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ABSTRACT

The Multitasking of Household Production^{*}

The standard household production model does not incorporate multitasking, although time-diary data reveal that individuals regularly multitask. We formulate a model where time spent in child care can be sole-tasked or multitasked with other household production activities. This model implies associations between household productivity factors and both child outcomes and parental time use. We then use data from the Longitudinal Study of Australian Children and the Australian Time Use Surveys to examine the empirical validity of these implications. Consistent with our model's predictions, household productivity factors are associated both with child outcomes and parental time use.

NON-TECHNICAL SUMMARY

We investigate parents' multitasking of child care with other household tasks and find that the better are mothers at multitasking the better are their children's developmental outcomes. We do not, however, find a similar result for fathers. We also find that the presence in a household of certain household aids such as a dishwasher, clothes dryer, and microwave affect how much child care time spent by parents is multitasked.

JEL Classification: D13, J13

Keywords: multitasking, child care, household production

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1 Introduction

The standard household production model pioneered by Gary Becker (Becker 1965) does not allow time to be spent simultaneously in different activities. From a conceptual perspective, this is problematic if an important activity cannot be started and ended discretely, which is true in the case of parental child care. As noted by Folbre, Yoon, Finnoff & Fuligni (2005), Folbre & Yoon (2007) and others, children cannot be ‘turned off’ in order for their parents to do other things. Yet, if a mother supervises her child while doing the dishes, her choice to multitask could only be mapped into the Beckerian framework if a fraction of the total minutes spent in this combined activity was allocated to child care and the rest to doing the dishes.

At the time Becker’s model was formulated, very little if any information about the multitasking of household production was 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-tasked and multitasked time. For example, Kimmel & Connelly (2007), consistent 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 pro-

duction that use time-diary data, while relying loosely on Becker’s model for motivation, 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 factors that predict such behavior. Closer 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 these work activities. Kalenkoski & Foster (2008) regress sole-tasked and multitasked child care time on an even more exhaustive list of demographic and other explanatory variables, and find significant differences in the correlates of each. Attention to the nature of multitasking has also been paid 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., Jackson 2004, Folsom 2008, Rosen 2008).

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 derive empirical predictions from this model that we test

using two sources of Australian data. We first utilize data from the Longitudinal Study of Australian Children (LSAC) to illustrate the associations of household productivity factors with child outcomes. Then, we examine the relationships between household productivity factors and actual parental time use using repeated cross-sections of data from the Australian Time Use Surveys (TUS). We provide evidence of relationships between household productivity factors and child outcomes using the LSAC, and we show using the TUS that multitasking by parents is not random: how much multitasking occurs is associated with household productivity factors as well as other factors. 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 economists better understand the underlying theoretical determinants of individuals' decisions to sole-task or multitask.

2 Model

In Gary Becker's original household production model (Becker 1965), individuals choose time spent in market work and household production to maximize utility subject to production functions for household commodities, a budget constraint, and a 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,

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

where individuals obtain utility from a child ‘good’, C , and a household ‘good’, H . α and β are preference parameters. The restrictions on their values ensure diminishing marginal utility from each of the utility-providing goods. We exclude work and market goods from our model for two reasons. First, we are interested in the division of household production time rather than the division of time into household production and market production.¹ Second, incorporating market work as an additional choice makes our model intractable.

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. γ_1 is the productivity factor for sole-tasked time in producing the child good and γ_2 is the productivity factor for multitasked time in producing the child good. This Cobb-Douglas production function ensures positive, but diminishing, marginal products of each type of time. It allows t_{SC} and t_M to be substitutes in the production of the child good, yet each type of time positively affects the marginal product of the other, which is quite plausible in this application. For example, if a parent takes care of less important child care tasks while multitasking them with housework, then the parent can perform more important child care tasks in a sole-tasked format, thereby increasing his or her marginal product of sole-tasked child care. Analogously, if a parent already spends quite a bit of high-quality

¹To check the sensitivity of our empirical results to the exclusion of the market work choice, we estimate time use models that include market work and find that including these controls does not change our results, supporting our decision to abstract from market work in our theoretical model.

sole-tasked time with a child, that parent does not feel guilty about multitasking some time and thus is not distracted while multitasking, thereby increasing his or her marginal product of multitasked care.

Analogously, the household production function we use 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 time in producing the household good.

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

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

where T refers to the total time available for household production activities.

