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Introduction to *A Theory of the Allocation of Time* by Gary Becker

James Heckman

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Forschungsinstitut
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Institute for the Study
of Labor

Introduction to *A Theory of the Allocation of Time* by Gary Becker

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ABSTRACT

Introduction to *A Theory of the Allocation of Time* by Gary Becker*

Gary Becker's classic study, *A Theory of the Allocation of Time*, laid the analytical foundations for the study of household production and the allocation of time within the household. The analytical framework of household production theory developed in this paper remained a pillar of his later work on the economics of the family and the economics of nonmarket activities more generally. Becker provided a formal model of households producing outputs like food, children, and housing that bundled goods and time. Becker's great contribution was to apply the model to interpret a broad array of empirical phenomena. Becker's framework allowed for a deeper understanding of the mechanisms of consumer choice, and interpretation of income and substitution effects. Its continuing relevance in empirical economics is a testimony to its power.

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Gary Becker's classic study, *A Theory of the Allocation of Time*, laid the analytical foundations for the study of household production and the allocation of time within the household. It spawned a large literature and continues to influence economics and other social sciences.

The paper was written when Becker was in his mid 30s, teaching at Columbia University and conducting research at the National Bureau of Economic Research, then headquartered in New York. Over the period 1958–1970, Becker, along with Jacob Mincer, organized the legendary Columbia Labor Economics Workshop. Becker, Mincer, and their students applied price theory to study the economics of fertility, labor supply, income inequality, education, on-the-job training, crime and punishment and the theory of irrational behavior, among other topics. The interplay between theory and data was the hallmark of that group. From this crucible emerged the modern theory of human capital (Becker, 1964, 1975) and important components of the modern economics of the family that were distilled and extended in Becker's classic *A Treatise on the Family* (1981, enlarged in 1991). A generation of productive and influential scholars was trained at Columbia during this period.[1]

In his introduction to this paper, Becker discusses the body of research on the economics of time that was being conducted at Columbia, to which he contributed and from which he had drawn. This paper is the analytical synthesis of a body of ideas developed in that intense intellectual climate.

Many scholars have tried to disentangle the contributions of Jacob Mincer from those of Gary Becker during the period of their synergistic collaboration. Attempts to do so miss the highly interactive and mutually supportive intellectual environment of the Columbia group and the ability of Becker to create clean analytical insights from diverse bodies of empirical work and to stimulate all around him.

[1]See Heckman (2014).

1 Some Background on This Article

Prior to the work of Becker, the household had a shadowy place in analytical economics. Wesley Clair Mitchell (1912) wrote about the "backward art of spending money" and compared the efficiency of firms in producing goods for the market to the inefficiency of households in producing domestic services. Kuznets (1934) lamented that GNP accounts omitted important components of household production.[2] Margaret Reid (1934) wrote a textbook on home production aimed at students of home economics. It offered practical advice, sketched some analytical principles, and offered interesting speculation about the future of the household and role of women.[3]

It was not until the work of Becker (1965) that economists began to formally model households as engaged in activities producing outputs like food, children, and housing (the Z_i for commodity i in his paper) that bundled goods and time. The household consumed these commodities as the direct objects of utility.[4] The outputs of the activities were produced by distinct inputs.[5] The commodities were associated with consumption in different time periods (e.g., Ghez and Becker, 1975) or production of different activities (meals, health, housing, child rearing) as in Becker (1965); Grossman (1972a,b); Michael (1972, 1973), and Muth (1966).[6] Becker and Mincer breathed empirical life into these models and spawned a large literature (see, e.g., Gronau, 1970, 1977, 1986, 1997, 2008; Grossman, 1972a,b; Juster and Stafford, 1985, 1991; Leibowitz, 1974; Michael, 1973, 1974; Michael and Becker, 1973;

[2]See Bridgman et al. (2012) for a recent discussion of household production in national accounts. Nordhaus and Tobin (1973) created estimates of nonmarket production to supplement GNP accounts. See also the National Research Council (2005) for chapter "Home Production," and Stiglitz et al. (2009).

[3]Gary Becker checked out her book from the University of Chicago Library in 1956.

