

# The Multitasking of Household Production \*

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## Abstract

The standard household production model pioneered by Gary Becker (1965) does not allow time to be spent simultaneously in different activities. No theoretical framework for household production to date incorporates multitasking as an economic decision. Yet, time-diary data are often specifically collected in such a way as to capture multitasking, and these data reveal that individuals indeed regularly multitask. For example, child care—a core component of household production—is regularly performed while doing housework. In this paper, we formulate a household production model that allows time spent in child care to be sole-tasked or multitasked with other household production activities. We then use data from the Longitudinal Study of Australian Children to empirically examine our prior that sole-tasked and multitasked child care have different productivities (in terms of child outcomes). Finally, we derive some empirical implications of our model that we test using repeated cross-sections of data from the Australian Time Use Surveys to show that parents make choices to sole-task or multitask for reasons related to constraints and

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preferences, rather than randomly. Our goals are to suggest the treatment of multitasking as an economic decision rather than as a random choice, to provide suggestive evidence that sole-tasked and multi-tasked child care may have different impacts on children, and to help labor economists better understand the underlying theoretical determinants of individuals' decisions to multitask or sole-task.

## 1 Introduction

The standard household production model pioneered by Gary Becker (Becker 1965) does not allow time to be spent simultaneously in different activities. Thus, if a mother watches her child while doing the dishes, her choice to multitask could only be mapped into the Beckerian framework if the researcher allocated one fraction of the total minutes spent in this combined activity into child care, and another fraction to doing the dishes. At the time Becker's model was formulated, information about the multitasking of household production was not available in household survey data. Since that time, however, many national statistical agencies have undertaken detailed time-diary studies of their populations that allow respondents to report primary, secondary, and sometimes even tertiary activities they are performing at any given time, in the order given by the respondent.

Few time use researchers have exploited the opportunity represented by the recording of simultaneous activities to differentiate between sole- and multitasked time. For example, Kimmel & Connelly (2007), in order to conform with Becker's model, focus only on time spent in child care as a primary activity, as in their framework minutes spent in all primary activities must sum to 24 hours. Ignoring secondary household production such as cooking and cleaning, however, seriously underestimates individuals' economic contributions (Floro & Miles 2003). More commonly, empirical analyses of household production that use time-diary data, while relying loosely on Becker's model to motivate their analyses, analyze primary and secondary activities separately (e.g., Bianchi 2000, Kalenkoski, Ribar & Stratton 2005, Kalenkoski, Ribar & Stratton 2007, Kalenkoski, Ribar & Stratton 2009).

One of the few studies that have attempted to analyze multitasked time directly is Jirjahn (2000),

who examines a theoretical model of multitasking in the workplace to determine whether fixed wages or profit-sharing is the better payment scheme to reward employees who multitask. Jeong & Fishbein (2007) examine the prevalence and patterns of multitasking among 14- to 16-year-olds and the media and audience factors that predict such behavior. Closest in spirit to the present paper, Floro & Miles (2003) examine the incidence and determinants of time spent in “overlapped” work activity, including household work. They find that gender, household life cycle and composition, education, cultural norms, employment status, and income influence the extent to which individuals (particularly women) perform secondary work activities. Kalenkoski & Foster (2008) regress multitasked child care time on an even more exhaustive list of demographic and other explanatory variables. Significant attention to the nature of multitasking has also been given in the psychology literature and in the popular press. Psychologists (e.g., Rubinstein, Meyer & Evans 2001, Levy & Pashler 2008) have found evidence that the brain works differently during multitasking than during sole-tasking, and writers in the popular press have suggested various causes and effects of multitasking that clearly differentiate it from sole-tasking (e.g., Folsom 2008, Rosen 2008, Jackson 2004).

In this paper, we introduce a household production model that allows time spent in child care to be sole-tasked or multitasked with other household production activities such as cooking and cleaning. We then empirically examine our prior that sole-tasked and multitasked child care may have different productivities (in terms of child outcomes) using data from the Longitudinal Study of Australian Children (LSAC). Finally, we derive some empirical implications of our model that we test using repeated cross-sections of data from the Australian Time Use Surveys (TUS). We find strong suggestive evidence that multitasking by parents is not random but represents a choice under constraints, and that multitasking preferences and decisions are significant to child outcomes. Our goals are to suggest the treatment of multitasking in household production as an economic decision rather than a random choice, to highlight its potential relevance to child production, and to help labor economists better understand the underlying theoretical determinants of individuals’ decisions to multitask or sole-task.

## 2 Model

In Gary Becker’s original household production model (Becker 1965), individuals maximize utility by choosing time spent in market work and household production subject to production functions for household commodities and a budget and time constraint. In this model, a unit of time may be spent only in one activity. To our knowledge, no theoretical economic model exists that specifically addresses or derives implications about individuals’ decisions to multitask household production and child care.

We begin with a simple utility function that is not dissimilar from Becker’s original formulation,

$$U = C^\alpha H^\beta, \quad 0 < \alpha < 1, 0 < \beta < 1$$

where individuals obtain utility from the production of the household ‘good’ and the child ‘good’.  $\alpha$  and  $\beta$  are preference parameters. The restrictions on their values ensure diminishing marginal utility from each of goods. We exclude work and market goods from our model for simplicity.<sup>1</sup>

The child production function we use is

$$C = t_{SC}^{\gamma_1} t_M^{\gamma_2}, \quad 0 < \gamma_1 < 1, 0 < \gamma_2 < 1$$

where  $t_{SC}$  is sole-tasked time spent by the parent in production of the child good and  $t_M$  is multitasked time spent by the parent in both child-related and housework activities.  $\gamma_1$  is the productivity factor for sole-tasked time in producing the child good and  $\gamma_2$  is the productivity factor for multitasked time in producing the child good. The restrictions on these parameters ensure diminishing returns to each sort of time spent.