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:

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

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

Rewriting Equations (1) and (2) yields

$$\frac{\gamma_1 \alpha T}{(z_1 \beta + \gamma_1 \alpha)} - \frac{\gamma_1 \alpha}{(z_1 \beta + \gamma_1 \alpha)} t_M = t_{sc} \quad (3)$$

$$\frac{(\gamma_2 \alpha + z_2 \beta)}{(z_1 \beta + \gamma_2 \alpha + z_2 \beta)} T - \frac{(\gamma_2 \alpha + z_2 \beta)}{(z_1 \beta + \gamma_2 \alpha + z_2 \beta)} t_{sc} = t_M \quad (4)$$

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

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

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

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

Substituting these solutions back into the time constraint then yields

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

We now use this model to generate predictions of two types. First, we derive predictions about the relationships between each household productivity factor and the optimal levels of the child and household goods. Later in the paper, we explore the empirical validity of some of these predictions using data from the LSAC. Secondly, we derive predictions about the relationships between the household productivity factors and parents' sole-tasked and multitasked time, which we later explore empirically using data from the TUS.

2.1 Partial derivatives of C^* and H^* with respect to productivity factors

Given the measures available in the LSAC, we are interested in how the optimal level of the child good, C , changes with *ceteris paribus* changes in each of the productivity factors. From our model, we derive $\frac{\partial C^*}{\partial \gamma_1}$, $\frac{\partial C^*}{\partial \gamma_2}$, $\frac{\partial C^*}{\partial z_1}$, and $\frac{\partial C^*}{\partial z_2}$ (and, for completeness, their household good counterparts, $\frac{\partial H^*}{\partial \gamma_1}$, $\frac{\partial H^*}{\partial \gamma_2}$, $\frac{\partial H^*}{\partial z_1}$, and $\frac{\partial H^*}{\partial z_2}$), where asterisks indicate optimal output levels.² These results are summarized as follows.

We find that $\frac{\partial C^*}{\partial z_1} < 0$, implying that increases in the productivity factor of sole-tasked housework are unambiguously bad for child outcomes. We find that $\frac{\partial C^*}{\partial \gamma_1} > 0$ if $t_{sc}^* > 1$, a fairly innocuous condition, implying that increases in the productivity factor of sole-tasked child care are good for child outcomes. $\frac{\partial C^*}{\partial \gamma_2}$ and $\frac{\partial C^*}{\partial z_2}$ are both positive if $0 < z_2 < z_1 < 1$ and $0 < \gamma_1 < \gamma_2 < 1$.³ These conditions state that sole-tasked housework must have a higher productivity factor than multitasked housework in the production of the household good, and that sole-tasked child care must have a lower productivity factor than multitasked child care in the production of the child good. Under these conditions, *ceteris paribus* increases in either the productivity factor of multitasked time in the production of the child good or the productivity factor of multitasked time in the production of the household good benefit child outcomes.

The results for the household good are similar. Specifically, $\frac{\partial H^*}{\partial \gamma_1} < 0$, implying that increases in the productivity factor of sole-tasked child care unambiguously result in a

² Full derivations of these comparative statics are available upon request from the authors.

³ $\frac{\partial C^*}{\partial \gamma_2} > 0$ also requires the innocuous condition that $t_M^* > 1$.

lower optimal level of the household good. $\frac{\partial H^*}{\partial z_1} > 0$ if $t_{SH}^* > 1$, implying that increases in the productivity factor of sole-tasked housework lead to higher production of the household good. $\frac{\partial H^*}{\partial z_2}$ and $\frac{\partial H^*}{\partial \gamma_2}$ are both positive if $0 < z_1 < z_2 < 1$ and $0 < \gamma_2 < \gamma_1 < 1$.⁴ This means that a *ceteris paribus* increase in the productivity factor related to either multitasked time in household good production or multitasked time in child good production will result in unambiguously more production of the household good if (1) the multitasked housework productivity factor is greater than the sole-tasked housework productivity factor in the household good production equation, and (2) the sole-tasked child care productivity factor is greater than the multitasked child care productivity factor in the child good production equation. Table 1 summarizes these results and the conditions that they require.

2.2 Partial derivatives of t_{SC}^* , t_{SH}^* , and t_M^* with respect to productivity factors

Given the 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 γ_1 , γ_2 , z_1 , and z_2 .

Considering t_M^* first, its partial derivative with respect to γ_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

⁴ $\frac{\partial H^*}{\partial z_2} > 0$ also requires the condition that $t_M^* > 1$.