[4]Muth (1966) modeled household production in this fashion but did not focus on the crucial role of time or on the range of phenomena analyzed by Becker. Gorman (1956, 1980) and Lancaster (1966, 1971) analyzed the demand for characteristics produced by goods. Characteristics in that model play a role analogous to commodities in Becker's model. As in Becker's model, goods produce outputs that are valued in final consumption. In Becker's model, goods are allocated to produce a single commodity. In the Gorman-Lancaster model, the same market goods can produce multiple characteristics (commodities) so there is jointness, which is ruled out in Becker's model. See Pollak and Wachter (1975) and Gronau (1986).

[5]Later work incorporated joint production (Pollak and Wachter, 1975).

[6]Closely related analytically was the work on separability in preferences studied by Strotz (1957) and Gorman (1959). See also Green (1964) and Blackorby et al. (1978).

Pollak, 2003; Rosenzweig and Schultz, 1983).

The Becker-Mincer research on human capital (Becker, 1962, 1964, 1975; Mincer, 1958, 1962a, 1974) emphasized the importance of time foregone from earnings as the primary cost of education and job training, far more important than costs arising from tuition or fees. In other work, Mincer (1962b, 1963) made a major contribution to empirical research on the labor supply of women by isolating the effects of wages (the price of time) from pure income effects, explaining both the cross-section and time series of married female labor supply.[7]

While Lionel Robbins (1930) had previously distinguished income effects from substitution effects in labor supply, the empirical literature on female labor supply had not made this distinction. Clarence Long (1958), in an extensive empirical study, emphasized the role of consumer durables in releasing female time from housework for market uses, but did not study the effects of wages on labor supply.[8] In a similar spirit, Becker's (1960) early work on fertility focused on income effects and did not discuss the importance of female time and its price in explaining fertility.[9] It was Mincer who first emphasized the role of the rise in the wage of women as a primary force explaining the growth of female labor supply.

Mincer (1962b) introduced another feature of household production that is formalized in Becker (1965). Mincer claimed that the multiple uses of nonmarket time (in child care and other household activities) produced a greater wage elasticity for women than for men because they faced more margins of substitution. While formally this argument is incorrect, the intuition behind it is powerful and continues to shape thinking about female labor supply.[10]

[7] Mincer (1963) analyzed the bias in estimating pure income effects when the price of time was omitted from consumer demand analyses.

[8] Greenwood et al. (2005) formalize Long's idea in a general equilibrium setting.

[9] However, he hints at the role of the price of time in his footnote 8.

[10] See Heckman (1988).

2 The Becker Model

The household is assumed to produce and consume a vector of commodities $Z = (Z_i), i = 1, \ldots, I$. These commodities are associated with different levels of activities performed by the household (e.g., consumption of food, child-rearing, leisure activities), including leisure on the job.[11] Utility is a function of these commodities:

$$U(Z_1, \cdots, Z_I) \tag{1}$$

where

$$Z_i = f^{(i)}(X_i, T_i), \quad i = 1, \ldots, I. \tag{2}$$

X_i is a vector of goods used to produce Z_i and T_i is time (usually assumed scalar but allowed to be a vector in Becker, 1965).[12] The price of Z_i depends on the prices of its components. Assuming that each $f^{(i)}$ is homogeneous of degree 1, one can construct a scale-invariant price index π_i for each commodity.

The household faces both time and traditional budget constraints. Using elementary algebra, Becker shows that under his assumptions the household effectively faces one constraint.[13] Under the assumption that T_i is scalar, and that the price of time is w across all uses, the maximum amount of income that the person can earn is *Full Income* $B = wT + V$ where $T = \sum T_i$ and V is the amount of unearned income accruing to the household. The Z_i encompass all activities in which time can be used (including the consumption of leisure on the job) and

[11] See Juster and Stafford (1985), Aguiar and Hurst (2007), and Aguiar et al. (2012).
[12] See Becker (2007a) for one exposition of this model.
[13] See Heckman (1988) for an analysis of households facing multiple constraints.

$$\sum_{i=1}^{I} \pi_i Z_i = wT + V = B. \tag{3}$$

The household is assumed to maximize (1) subject to (2) and (3). The demands for inputs X_i,T_i are derived from the demands for Z_i. The responsiveness of the demands for different activities in response to changes in the prices of goods and time depends, in part, on the time and goods intensities in producing the commodities. Becker goes on to develop a more general analysis where the marginal cost of time varies across activities.