Analogously, the household production function is

$$H = t_{SH}^{z_1} t_M^{z_2}, \quad 0 < z_1 < 1, 0 < z_2 < 1$$

where  $t_{SH}$  is sole-tasked time spent by the parent in household production,  $z_1$  is the productivity factor for sole-tasked time in producing the household good, and  $z_2$  is the productivity factor for multitasked

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<sup>1</sup>In a forthcoming version of this paper, we expand the model to incorporate time spent in market work as a choice. However, including controls for market work in the empirical analyses does not change our results.

time in producing the household good. The restrictions on these parameters ensure diminishing returns to each sort of time spent.

Each individual maximizes his or her utility subject to these production functions and the following time constraint:

$$\begin{aligned} T &= t_{\text{SC}} + t_{\text{SH}} + t_{\text{M}} \\ \Rightarrow t_{\text{SH}} &= T - t_{\text{SC}} - t_{\text{M}} \end{aligned}$$

where T refers to the total time available. Substituting the production functions and time constraint into the utility function we have an unconstrained utility maximization problem where the first order necessary conditions are:

$$\begin{aligned} \frac{\partial U}{\partial t_{\text{SC}}} &= \gamma_1 \alpha t_{\text{SC}}^{(\gamma_1 \alpha - 1)} t_{\text{M}}^{(\gamma_2 \alpha + z_2 \beta)} (T - t_{\text{SC}} - t_{\text{M}})^{z_1 \beta} \\ &\quad - \left[ t_{\text{SC}}^{\gamma_1 \alpha} t_{\text{M}}^{(\gamma_2 \alpha + z_2 \beta)} \right] z_1 \beta (T - t_{\text{SC}} - t_{\text{M}})^{(z_1 \beta - 1)} = 0 \end{aligned} \quad (1)$$

$$\begin{aligned} \frac{\partial U}{\partial t_{\text{M}}} &= (\gamma_2 \alpha + z_2 \beta) t_{\text{SC}}^{\gamma_1 \alpha} t_{\text{M}}^{(\gamma_2 \alpha + z_2 \beta - 1)} (T - t_{\text{SC}} - t_{\text{M}})^{z_1 \beta} \\ &\quad - \left[ t_{\text{SC}}^{\gamma_1 \alpha} t_{\text{M}}^{(\gamma_2 \alpha + z_2 \beta)} \right] z_1 \beta (T - t_{\text{SC}} - t_{\text{M}})^{(z_1 \beta - 1)} = 0 \end{aligned} \quad (2)$$

Rewriting Equations (1) and (2) yields

$$\frac{\gamma_1 \alpha T}{(z_1 \beta + \gamma_1 \alpha)} - \frac{\gamma_1 \alpha}{(z_1 \beta + \gamma_1 \alpha)} t_{\text{M}} = t_{\text{SC}} \quad (3)$$

$$\frac{(\gamma_2 \alpha + z_2 \beta)}{(z_1 \beta + \gamma_2 \alpha + z_2 \beta)} T - \frac{(\gamma_2 \alpha + z_2 \beta)}{(z_1 \beta + \gamma_2 \alpha + z_2 \beta)} t_{\text{SC}} = t_{\text{M}} \quad (4)$$

Solving these equations yields reduced-form expressions for the optimal choices of sole-tasked and multitasked time. We can first derive

$$t_{\text{M}}^* = \frac{\gamma_2 \alpha T + z_2 \beta T}{z_1 \beta + \gamma_1 \alpha + \gamma_2 \alpha + z_2 \beta}$$

and then, substituting  $t_M^*$  into equation (3), we arrive at

$$t_{SC}^* = \frac{z_1 \gamma_1 \alpha \beta T + \gamma_1^2 \alpha^2 T}{z_1^2 \beta^2 + 2z_1 \gamma_1 \alpha \beta + z_1 \gamma_2 \alpha \beta + z_1 z_2 \beta^2 + \gamma_1^2 \alpha^2 + \gamma_1 \gamma_2 \alpha^2 + z_2 \gamma_1 \alpha \beta}$$

Given these optimal values for individuals' multitasked time and sole-tasked time, we can examine how time allocation decisions change when productivity factors change by taking the partial derivatives of these optimal values with respect to the productivity parameters  $\gamma_1$ ,  $\gamma_2$ ,  $z_1$ , and  $z_2$ .

Considering  $t_M^*$  first, its partial derivative with respect to  $\gamma_1$  is

$$\frac{\partial t_M^*}{\partial \gamma_1} = \frac{-(\gamma_2 \alpha^2 T + z_2 \alpha \beta T)}{(z_1 \beta + \gamma_1 \alpha + \gamma_2 \alpha + z_2 \beta)^2} < 0$$

Thus, as we would expect, an increase in the sole-tasked child care productivity factor should reduce multitasked child care time. In a similar fashion, the derivative of  $t_M^*$  with respect to  $\gamma_2$  is

$$\frac{\partial t_M^*}{\partial \gamma_2} = \frac{z_1 \alpha \beta T + \gamma_1 \alpha^2 T}{(z_1 \beta + \gamma_1 \alpha + \gamma_2 \alpha + z_2 \beta)^2} > 0$$

implying that an increase in the multitasked child care productivity factor is expected to increase multitasked child care time.