Table 1: Signs of partial derivatives of optimal quantities of the child and household goods with respect to productivity factors

	$\frac{\partial}{\partial \gamma_1}$	$\frac{\partial}{\partial \gamma_2}$	$\frac{\partial}{\partial z_1}$	$\frac{\partial}{\partial z_2}$
C^*	+	+	-	+
Conditions	$t_{SC}^* > 1$	$t_M^* > 1$		$0 < z_2 < z_1 < 1$
		$0 < z_2 < z_1 < 1$		$0 < \gamma_1 < \gamma_2 < 1$
		$0 < \gamma_1 < \gamma_2 < 1$		
H^*	-	+	+	+
Conditions		$0 < \gamma_2 < \gamma_1 < 1$	$t_{SH}^* > 1$	$t_M^* > 1$
		$0 < z_1 < z_2 < 1$		$0 < \gamma_2 < \gamma_1 < 1$
				$0 < z_1 < z_2 < 1$

respect to γ_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 γ_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 γ_2 , z_1 , and z_2 , as follows:

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

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

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

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 time productivity factor in the child good equation or in either the sole-tasked or multitasked time productivity factors in the household good equation.

For completeness, we can also derive the partial derivatives of t_{sh}^* with respect to γ_1 , γ_2 , z_1 , and z_2 , which are as follows:

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

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

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

$$\frac{\partial t_{\text{SH}}^*}{\partial z_2} = \frac{- (z_1^3 \beta^4 T + 2z_1^2 \gamma_1 \alpha \beta^3 T + z_1 \gamma_1^2 \alpha^2 \beta^2 T)}{(z_1^2 \beta^2 + 2z_1 \gamma_1 \alpha \beta + z_1 \gamma_2 \alpha \beta + z_1 z_2 \beta^2 + \gamma_1^2 \alpha^2 + \gamma_1 \gamma_2 \alpha^2 + z_2 \gamma_1 \alpha \beta)^2} < 0$$

As we expect, there is a positive *ceteris paribus* change in sole-tasked housework when the productivity parameter of sole-tasked time in household production rises. Increases in the other productivity parameters in our model all yield decreases in sole-tasked housework. These results follow the same pattern as our results for sole-tasked child care. Table 2 summarizes the partial derivatives of time use yielded by our model.

3 Data and Methods

The theoretical model motivates two empirical analyses. First, we analyze the associations of household productivity factors with child outcomes using the LSAC. Then, because the proposed mechanism through which these productivity factors work is via parents' choices

Table 2: Signs of partial derivatives of sole-tasked and multitasked time with respect to productivity factors

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

to spend sole-tasked and multitasked child care time, we will analyze the effects of household productivity factors on such time using the TUS.

3.1 LSAC

The first data set we employ is the LSAC. This panel survey of young Australian children includes detailed measures of child development taken when children are quite young. We focus on a cross-section of children who appear as babies in Wave 1 of the survey (the ‘birth cohort’ from 2004), and our outcome variables along with most controls come from the Wave 2 follow-up (2006) when these children had grown to between 2 and 3 years old.⁵ The variables we do use from Wave 1 include measures of children’s developmental levels in babyhood and self-reported measures of parental ability to keep the child busy while doing housework. The advantage of using the LSAC data is that they provide detailed measures of child outcomes, unlike most time-diary data. A disadvantage, however, is that no direct

⁵ Because the outcomes and other variables are different in nature across waves, we are unable to employ a differencing type of estimation strategy.

measures are available of the sole- and multitasked parental child care time inputs used to produce child outcomes.⁶

The unit of observation in our LSAC sample is a child. We exclude those children with a parent who is studying in any capacity. We also exclude those children with missing information on our analysis variables. After these exclusions, our estimation sample contains 632 children, each of whom is from a different household.

Our child outcome measures 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. These measures are as follows:

- 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

⁶ While there are direct questions about the average number of minutes spent per week by both mothers and fathers in housework and in child care of any type (presumably including both sole-tasked and multitasked child care) in the LSAC, there is a prohibitive degree of non-response. Useable responses to these questions are available for fewer than 30 observations in our analysis sample.

compiled by AIFS in each of these three domains of child development.⁷ 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.’⁸

The household productivity measures, which are our key explanatory variables, include the frequency with which each parent reports that s/he feels rushed (on a 1-to-5 Likert-style response scale from ‘never’ to ‘always’), whether s/he agrees 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’), and the mother’s and father’s responses respectively to the following question regarding perceived self-efficacy as a parent: ‘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.⁹ These

⁷ Detailed information about how these indices are derived is available in LSAC Technical Paper 2 (Sanson, Misson, Wake, Zubrick, Silburn, Rothman & Dickenson 2005).

⁸ 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?’