Becker's model of commodity demand is an instance of Terence Gorman's general separability analysis (Gorman, 1959) where U is weakly separable in the arguments producing the Z_i, and the $f^{(i)}$ are homogeneous of degree 1.[14] Under homogeneous weak separability, consumer decision making can be characterized by a two stage budgeting process. Agents allocate budgets E_i to each commodity i, based on the price index π_i and in a second stage maximize each Z_i subject to these allocations determined from the first stage to determine X_i and T_i. (See Strotz, 1957 and Gorman, 1959).[15] Pollak and Wachter (1975) present a definitive analysis of the limitations of the Becker model when the assumption of homogeneous separability is relaxed and when joint production is considered.[16] See also the discussion in Gronau (1977, 1986).[17]

3 Its Influence

Although others had developed analytical frameworks with similar features, Becker's great contribution was to apply the model to interpret a broad array of empirical phenomena and to inspire the generations that followed in his wake to investigate the economics of

[14]However, Gorman does not specifically analyze time or allow marginal prices to vary across activities.

[15]See Green (1964) and Blackorby et al. (1978) for discussions of this literature.

[16]They stress a key limitation that time spent in producing commodities is not valued in itself. Thus, in producing children, the time spent in producing them is not valued in itself. For a discussion of estimation of non-separable technologies see Pollak and Wales (1987).

[17]Gronau (1977) distinguishes between the non-utility bearing use of time in producing goods (work at home) from use of time in producing utility.

home production. The concept of nonmarket production of human capital (Ben-Porath, 1967), children (Becker and Lewis, 1973; Willis, 1973), health (Becker, 2007b; Grossman, 1972a,b), the value of life (Viscusi and Aldy, 2003), the production of child quality (Cunha and Heckman, 2007; Leibowitz, 1974), transportation (Gronau, 1970), the consumption of leisure on-the-job (Aguiar and Hurst, 2007; Aguiar et al., 2012; Juster and Stafford, 1985) are just a few of the numerous applications of these ideas.[18] Becker's paper also stimulated the collection of data on time use in household production (see e.g. Aguiar et al., 2012; Juster and Stafford, 1985, 1991).

4 Theory of Labor Supply

When Becker's paper was initially published, many scholars noted that under the assumption that the price of time was uniform across alternative uses, application of Hicks' composite commodity theorem (Hicks, 1939) leads back to the elementary analysis of labor supply by Lionel Robbins. All non-market time can be aggregated into a single composite "leisure."[19] There was no need for household production theory to analyze the supply of labor to the market.

While formally true, this commentary misses several key points. First, Becker analyzed a situation in which the marginal prices of time may differ in different uses.[20] Second, his paper reconciled the Long (1958) interpretation of the growth of the labor supply of women as arising from a shift in the supply of labor through the introduction of labor-saving consumer durables, and the model favored by Mincer (1962b) that shifts in the demand for female labor led to higher wages and higher labor supply.[21]

More generally, Becker's framework allowed for a deeper understanding of the mechanisms of consumer choice, and interpretation of income and substitution effects. Its continuing

[18] Gronau (1997) gives a useful survey of the applications of the model in both micro and macro economics.
[19] See, e.g., Heckman (1988).
[20] For example, overtime pay, weekend pay and nighttime pay may differ.
[21] See Greenwood et al. (2005).

relevance in empirical economics is a testimony to its power.

5 Developments After This Paper

Becker was near the beginning of his long and productive career when he wrote this paper. He elaborated the model in his later work. However, the analytical framework of household production theory developed in this paper remained a pillar of his later work on the economics of the family and the economics of nonmarket activities more generally.

He devotes only one paragraph of this paper to the idea that household members might specialize in the production of commodities. He developed it much further in Becker (1973, 1974) and Becker (1981, 1991). There he developed theories of household formation and marital sorting and investigated the consequences of intrahousehold specialization in tasks for life cycle earnings and productivity.[22] For a recent exposition of the development of these themes, see Browning et al. (2014).

[22]Pollak (2013) presents an illuminating discussion of Becker's work on specialization in the household.

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