The partial derivative of  $t_M^*$  with respect to  $z_1$  is

$$\frac{\partial t_M^*}{\partial z_1} = \frac{-(\gamma_2 \alpha \beta T + z_2 \beta^2 T)}{(z_1 \beta + \gamma_1 \alpha + \gamma_2 \alpha + z_2 \beta)^2} < 0$$

implying that an increase in the sole-tasked housework productivity factor should reduce time spent in multitasking. The derivative of  $t_M^*$  with respect to  $z_2$  is

$$\frac{\partial t_M^*}{\partial z_2} = \frac{z_1 \beta^2 T + \gamma_1 \alpha \beta T}{(z_1 \beta + \gamma_1 \alpha + \gamma_2 \alpha + z_2 \beta)^2} > 0$$

implying that an increase in the multitasked housework productivity factor should increase time spent multitasking.

Turning to  $t_{SC}^*$ , its simplified partial derivative with respect to  $\gamma_1$  is

$$\frac{\partial t_{SC}^*}{\partial \gamma_1} = \frac{\left\{ \begin{array}{l} z_1^3 \alpha \beta^3 T + 2z_1^2 \gamma_1 \alpha^2 \beta^2 T + z_1^2 \gamma_2 \alpha^2 \beta^2 T + 2z_1 \gamma_1 \gamma_2 \alpha^3 \beta T + z_1^2 z_2 \alpha \beta^3 T \\ + 2z_1 z_2 \gamma_1 \alpha^2 \beta^2 T + z_1 \gamma_1^2 \alpha^3 \beta T + \gamma_1^2 \gamma_2 \alpha^4 T + z_2 \gamma_1^2 \alpha^3 \beta T \end{array} \right\}}{(z_1^2 \beta^2 + 2z_1 \gamma_1 \alpha \beta + z_1 \gamma_2 \alpha \beta + z_1 z_2 \beta^2 + \gamma_1^2 \alpha^2 + \gamma_1 \gamma_2 \alpha^2 + z_2 \gamma_1 \alpha \beta)^2} > 0$$

implying that an increase in the sole-tasked child care productivity factor increases sole-tasked child care time.

In a similar manner, we can write and sign the rest of the partial derivatives of  $t_{sc}$  with respect to productivity factors  $\gamma_2$ ,  $z_1$ , and  $z_2$ , as follows:

$$\frac{\partial t_{sc}^*}{\partial \gamma_2} = \frac{-(z_1\alpha\beta + \gamma_1\alpha^2)(z_1\gamma_1\alpha\beta T + \gamma_1^2\alpha^2 T)}{(z_1^2\beta^2 + 2z_1\gamma_1\alpha\beta + z_1\gamma_2\alpha\beta + z_1z_2\beta^2 + \gamma_1^2\alpha^2 + \gamma_1\gamma_2\alpha^2 + z_2\gamma_1\alpha\beta)^2} < 0$$

$$\frac{\partial t_{sc}^*}{\partial z_1} = \frac{-(z_1^2\gamma_1\alpha\beta^3 T + 2z_1\gamma_1^2\alpha^2\beta^2 T + \gamma_1^3\alpha^3\beta T)}{(z_1^2\beta^2 + 2z_1\gamma_1\alpha\beta + z_1\gamma_2\alpha\beta + z_1z_2\beta^2 + \gamma_1^2\alpha^2 + \gamma_1\gamma_2\alpha^2 + z_2\gamma_1\alpha\beta)^2} < 0$$

$$\frac{\partial t_{sc}^*}{\partial z_2} = \frac{-(z_1\beta^2 + \gamma_1\alpha\beta)(z_1\gamma_1\alpha\beta T + \gamma_1^2\alpha^2 T)}{(z_1^2\beta^2 + 2z_1\gamma_1\alpha\beta + z_1\gamma_2\alpha\beta + z_1z_2\beta^2 + \gamma_1^2\alpha^2 + \gamma_1\gamma_2\alpha^2 + z_2\gamma_1\alpha\beta)^2} < 0$$

All of these partial derivatives are negative, implying that time devoted to sole-tasked child production will fall with a *ceteris paribus* rise in the multitasked child productivity factor or in either of the housework productivity factors (sole-tasked or multitasked). Table 1 summarizes the partial derivatives yielded by our model.

Table 1: Partial derivatives: Household production model with sole-tasked and multitasked time

	$\frac{\partial t}{\partial \gamma_1}$	$\frac{\partial t}{\partial \gamma_2}$	$\frac{\partial t}{\partial z_1}$	$\frac{\partial t}{\partial z_2}$
$t_{SC}$	+	-	-	-
$t_M$	-	+	-	+

### 3 Data

We use data for this paper from two Australian sources. The first is the LSAC. This panel survey of young children and their home environment focuses on inputs to child development, and includes detailed measures of child development when children are still quite young. We use the LSAC birth-cohort file, which provides a cross-sectional sample of children who were ages 2 to 3 years old in 2006.<sup>2</sup> We examine measures of a variety of physical, social, and intellectual development aspects of these children at this young age. While these data are appealing because of the availability of child outcome measures, they do not include parental time diaries and therefore we are unable to ascertain directly how much multitasking is done in the household where the child lives. We are still able to examine the relationship between child outcome and type of parents' child care time, however, by using a small number of responses to survey questions about time use. We describe this strategy below.