⁹ The lowest actual response for each of these questions was 2.

measures are the data's best available proxies for the productivity factors in the child and household good production functions. In particular, our proxies for the productivity of parental multitasked time are the self-reported feeling of being rushed and parental self-appraisal of how good s/he is at keeping the child busy while doing housework. The overall parental self-efficacy variables may capture the productivity of sole-tasked child care. Table 3 provides means and standard deviations for our key variables.

After presenting the unconditional relationships between each child outcome variable and these household productivity measures, we then run a series of regressions to explore whether the associations that we find hold up once we control for other factors likely to affect both variables. In addition to our productivity measures, our regressions also include, from the Wave 1 questionnaire, the hours per week that the child spent in non-parental care as a baby; behavioral development measures appropriate to babyhood; and whether the primary parent had any concern about the child's development, learning, or behavior when the child was a baby (which we also interact with each parent's perceived self-efficacy). The behavioral development measures we use from the first wave are the child's raw scores on the social, speech, and symbolic item composites from the Communication and Symbolic Behavior Scales instrument used in the Wave 1 interview questionnaire.¹⁰ Concern about the child's development in the first wave was measured as a binary indicator constructed from the primary parent's response to the question, 'Do you have any concerns about child's development, learning, or behavior? Would you say no, yes, or a little?', where responses of 'yes' or 'a little' were coded as 1.

Finally, we include in our regressions numerous other measures of child and family

¹⁰ Detailed information about these scales is available in LSAC Technical Paper 2 (Sanson et al. 2005).

Table 3: Means and Standard Deviations: LSAC

Physical domain score	100.33 (9.81)
Learning domain score	101.80 (9.32)
Socio-emotional domain score	101.91 (8.52)
Continuous outcomes index	101.46 (8.99)
Grammar score	6.74 (3.83)
Communication score	2.42 (0.32)
Feels rushed (mother)	2.32 (0.76)
Feels rushed (father)	2.54 (0.92)
Good at keeping child busy (mother)	7.25 (1.97)
Good at keeping child busy (father)	6.27 (2.10)
Parental self-efficacy (mother)	4.04 (0.77)
Parental self-efficacy (father)	4.05 (0.75)
Number of observations	632

Note: Based on data from the Longitudinal Study of Australian Children.

characteristics. These are the number of other adults in the household; the child's age in weeks; his or her number of siblings; 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 the mother and the father; an array of dummies for the mother's smoking status and the mother's highest education level; dummies for whether the child enjoys child care 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 the child's gender.

3.2 TUS

The second data set we employ in our empirical analyses is drawn from two iterations (1997 and 2006) of the Australian TUS, a random sample of Australian households. Each cross-sectional survey contains 48 hours' worth of detailed time-diary data per adult that allow us to construct direct measures of the amount of sole-tasked child care time, sole-tasked housework time, and multitasked child care and housework time spent by parents. However, because these data do not contain child outcome measures, we can only use them to investigate the determinants of parents' sole-tasked and multitasked child care time, not to estimate child outcome production functions.

From the TUS, we examine only households with children, and only those adults in those households who filled out complete time diaries. As is the case with 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 final estimation sample contains 1,996 fathers and 2,418 mothers.

The detailed time diaries in the TUS 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 three key types of time use that appear in our model: sole-tasked child care time (time spent doing only child care), sole-tasked housework time (time spent doing only housework), and multitasked child care and housework time, where the parent reports being engaged in both child care and housework. We regress each of these measures on a number of proxies for the productivities of sole-tasked and multitasked time that our model suggests should affect time use decisions. In particular, we include four dummy variables that capture the presence of household equipment that we believe is reasonably related to the productivity of sole-tasked and multitasked time. These dummy variables indicate separately 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 sole-tasked or multitasked time or the extent to which the time use decisions of the parent are constrained. 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 in the household (most of whom are under the age of 25), 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 whether a non-English language is 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 the 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.

Descriptive statistics for our key variables are shown in Table 4. 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 child care from 1997 to 2006 for both genders, and an associated decline in sole-tasked child care. While these changes may reflect real shifts over these nine years in Australians' proclivity to sole-task or multitask child care, we are also aware of the possibility for changes across the years in housework categories and instructions to respondents, which is why we include year-by-quarter dummies in all regressions. Table 4 also shows, consistent with intuition, that the incidence of every type of household aid except deep freezers rises from 1997 to 2006.

