needed. Joint production time can be drawn from data such as the data used in this study; however, the purpose of these data was more general in scope. A more direct focus might yield more accurate reporting of joint production time.

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