The second set of data we use is drawn from two iterations (in 1997 and 2006) of the TUS. These data do not contain child outcome measures, but each survey contains 48 hours' worth of detailed time-diary data on all adults in a random sample of Australian households. These time diaries allow for primary and secondary time to be recorded, enabling us to construct a direct measure of the amount of sole-tasked and multitasked time spent by parents in the home.

Our sample selection criteria are as follows. From the LSAC, we focus on the birth cohort from

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<sup>2</sup>Although the LSAC is a panel survey, the outcome measures and many of the other measures about children and parents, including the ones regarding parental time on which we focus in this paper, differ between waves.



Wave 1. Our outcomes and most controls, including most measures related to parental time,<sup>3</sup> are drawn from the follow-up on that same cohort in Wave 2 (year 2006) when the children were 2 to 3 years old. We exclude households in which either the mother or the father of the child is studying in any capacity. Finally, we exclude from each regression any children whose records are missing the outcome measure being modeled or one or more of the independent variables. Our base estimation sample contains 721 children, each of whom is from a different household.

From the TUS, we draw only households with children and only those adults in those households who filled out complete time diaries. As is the case in our LSAC sample, we also exclude households in which either primary adult (the householder or the spouse of the householder) is engaged in studying in any capacity, and those for whom variables are missing. Our base estimation sample contains 1996 fathers and 2418 mothers.

## 4 Estimation

### 4.1 LSAC: Empirical Approach

Our analysis of the LSAC data proceeds as follows. First, we explore the unconditional relationships of the following variables with our raft of child outcome measures: the frequency with which the mother self-reports that she feels rushed (on a 1 to 5 Likert-style response scale from ‘never’ to ‘always’); whether the parents agree with the statement “I feel that I am very good at keeping this child busy while I am doing housework” (on a 1 to 10 Likert scale from ‘not at all how I feel’ to ‘exactly how I feel’, measured for each parent separately); and the minutes of time that each parent reports spending in each of two ways. Answers to these latter time use questions are not available for the vast majority of our base estimation sample, nor do they measure actual multitasking, yet they do provide direct measures of the time spent in active child care and the time spent doing housework—either with or without children present—for each parent. The questions asked on the survey from which we draw

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<sup>3</sup>The two variables we draw from the Wave 1 survey are how good the mother and father respectively rate themselves to be at keeping the child busy while doing housework. These variables do not appear in the Wave 2 survey.

this information are as follows:

- “How much time per week do you personally spend on domestic tasks such as housework, home maintenance, shopping and cooking? Minutes”
- “How much time per week do you personally spend playing with your children, helping them with personal care, teaching, coaching or actively supervising them, getting them to childcare, school or other activities? Minutes”

We interpret answers to the first of these questions to be a rough proxy for the total of sole-tasked housework plus multitasked housework and child care that the parent undertakes (i.e.,  $t_{SH} + t_M$ ). The second question asks about active or primary child care, which we take as a rough proxy for the amount of sole-tasked child care that the parent undertakes per week (i.e.,  $t_{SC}$ ). Given that we expect no relationship between the amount of sole-tasked housework performed and the development of children, we interpret any statistical relationship between our measure of  $t_{SH} + t_M$  and child outcomes to reflect an underlying relationship between  $t_M$  and child outcomes.

The child outcome measures that we use in this analysis are a mix of test scores and indices derived by the Australian Institute of Family Studies (AIFS), the producers and managers of the LSAC data. The list of measures follows. Again, each measure is taken when the child is 2 to 3 years old (all regressions control for child’s sex and age in weeks):

- BCOI: Continuous Outcomes Index
- BLRNDOM: Learning Domain Score
- BSEDOM: Social/Emotional Domain Score
- BPHYSDOM: Physical Domain Score
- BGRAMMRK: MCDI-III Grammatical Markers
- BCOMMUN: Child’s Communication Skills

The BCOI score for a given child is the mean of that child’s scores on BLRNDOM, BSEDOM, and BPHYSDOM, which themselves are general development outcome indices, compiled by AIFS, in each of these three domains of child development.<sup>4</sup> BGRAMMRK is the total number of ‘2’ responses (indicating more advanced grammatical development) that parents gave on 12 questions, where for each question, the parent selected one of two options for the way the child usually speaks (e.g., ‘Why he run away?’ versus ‘Why did he run away?’). BCOMMUN is the mean of parental responses to six questions aimed at assessing the child’s level of general communication skills. Responses to each of these questions were captured on a 1 to 3 scale, with 1 representing ‘Never’, 2 ‘Sometimes’, and 3 ‘Always.’<sup>5</sup>

After presenting the unconditional relationships between each child outcome variable and each parental time use measure, we then run a series of regressions to explore whether the associations that we find between child outcomes and parental time use hold up once we control for other factors likely to affect both variables.

## 4.2 LSAC: Results

Table 2 provides means and standard deviations of key variables in our two LSAC estimation samples. The first (in Column 1 of Table 2) is used for reduced-form style regressions, excluding direct parental time measures. The second (in Column 2 of Table 2) is used when we include our direct measures of parental time. Most variables are similarly distributed for the two samples, with mild evidence of more parental time and better child outcomes in the larger sample.

Table 3 shows the pairwise correlations observed in the LSAC data amongst child outcome measures

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<sup>4</sup>Detailed information about how these indices are derived is available in LSAC Technical Paper 2 (Sanson, Misson, Wake, Zubrick, Silburn, Rothman & Dickenson 2005).