4 Empirical Results

4.1 LSAC

Table 5 shows the pairwise correlations observed in the LSAC data between each child outcome and each of our three measures of the mother's (Panel A) and father's (Panel B) productivity factors. The table shows positive and significant unconditional relationships between the degree to which a mother rates herself as being 'very good at keeping this child busy while I am doing housework' and three of the six child outcome measures. Such results suggest that the better a mother is at multitasking child care and housework, the better are her child's outcomes. Both mothers' and fathers' self-perceived efficacy as parents is also strongly associated with four of our six children's outcomes. These strong correlations are in line with our prediction of a positive effect on child outcomes when the productivity of sole-

Table 4: Means and Standard Deviations: TUS

	Mothers only		Fathers only	
	1997	2006	1997	2006
Minutes in sole-tasked C	70.44	45.25	17.02	13.33
	(128.58)	(103.97)	(50.13)	(43.20)
Minutes in sole-tasked H	10.46	8.63	2.52	3.99
	(29.54)	(25.19)	(18.10)	(20.52)
Minutes in multi-tasked C and H	117.39	169.80	26.06	80.73
	(158.68)	(226.40)	(67.56)	(137.22)
HH has a microwave	.8647	.9680	.8762	.9743
HH has a freezer	.5744	.5212	.6004	.5428
HH has a dryer	.7045	.7400	.7220	.7661
HH has a dishwasher	.3587	.5772	.3876	.6248
Feels rushed (0 to 5 scale)	2.23	2.12	2.43	2.20
	(1.01)	(0.98)	(1.07)	(1.09)
Other adults present in HH	.2787	.4689	.3058	.4943
Disabled child present in HH	.1670	.1218	.1540	.1069
Disabled adult present in HH	.3099	.4723	.3239	.4580
Number of women present in HH	1.32	1.54	1.16	1.26
	(0.65)	(0.70)	(0.51))	(0.61)
Marital status is single	.2646	.4311	.1687	.3484
Number of Observations	1105	1313	921	1075

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.

tasked child care is higher. There appears to be little relationship between child outcomes and whether a mother feels rushed, however, and a negative relationship if anything between a father's feeling of being rushed and his child's outcomes.

Table 6 presents the results of reduced-form regressions of our six child outcome measures on the household productivity factors, using an array of controls that include early childhood outcomes that proxy for child ability. As in the unconditional correlations, Table 6 shows evidence of generally positive, statistically significant relationships between maternal multitasking productivity factors and child outcomes. Children's physical development score, their social and emotional development score, and their continuous outcomes score are all statistically significantly higher with increases in mothers' multitasking productivity, as measured by the 'Good at keeping kid busy (m)' variable. A mother's feeling of being rushed, another proxy for her multitasking productivity, is also positively and significantly associated with her child's social and emotional development score. Conversely, a father's feeling of being rushed is negatively associated with children's scores almost across the board and in one regression this association is significant, again providing some support for the contention that, unlike mothers, fathers are more effective in producing child outcomes when they sole-task than when they multitask their children's care. Parental self-efficacy, though often positive in sign, is no longer significant with the addition of controls.¹¹

Table 5: Unconditional correlations: Longitudinal Study of Australian Children (N=632)

	BCOI	BLRNDOM	BSEDOM	BPHYSDOM	BGRAMMRK	BCOMMUN
<i>Panel A: Mothers</i>						
Mother is good at	.15***	.01	.18***	.14***	-.03	.01
keeping child busy						
Frequency with which	.01	-.07*	.04	.05	-.04	-.07
mother feels rushed						
Maternal self-efficacy	.17***	.06	.17***	.14***	.01	.10**
<i>Panel B: Fathers</i>						
Father is good at	.01	-.03	.01	.05	-.05	.03
keeping child busy						
Frequency with which	-.05	-.07*	-.04	.00	-.11***	-.01
father feels rushed						
Paternal self-efficacy	.13***	.06	.11***	.10***	.01	.10**

Note: Based on data from the Longitudinal Study of Australian Children. Correlations significant at the 10%/5%/1% level are single-/double-/triple-starred.

Table 6: Associations of Child Outcomes with Parental Productivity Measures, Controlling for Child Ability

Dep var:	Physical domain	Learning domain	SE domain	Continuous outcomes	Grammar score	Comm. score
Feels rushed (m)	0.65 (0.53)	-0.35 (0.49)	0.93** (0.44)	0.57 (0.46)	-0.09 (0.19)	-0.02 (0.02)
Feels rushed (f)	-0.22 (0.44)	-0.37 (0.41)	-0.39 (0.37)	-0.45 (0.38)	-0.27* (0.16)	0.00 (0.01)
Good at keeping kid busy (m)	0.69*** (0.21)	0.12 (0.19)	0.82*** (0.17)	0.75*** (0.18)	0.02 (0.07)	0.00 (0.01)
Good at keeping kid busy (f)	0.02 (0.19)	-0.20 (0.18)	-0.15 (0.16)	-0.15 (0.17)	-0.08 (0.07)	0.00 (0.01)
Parental self-efficacy (m)	2.75 (4.27)	4.37 (3.91)	1.15 (3.53)	3.80 (3.71)	1.94 (1.56)	0.13 (0.14)
Parental self-efficacy (f)	-4.37 (4.99)	0.19 (4.56)	1.86 (4.12)	-1.07 (4.33)	0.28 (1.82)	0.06 (0.16)
N	632	632	632	632	632	632
Adj R^2	.0522	.1207	.1397	.1475	.1746	.0883

Note: Based on data from the Longitudinal Study of Australian Children. See Section 3.1 for precise variable definitions. All regressions also include child's scores on three item composites from the Communication and Symbolic Behavior Scales instrument measuring child development in Wave 1; child's age in weeks, number of siblings, 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; self-reported parental efficacy of both mother and father and interactions of those variables with parental concern regarding the child's development, from Wave 1; the parental concern variable by itself; hours per week spent in non-parental care, from Wave 1; an array of dummies for mother's smoking status and each parent's highest education level achieved, dummies for whether the child enjoys child care, whether there are other adults in the household, 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. 'm' stands for mother; 'f' stands for father. Estimates significant at the 10%/5%/1% level are single-/double-/triple-starred.

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

<i>Panel A: 1997 (N=1105)</i>						
	t_M	t_{SC}	Microwave	Freezer	Dryer	Dishwasher
t_M	1.00					
t_{SC}	.48***	1.00				
t_{SH}	.03	-.05	.02	.06*	.01	-.01
Microwave	.00	.02	1.00			
Freezer	-.03	-.06	.16***	1.00		
Dryer	.03	.02	.19***	.17***	1.00	
Dishwasher	.03	.02	.14***	.10***	.28***	1.00
<i>Panel B: 2006 (N=1313)</i>						
	t_M	t_{SC}	Microwave	Freezer	Dryer	Dishwasher
t_M	1.00					
t_{SC}	.34***	1.00				
t_{SH}	-.08***	.03	-.01	-.01	.01	-.01
Microwave	-.04	.03	1.00			
Freezer	-.07***	-.07**	.09***	1.00		
Dryer	-.01	-.02	.15***	.22***	1.00	
Dishwasher	-.02	-.02	.10***	.01	.24***	1.00

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.

4.2 TUS

Table 7 shows unconditional associations, in each year, between each of our maternal time use measures and each of our household aid variables that are intended to proxy for the productivity of parental time. 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 the following exceptions: the negative associations in 2006 between having a deep freezer and both multitasked time and sole-tasked child care time, and a mild positive association in 1997 between having a deep freezer and time spent in sole-tasked housework. Thinking back to the theoretical implications summarized in Table 2, this may indicate that having a deep freezer reflects a higher sole-tasked housework productivity factor.¹² This may reflect 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 , perhaps indicative of cross-household variation in the total factor productivity of child production; and, in 2006, a negative association between t_{SH} and t_M .

Table 8 shows the associations between fathers' time use and the household aid variables. We again see a positive association between multitasked time and sole-tasked child care time in each year, along with a negative association between t_{SH} and t_M in 2006 (although this association is positive in 1997). The result for mothers regarding deep freezers is

¹¹Results are qualitatively identical if we include potentially endogenous measures of family income and parental labor force status in the list of control variables.

¹² Recall that a *ceteris paribus* increase in the sole-tasked housework productivity factor increases sole-tasked housework, but decreases both sole-tasked and multitasked child care.

Table 8: Unconditional correlations: Australian TUS Data (fathers only)

<i>Panel A: 1997 (N=921)</i>						
	t_M	t_{SC}	Microwave	Freezer	Dryer	Dishwasher
t_M	1.00					
t_{SC}	.24***	1.00				
t_{SH}	.08**	.02	.01	-.01	.02	.01
Microwave	.00	-.01	1.00			
Freezer	-.05*	-.06*	.16***	1.00		
Dryer	.05	.01	.19***	.20***	1.00	
Dishwasher	.04	-.03	.17***	.08**	.30***	1.00
<i>Panel B: 2006 (N=1075)</i>						
	t_M	t_{SC}	Microwave	Freezer	Dryer	Dishwasher
t_M	1.00					
t_{SC}	.32***	1.00				
t_{SH}	-.12***	.08***	-.03	.02	-.02	.02
Microwave	.03	.03	1.00			
Freezer	-.04	-.01	.09***	1.00		
Dryer	.00	-.06**	.11***	.17***	1.00	
Dishwasher	-.02	-.01	.10***	.01	.23***	1.00