<sup>5</sup>The specific questions are: (1) ‘How often does this child carry out a simple instruction?’ (2) ‘How often does this child ask for a question to be repeated?’ (3) ‘How often does this child follow a conversation?’ (4) ‘How often does this child pass on a simple message?’ (5) ‘How often does this child clearly explain things?’ and (6) ‘How often does this child use speech that is easily understood?’

Table 2: Means and Standard Deviations: LSAC Estimation Samples

	<b>Sample 1</b>	<b>Sample 2</b>
Physical domain score	100.32 (10.24)	99.82 (12.45)
Learning domain score	101.52 (9.46)	100.74 (11.77)
Socio-emotional domain score	101.69 (9.00)	100.72 (7.36)
Continuous outcomes index	101.22 (9.57)	100.19 (12.13)
Grammar score	6.56 (3.89)	5.21 (4.16)
Communication score	2.40 (0.34)	2.34 (0.39)
Feels rushed (mother)	2.31 (0.77)	2.52 (0.96)
Good at keeping child busy (mother)	7.32 (1.95)	7.96 (1.81)
Good at keeping child busy (father)	6.22 (2.13)	6.64 (1.91)
Self-efficacy (mother)	4.03 (0.77)	3.96 (0.73)
Self-efficacy (father)	4.04 (0.76)	4.16 (0.85)
Presence of other adults	0.05 (0.23)	0 (-)
$t_{SH} + t_M$ (mother)	14.17 (15.83)	9.88 (16.02)
$t_{SC}$ (mother)	11.24 (15.00)	11.08 (14.39)
$t_{SH} + t_M$ (father)	14.95 (16.28)	10.00 (14.84)
$t_{SC}$ (father)	12.09 (16.90)	5.56 (11.40)

Note: Based on data from the Longitudinal Study of Australian Children. These are the two base samples used notionally for the estimation whose results are presented in later tables. For the direct parental time questions, fewer than 100 of the children's records from Sample 1 have nonmissing observations. Additionally, a few observations are dropped for each sample from the calculations of means for certain outcomes, due to missing observations on those outcomes (see observation counts in later tables).

(across the top of the table) and variables related to mother’s time use, for all observations for which the given pair of variables is nonmissing. The table shows a strikingly consistent, significant, and positive unconditional relationship evident between the degree to which a mother self-rates as being “very good at keeping this child busy while I am doing housework” and the child’s outcomes. If we take a mother’s answer to this question as a proxy for either the inherent productivity of multitasked child care or the inherent productivity of multitasked housework that she faces—i.e., either  $\gamma_2$  or  $z_2$ —then we should expect multitasked child care and housework time to be higher for women with higher self-ratings on this question.<sup>6</sup> There also are some significant relationships between child outcomes and whether a mother feels rushed, and these are mostly in the positive direction. Finally, the table shows some statistically significant negative unconditional associations between child outcomes and total minutes spent by the mother in child care of any sort (sole-tasked or multitasked).

Our conclusion from Table 3 is that there are relationships between a child’s outcomes and her mother’s constraints and behavior with regard to sole-tasked and multi-tasked time use, but these relationships may not be in the expected direction. If anything, mothers who spend less time with their children of any sort, and mothers who may be more pressed for time and/or more likely to multitask childcare with housework, appear to have children who score higher on developmental scales than children of other mothers. Because these associations are only unconditional, we now proceed to several regressions of child outcomes where a range of other aspects of the child and the household are controlled.

Table 4 presents the results of regressions of the first three of our child outcome measures—BPHYSDOM, BLRNDOM, and BSEDOM—on the parent time constraint, preference, and behavior measures. Table 5 then provides the results of analogous regressions using the final three child outcome measures—BCOI, BGRAMMRK, and BCOMMUN—as the dependent variables. In each table, regressions on the full sample that exclude the actual parental time use measures themselves appear

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<sup>6</sup>The correlation between  $t_M$  and answers to this question is positive as expected, although the association is based on only 200 observations and is not statistically significant.

Table 3: Unconditional correlations: Longitudinal Study of Australian Children

	BCOI	BLRNDOM	BSEDOM	BPHYSDOM	BGRAMMRK	BCOMMUN
Mother is good at keeping child busy	.18***	.06***	.15***	.12***	.12	.09***
Frequency with which mother feels rushed	.05***	-.03	.05***	.09***	-.04**	-.00
$t_{SC}$ (mother)	-.11	-.10	-.14*	.00	-.18**	-.13*
$t_{SH} + t_M$ (mother)	-.11	-.12*	-.13*	.01	-.18**	-.13*

Note: Based on data from the Longitudinal Study of Australian Children; each pairwise correlation is calculated using all observations with nonmissing entries for both variables. Correlations significant at the 10%/5%/1% level are single-/double-/triple-starred.

Table 4: Associations of Child Outcomes with Parental Time Variables, By Outcome Type: BPHYS-  
DOM, BLRNDOM, and BSEDOM