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

also in evidence for fathers in 1997, and persists (although insignificantly so) in 2006. In addition, in 2006, those fathers in households that have a clothes dryer spent less time on average in sole-tasked child care than fathers in households without a clothes dryer. The associations of dryers with fathers' sole-tasked housework and multitasked time are insignificantly positive and negative, respectively. Table 2 would indicate then that the presence of dryers in the household may constitute an enhancement to the productivity of multitasked housework performed by men.

Results by parental gender from regressing each type of time against our household aid dummies and our extensive set of controls appear in Table 9. We show results for mothers in Columns 1 through 3 of this table, and results for fathers in Columns 4 through 6. Considering the results of our household aid variables first, we see a large and statistically significant negative relationship between the presence of a microwave oven in the home and mothers' time spent multitasking child care and housework. There are also positive signs on the estimates of the impact of the presence of a microwave on time spent in sole-tasked child care and sole-tasked housework, although these results are statistically insignificant. From our model's implications as presented in Table 2, these results suggest that adding a microwave oven to a household may increase that household's productivity factors for both sole-tasked child care and sole-tasked housework. Similar, but statistically insignificant results are seen for fathers. The direct, positive effect of having a microwave on sole-tasked child care time could compensate for the otherwise negative impact of a microwave on child production that our model would predict to result if its only effect was to increase the productivity of sole-tasked housework.

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. However, the positive association between having a dishwasher and mothers' sole-tasked child care time is unexplained by our model, as only an increase in a sole-tasked child care productivity factor should positively affect sole-tasked child care time.¹³ Dishwashers are statistically insignificant in the equations predicting fathers' time use, but the presence of a clothes dryer—as in our unconditional correlations—is associated with fathers' time. Fathers in households with clothes dryers are found to spend statistically significantly less time in sole-tasked child care, and statistically insignificantly more time in multitasked child care and housework, than other fathers. This underlines our interpretation above that dryers may enhance the productivity of fathers' multitasked time. Perhaps this is because they can load and unload the dryer and fold and sort clothes inside, while simultaneously looking after a child playing indoors, rather than having to go outside (potentially leaving the child unsupervised) to hang up laundry on a line.

Feeling rushed is negatively associated with sole-tasked child care and sole-tasked housework for mothers, and positively (although statistically insignificantly) associated with multitasked time. This suggests that the 'feeling rushed' variable is picking up increased relative productivity in multitasked compared to sole-tasked production of the household

¹³One possible way that a dishwasher can increase the productivity of child care is by making sterilization of bottles and pacifiers easier. To sterilize bottles using a dishwasher one only needs to put the bottles in the dishwasher. Without a dishwasher one must first boil water and then put in the bottles and pacifiers. Not only is a step saved but one does not need to watch a dishwasher closely, while a pot of boiling water must be watched carefully.

Table 9: Associations of Productivity Measures with Time Use, By Type of Time Spent

Dep var:	Mothers only			Fathers only		
	t_M	t_{SC}	t_{SH}	t_M	t_{SC}	t_{SH}
Microwave	-24.27*	3.81	0.80	-4.38	0.42	0.13
	(13.13)	(8.31)	(2.17)	(9.10)	(4.11)	(1.78)
Freezer	2.15	-4.29	0.95	-1.96	-0.89	-0.24
	(7.30)	(4.62)	(1.21)	(4.96)	(2.24)	(0.97)
Dryer	3.28	-6.33	0.16	2.01	-4.27*	-0.12
	(8.24)	(5.21)	(1.37)	(5.63)	(2.54)	(1.10)
Dishwasher	18.44**	8.13*	-1.67	7.37	-0.31	1.27
	(7.37)	(4.66)	(1.22)	(4.95)	(2.23)	(0.97)
Feels rushed	4.24	-3.95*	-1.72***	2.17	-0.54	-0.17
	(3.51)	(2.22)	(0.58)	(2.15)	(0.97)	(0.42)
Number of Observations	2418	2418	2418	1996	1996	1996
Adj R^2	.3499	.2295	.0377	.2603	.0920	.0181

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, dummies for the highest level of education achieved by 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.

good, thereby supporting our interpretations of the ‘feeling rushed’ variables in our analysis of the LSAC data.