Dep var	Physical domain	Learning domain	Socio-emotional domain
<i>Panel A: Reduced-form</i>			
Feels rushed	0.91*	-0.35	1.07**
(mother)	(0.51)	(0.46)	(0.42)
Good at keeping	0.66***	0.09	0.77***
child busy (mother)	(0.20)	(0.19)	(0.17)
Good at keeping	0.03	-0.16	-0.15
child busy (father)	(0.19)	(0.17)	(0.16)
Self-efficacy	1.43***	0.56	1.52***
(mother)	(0.51)	(0.47)	(0.43)
Self-efficacy	0.85	0.36	0.64
(father)	(0.53)	(0.48)	(0.44)
Other adults	-4.51**	1.43	-3.18**
	(1.83)	(1.67)	(1.53)
Number of Observations	721	721	721
Adj $R^2$	.0378	.0601	.1323
<i>Panel B: Production model</i>			
$t_{SH} + t_M$	0.73	-0.00	0.10
(mother)	(0.67)	(0.28)	(0.39)
$t_{SC}$	-0.62	0.24	-0.25
(mother)	(0.91)	(0.38)	(0.53)
$t_{SH} + t_M$	-0.53	-0.70***	-0.14
(father)	(0.36)	(0.15)	(0.21)
$t_{SC}$	-0.46	-0.19	-0.12
(father)	(0.41)	(0.17)	(0.24)
Number of Observations	25	25	25
Adj $R^2$	-.1289	.7841	-.0996

Note: Based on data from the Longitudinal Study of Australian Children. Regressions reported in Panel A also include child's age in weeks, number of siblings, log of household income, dummies for unemployment of father, labor force participation of mother and part-time working status of mother, dummies for whether a language other than English is spoken in the home and whether a non-English language is regularly spoken to the child, the ages of both mother and father, an array of dummies for mother's smoking status and mother's highest education level achieved, dummies for whether the child enjoys child care, whether the family finances are reported to be in good condition, and whether the child is disabled, the age in weeks at which the child stopped breastfeeding, the ages of the youngest and oldest children in the household, and child gender. Regressions reported in Panel B also include all controls shown in Panel A except for 'other adults'; log of household income, the ages of the youngest and oldest children in the household, child's age in weeks, the ages of both mother and father, a dummy for the labor force participation of the mother, and child gender. Estimates significant at the 10%/5%/1% level are single-/double-/triple-starred.

Table 5: Associations of Child Outcomes with Parental Time Variables, By Outcome Type: BCOI, BGRAMMRK, and BCOMMUN

Dep var	Continuous outcomes	Grammar score	Communication score
<i>Panel A: Reduced-form</i>			
Feels rushed	0.74	-0.22	-0.01
(mother)	(0.46)	(0.18)	(0.02)
Good at keeping	0.70***	0.03	0.00
child busy (mother)	(0.18)	(0.07)	(0.01)
Good at keeping	-0.13	-0.07	0.00
child busy (father)	(0.17)	(0.07)	(0.01)
Self-efficacy	1.61***	0.08	0.04**
(mother)	(0.46)	(0.18)	(0.02)
Self-efficacy	0.85*	-0.06	0.03*
(father)	(0.48)	(0.19)	(0.02)
Other adults	-2.88*	0.77	-0.03
	(1.65)	(0.66)	(0.06)
Number of Observations	721	709	720
Adj $R^2$	.1043	.1571	.0731
<i>Panel B: Production model</i>			
$t_{SH} + t_M$	0.38	0.14	0.02
(mother)	(0.43)	(0.08)	(0.02)
$t_{SC}$	-0.29	-0.10	-0.02
(mother)	(0.58)	(0.11)	(0.03)
$t_{SH} + t_M$	-0.63**	-0.20***	-0.02
(father)	(0.23)	(0.04)	(0.01)
$t_{SC}$	-0.35	-0.15**	-0.01
(father)	(0.26)	(0.06)	(0.01)
Number of Observations	25	24	25
Adj $R^2$	.5216	.8746	.0901

Note: Based on data from the Longitudinal Study of Australian Children. Regressions reported in Panel A also include child's age in weeks, number of siblings, log of household income, dummies for unemployment of father, labor force participation of mother and part-time working status of mother, dummies for whether a language other than English is spoken in the home and whether a non-English language is regularly spoken to the child, the ages of both mother and father, an array of dummies for mother's smoking status and mother's highest education level achieved, dummies for whether the child enjoys child care, whether the family finances are reported to be in good condition, and whether the child is disabled, the age in weeks at which the child stopped breastfeeding, the ages of the youngest and oldest children in the household, and child gender. Regressions reported in Panel B also include all controls shown in Panel A except for 'other adults'; log of household income, the ages of the youngest and oldest children in the household, child's age in weeks, the ages of both mother and father, a dummy for the labor force participation of the mother, and child gender. Estimates significant at the 10%/5%/1% level are single-/double-/triple-starred.



in Panel A, and results from regressions on the smaller sample that include actual parental time use behavior appear in Panel B. Regressions in both panels include an array of control variables describing the household, the parents, and the children. In addition to the time use variables described above and a dummy for the presence of others in the household over age 15, two other variables of interest whose results are shown in the tables are the mother’s and father’s responses respectively to the question, ‘Overall, as a parent, do you feel that you are...’ with answer options as follows: 1=Not very good at being a parent; 2=A person who has some trouble being a parent; 3=An average parent; 4=A better than average parent; or 5=A very good parent. Additional controls are listed in the footnotes to each table.

In Panel A of both tables, we see evidence of a positive relationship for some child outcome measures, even in the presence of controls, between child outcomes and both a mother’s feeling of being rushed and her self-rating as being good at keeping the child busy while doing housework. Children’s overall rating on the Continuous Outcomes measure, their social and emotional development, their physical development, and their grammatical markers are all higher with increases in one or both of these maternal time use measures. Panel B shows that actual maternal time spent with children, controlling for these productivity and constraint variables, is not statistically associated with child outcomes. By contrast, several child outcomes (learning domain scores, continuous outcomes index scores, and grammar scores) are statistically associated—negatively—with either or both of fathers’ time use variables. Fathers’ multitasked housework and child care time is more robustly negatively associated with child outcomes than is fathers’ sole-tasked child care time.<sup>7</sup>

We conclude from these results that child outcomes are statistically associated with aspects of parental preferences, constraints, and behavior related to the multitasking of child care and housework in the home. We now turn to far more detailed time-diary evidence to provide some empirical validation

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<sup>7</sup>Our controls for female gender and age of the child in weeks indicate that in every outcome equation, girls are as developed as or more developed than boys, and older children are as developed as or more developed than younger children.

for our model of household production.

### 4.3 TUS: Empirical approach

The TUS provide detailed time diaries that enable respondents to record both primary and secondary uses of time for all adults in each sampled household. We use these diaries to construct measures of the two key types of time use that appear in our model: sole-tasked child care time (time spent only doing child care) and multitasked child care and housework time, where the parent reports being engaged in both child care and housework. We regress sole-tasked child care time and multitasking time on a number of proxies for the productivity of multitasked time, which our model suggests affect time use decisions. In particular, we include four dummy variables that capture the presence of household equipment that we believe are reasonably related to the productivity of multitasked or sole-tasked time. These dummy variables capture the presence in the household of a dishwasher, a clothes dryer, a deep freezer, and a microwave oven. We also include some other variables that may affect either the productivity of multitasked or sole-tasked time, or the extent to which the time use decisions of the parent are constrained (we would expect that, the greater the degree of constraint, the less sole-tasked time and/or the more multitasked time that would be spent). These variables include the degree to which the respondent reports feeling ‘rushed’, a dummy for the presence of other people 15 years of age or older (most of whom are under the age of 25) in the household, dummies for the presence of disabled children or adults in the household, the number of women in the household, and whether the parent is single.

We also include the following variables in every regression: age of the parent, a dummy variable for non-English language spoken in the home, the number of individuals in the household in different age ranges, the number of dependent children in the household, the age of youngest dependent child in the household, occupation and industry dummies for the individual, the number of weekend days included in the time window, and year-by-quarter dummies.

Table 6: Means and Standard Deviations: Australian TUS Data

	Fathers only		Mothers only	
	1997	2006	1997	2006
Minutes in sole-tasked C	17.02 (50.13)	13.33 (43.20)	70.44 (128.58)	45.25 (103.97)
Minutes in sole-tasked H	2.52 (18.10)	3.99 (20.52)	10.46 (29.54)	8.63 (25.19)
Minutes in multi-tasked C and H	26.06 (67.56)	80.73 (137.22)	117.39 (158.68)	169.80 (226.40)
Minutes in labor market tasks	672.65 (536.58)	560.68 (542.45)	247.01 (380.62)	261.88 (379.63)
Feels rushed (0 to 5 scale)	2.43 (1.07)	2.20 (1.09)	2.23 (1.01)	2.12 (0.98)
Count of aids in HH	2.57 (1.10)	2.91 (0.95)	2.50 (1.09)	2.81 (0.99)
HH has a microwave	.8762	.9743	.8647	.9680
HH has a freezer	.6004	.5428	.5744	.5212
HH has a dryer	.7220	.7661	.7045	.74
HH has a dishwasher	.3876	.6248	.3587	.5772
Other adults present in HH	.3058	.4943	.2787	.4689
Childcare hard to find	.2287	.1920	.2386	.1806
Number of Observations	921	1075	1105	1313

Note: Based on data from the Australian Time Use Surveys. All means are weighted at the household level using weights provided by the Australian Bureau of Statistics. The standard deviation of each continuous variable appears in parentheses below the variable's mean.

Table 7: Unconditional correlations: Australian TUS Data (mothers only)

*Panel A: 1997*

	$t_M$	$t_{SC}$	Microwave	Freezer	Dryer
$t_M$	1.00				
$t_{SC}$	.48***	1.00			
Microwave	.00	.02	1.00		
Freezer	-.03	-.06	.16***	1.00	
Dryer	.03	.02	.19***	.17***	1.00
Dishwasher	.03	.02	.14***	.10***	.28***

*Panel B: 2006*

	$t_M$	$t_{SC}$	Microwave	Freezer	Dryer
$t_M$	1.00				
$t_{SC}$	.34***	1.00			
Microwave	-.04	.03	1.00		
Freezer	-.07***	-.07**	.09***	1.00	
Dryer	-.01	-.02	.15***	.22***	1.00
Dishwasher	-.02	-.02	.10***	.01	.24***

Note: Based on data from the Australian Time Use Surveys; only mothers are included. Correlations significant at the 10%/5%/1% level are single-/double-/triple-starred.

#### 4.4 TUS: Results

Descriptive statistics for the TUS data are shown in Table 6. As we expect, mothers spend more minutes in every type of activity being modeled than do fathers. We also see a steep rise in multitasked housework and childcare from 1997 to 2006, for both genders, and a concomitant decline in sole-tasked child care. The incidence of every type of household aid except deep freezers also rises from 1997 to 2006.

Table 7 shows unconditional associations, in each year, amongst our maternal time use measures and our household aid dummies. As expected, the presence of one household aid is significantly associated with the presence of every other aid. We see few unconditional associations between time use and household aids, with two exceptions: the negative associations in 2006 between having a deep freezer and both multitasked time and sole-tasked child care time. Thinking back to the results presented in Table 1, this may indicate that having a deep freezer reflects a higher sole-tasked housework productivity factor. This may be due to the ability of mothers with deep freezers to cook and freeze large batches of food in concentrated sessions during which they are less likely to also undertake child care. Table 7 also shows a positive relationship between  $t_{SC}$  and  $t_M$ . This may suggest cross-household variation in the total factor productivity of household production.