The results of several of our control variables are interesting and significant, but due to space limitations they do not appear in the table. There is 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 (as well as sole-tasked housework, for men), suggesting at first blush that other adults constitute a powerful enhancement to the sole-tasked housework productivity factor. Recalling prior evidence from the LSAC, however, it may be that households with additional co-resident adults have lower total factor productivities of child care time and thus spend far less time on child care compared to other families. Single mothers spend significantly more time than married mothers engaged in multitasked child care and housework, but there is no difference by mother’s marital status in sole-tasked time spent, suggesting perhaps that the unavailability of a spouse to do some necessary child care requires a single parent to multitask. Finally, if external child care is hard to find, then parents (and especially mothers) spend more time in both sole-tasked and multitasked child care, as we expect. Additional results not shown in the table include a positive association of sole-tasked child care time with the presence of more dependent children (though additional children are not associated with total multitasked time and are only slightly positively related to sole-tasked housework time) and negative pressure on all three types of time as the youngest child in the household grows in age. Higher counts of women in the household are associated with more sole-tasked housework for both genders, and the presence of a disabled adult is associated with less sole-tasked housework by fathers. 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 all insignificant in the equations predicting sole-tasked child care and multitasked time.

To test the sensitivity of our results, we first restricted our sample to individuals living in households where all householders, and their spouses where applicable, were employed, and re-estimated the models shown in Table 9. The objective of this exercise was to abstract from the labor force participation decision, which is possibly endogenous to child outcomes and/or to time spent engaged in household production. We find that, in these households, there is still a negative and significant association between the presence of a microwave and mothers' multitasked child care time. In addition, the negative association seen in Column 2 of Table 9 between the presence of a freezer and mothers' sole-tasked child care time remains and gains significance for this subsample. While no signs reverse for mothers, results for the presence of a dishwasher and feeling 'rushed' are insignificant for this subsample in all equations. All household aids in the fathers' time use equations are now insignificant with the exception of the presence of a dishwasher, which is now positively and significantly associated with fathers' multitasked time (as it was for mothers, but not fathers, when using the full analysis sample). We conclude that while there are differences between the time use patterns of households in which all primary adults are employed compared to our full sample, household-level productivity factors are associated with the levels of sole- and multitasked time spent by adults in both samples.

In a second sensitivity analysis, we re-estimated the time-use models using the subsample of parents who were living in rental housing (for which an indicator is only available in the 2006 data). We do this to account for the possible endogeneity of the presence of household aids: renters are less likely than owners to have control over the presence of

household aids. For this subsample, where we were forced to include fewer controls due to the smaller sample size, we find statistically significant associations between the presence of a dishwasher and multitasking time for mothers (with a positive sign, as for our full sample) and the presence of a deep freezer and mothers' multitasking time (with a negative sign, unlike in our full sample where this effect was positive and insignificant). We also find the feeling rushed variable to be significantly negatively associated with mothers' sole-tasked housework time, as in our full-sample results. For fathers in this subsample, the presence of a microwave is negatively associated with multitasked time (as in our main sample, but here the association is statistically significant) and the presence of a clothes dryer is negatively and significantly associated with sole-tasked child care time, as was the case in our main sample. We conclude that the potential endogeneity of household aids, as proxied by the home-owning status of the householder, is unlikely to be driving the association between time use and the presence of household aids. Full results from these sensitivity analyses are available upon request.

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 do not accommodate this basic fact. 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 use this model to derive implications about the relationships between productivity parameters in the child and household good production functions and

the optimal levels of C and H that are produced. We also derive implications about the relationships between these productivity factors and the optimal amounts of time parents spend in sole-tasked child care, sole-tasked housework, and multitasked child care and housework. We examine the model's implications with respect to the relationships between household productivity factors and child outcomes using the LSAC, and find that child outcomes are positively related to maternal multitasking productivity. We then examine the empirical implications of our model with regard to the impact of productivity factors on parental time use using two cross-sections of data from the Australian TUS. We find that parents' sole-tasked and multitasked child care time is affected by their household's productivity parameters as measured by labor-saving devices in the home. Specifically, we find that microwaves appear to enhance sole-tasking productivity of both child care and housework time for mothers, whereas dishwashers and clothes dryers appear to enhance multitasking productivity for mothers and fathers, respectively. 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. We believe further research in this vein would be fruitful and that this avenue of research would greatly benefit from a single data set that includes all three pieces of information: measures of households' productivity parameters, parental time allocation choices, and child outcomes.

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