Results by parental gender from regressing each type of time against our household aid dummies and a raft of controls appear in Table 8. We show results using only fathers in Columns 1 and 2 of this table, and results using only mothers in Columns 3 and 4. Considering the results of our household aid variables first, we see a strong negative relationship between the presence of a microwave oven in the home and mothers' time spent multitasking child care and housework. From our model's implications as presented in Table 1, this result suggests that adding a microwave oven to a household may increase that household's productivity factor of sole-tasked housework time. This may be because mothers who use a microwave to cook are able to spend less time preparing the same meal as could be prepared using a conventional oven, but the preparation requires more focused attention in the form of turning the food, setting and stopping the timer, alternating foods in and out of the oven over a short space of time,

and the like. This implies that watching children at the same time is less feasible. The presence of a dishwasher, by contrast, is statistically positively associated with mothers' multitasked time, suggesting that households with a dishwasher may have a higher multitasked productivity of housework and child care than other households. This may be because the type of work that a dishwasher enables mothers to substitute towards (loading and unloading the dishwasher), is more easily able to be multitasked with child care than traditional dishwashing during which the mother must face the sink and cannot easily look behind herself to engage with children. With the presence of the additional control variables in these regressions, the previous unconditional relationship between maternal time and the presence of a freezer is no longer present, although there is evidence in Column 2 that the presence of a clothesdryer works as an increase in the multi-tasked housework productivity factor,  $z_2$ .

Table 8 also shows a very strong and robust negative relationship between the presence of other adults in the household and both sole-tasked child care time and multitasked time, suggesting that other adults constitute a powerful enhancement to the sole-tasked housework productivity factor in a household. This is likely to be because such adults provide additional hands to do both household and child care work, removing time constraints on parents. Feeling rushed is negatively associated with sole-tasked child care for mothers, indicating that this feeling picks up the relative productivity of multitasked time compared to sole-tasked time. Single mothers spend significantly more time than married mothers engaged in multitasking of child care and housework, but there is no difference by mother's marital status in sole-tasked time spent. Finally, if external child care is hard to find, then parents (and especially mothers) spend more time in both sole-tasked and multitasked childcare, as we expect. Additional results not shown on the table include a positive association of sole-tasked child care time with the presence of more dependent children (though additional children is not associated with total multitasked time); and negative pressure on both sole-tasked and multitasked child care time as the youngest child in the household grows in age. Conditional on the other controls we include, the presence of a disabled child, the presence of a disabled adult, and the count of women in the household are insignificant in these equations.

Table 8: Associations of Productivity Measures with Time Use, By Type of Time Spent

Dep var	Fathers only		Mothers only	
	$t_M$	$t_{SC}$	$t_M$	$t_{SC}$
Feels rushed	2.17 (2.15)	-0.54 (0.97)	4.24 (3.51)	-3.95* (2.22)
Microwave	-4.38 (9.10)	0.42 (4.11)	-24.27* (13.13)	3.81 (8.31)
Freezer	-1.96 (4.96)	-0.89 (2.24)	2.15 (7.30)	-4.29 (4.62)
Dryer	2.01 (5.63)	-4.27* (2.54)	3.28 (8.24)	-6.33 (5.21)
Dishwasher	7.37 (4.95)	-0.31 (2.23)	18.44** (7.37)	8.13* (4.66)
Other adults	-42.47*** (11.47)	-2.94 (5.18)	-134.84*** (15.85)	-39.05*** (10.02)
Parent is single	6.69 (8.27)	1.86 (3.73)	45.22*** (11.84)	7.86 (7.49)
External child care hard to find	7.79 (5.71)	6.58** (2.58)	23.61*** (8.66)	18.45*** (5.48)
Number of Observations	1996	1996	2418	2418
Adj $R^2$	.2603	.0920	.3499	.2295

Note: Based on data from the Australian Time Use Surveys. All regressions also include age and marital status of the individual, a dummy for non-English language spoken in the home, the number of individuals in the household in different age ranges, the number of dependent children in the household, the age of youngest dependent child in the household, occupation and industry dummies for the individual, the number of weekend days included in the time window, and year-by-quarter dummies (quarter 1 of 1997 is the excluded category). Estimates significant at the 10%/5%/1% level are single-/double-/triple-starred.

## 5 Conclusion

This paper is motivated by the fact that children cannot be “turned off” while parents spend time doing housework, and yet existing models of household production cannot accommodate this basic fact. We introduce a household production model in the spirit of Becker (1965) that allows time spent in child care to be sole-tasked or multitasked with other household production activities such as cooking and cleaning. We use this model to derive implications about the relationship between productivity parameters in the household good and child good production functions and the optimal amount of time parents would spend in multitasked and sole-tasked production. We then provide suggestive evidence based on data from the LSAC that sole-tasked and multitasked child care may have different productivities in terms of an array of child developmental outcomes. Finally, we test the empirical implications of our model using two cross-sections of data from the TUS and find that multitasking by parents does respond to household productivity parameters—specifically, whether and what sort of labor- and time-saving devices are found in the home environment. Our evidence supports the treatment of multitasking in household production as an economic decision rather than a random choice, and one that has the potential to impact child development.

Based on the results in this paper, we believe further research in this vein would be fruitful. Linked data on household and child productivity parameters, actual parental time allocation choices, and child outcomes would greatly assist research in this area.



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