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Allocation of Parental Time and the Long-Term Effect on Children´s Education

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Allocation of Parental Time and the Long-Term Effect on Children's Education[*]

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Abstract

This paper empirically and theoretically links parental time use decisions to child development in a household with two full-time employed parents. Both parents' time spent on childcare is explicitly taken into account as well as childcare bought in the market. It is shown that the quality of market-provided childcare vs. the quality of parental childcare is crucial for parents' time use decisions but availability of paternal childcare does not directly affect the mother's childcare decision. The effect of parental childcare time on children's educational outcome is tested using Danish time use data combined with administrative register data. I find a statistically significant positive association between mothers' childcare time on weekdays and children's outcomes as well as a positive association between fathers' childcare time on weekends and children's outcomes. Parents' time spent on childcare is negatively related to the amount of time spent on paid work.

JEL Classification: D13, J13.

Keywords: Time use, childcare, child development

1 Introduction

There has been a long-standing interest in determining what affects child well-being and development. This study focuses on time spent in households and investigates whether there are any long-term effects on children associated with mothers' or fathers' time spent with children.

When economic studies attempt to relate parental childcare time to child development, they often end up studying the effect of maternal employment on pre-school children's cognitive development.[1] Thus, short-term effects of maternal employment have been intensively investigated in the empirical literature using a lot of different methods and datasets but so far without reaching any conclusive evidence.

Children's development is affected by both parents' decisions for the household. Therefore, there is no reason not to take fathers' decisions into account along with mothers', especially when two-parent households are considered. Home time and market work have become more equally distributed within most households during the latest decades. In Denmark, for example, the difference between men and women's time spent on housework has decreased from 1.25 hours per week to only 1 hour per week from 1987 to 2001. The difference between employed men and women's time spent on market work has decreased from 1.5 hours per week to 1.25 hours per week. Fathers seem to be spending more time with their children in the same time period, see Bonke (2002). Furthermore, Gørtz (2006) shows that the amount of housework increases for both men and women when children are present in the household, even when both parents are employed full-time. Therefore, fathers seem to be increasingly important for children's daily life and should have a more active role in economic models than as the breadwinner who works an exogenously determined amount of

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[1] There have been a few studies on the effect of maternal employment on adolescent development, see e.g. Ruhm (2008).

hours. However, in many studies on child cognitive development, fathers' role is neglected. There is scope for looking more into both determinants and effects of fathers' time with children.

The contribution of this study is to add to existing theoretical models of child development by setting up a model which explicitly takes mothers' *and* fathers' childcare time into account. Further, when measuring child outcomes as high school enrollment, I empirically investigate the long-term effect of mothers' and fathers' time with their children. Thus, this is one of the few studies that follow children into adulthood and can analyze children's long-term outcomes.

The remainder of this paper is structured as follows. Section 2 contains a literature survey. Section 3 describes previous theoretical models for child development. Section 4 presents a theoretical model that focuses on establishing a link between both parents' time inputs, childcare quality, and children's development. Section 5 presents an empirical study using Danish time use data. Finally, Section 6 concludes.

2   Literature Survey

There exist many theoretical and empirical studies of child well-being and child development. Waldfogel (2005) suggests dividing child well-being into three interacting main domains; child health, child cognitive development, and child social and emotional development. While economists' interest is now increasingly turning to child health, e.g. Currie and Neidell (2005), most often economists focus on the cognitive development of children. In this section, I will first briefly mention some of the theoretical approaches dealing with child development and then present a selection of empirical studies analyzing child health and child cognitive outcomes.

A logical way of categorizing models for child development is whether they are

static or dynamic. Todd and Wolpin (2003) suggest a dynamic model because they argue that child development is the result of a cumulative process depending on the history of the family and school inputs as well as on inherited endowments. On the other hand, the outcome of interest is the final child development outcome which may be seen as the outcome from one (long) time period. For the latter approach, a static model is optimal for describing child development, see e.g. Blau and Hagy (1998). Another approach is to use intergenerational mobility models which are appropriate for investigating the transmission of parental human capital to children. These models usually consist of few time periods and are e.g. used in Becker and Tomes (1986). I look at the theoretical studies in more detail in Section 3 and dedicate the rest of this section to empirical studies of child development and child outcomes.

For several reasons, many empirical studies focus on children's short-term outcomes, the most common one being the general problem of a lack of data on older individuals. Also, research has shown that early test scores are strong predictors for future educational and labor market outcomes, see e.g. Connolly et al. (1992) and Currie and Thomas (2001). Heckman (2000) and Knudsen et al. (2006) argue with reference to research in psychology and cognition that much learning starts in infancy and takes place outside schools. Heckman (2000) and Cunha and Heckman (2007) in particular argues that families' success or failure with respect to skill formation in the early pre-school years leads to success or failure in post-school learning. Cunha and Heckman (2008) further show that parental inputs have different effects at different stages of the child's life cycle.

Many studies focus only on the mother('s time) when investigating hypotheses about young children and focus only on the father('s income) when investigating hypotheses about older and grown-up children. This is, for example, the case in intergenerational mobility contexts as in Becker and Tomes (1986) and the literature

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review in Solon (1999). However, focusing on either the child's mother or father seems somewhat inconsistent, especially when the focus is *not* on lone parents.

The studies that focus on mothers' time use in relation to child outcomes are often concerned with maternal employment during early childhood. The results in these studies are rather mixed, possibly because different types of datasets, explanatory variables, and specifications are used. Most studies as Ermisch and Francesconi (2000) and Ruhm (2004) point toward a negative effect of maternal employment in the child's first year but other studies find opposite effects in the following years. These inconclusive results are not surprising given that it is possible theoretically to argue both for and against (early) maternal employment, see Ruhm (2000). Moreover, the mothers that work during early childhood can be positively or negatively selected.

The alternative to mothers' childcare may be an important determinant of the effect of maternal employment as suggested by Gregg et al. (2005) and Datta Gupta and Simonsen (2009). Other studies as Blau (1999) suggest that on average childcare characteristics have little association with child development. Few studies address the effect of paternal childcare but one exception is the study by Averett et al. (2005). They compare children's development across different types of childcare but condition on the mother being employed. Averett et al. show that paternal childcare, compared to other types of childcare for infants, does not seem to cause different development in the ages 5 to 8. On the other hand, paternal childcare, compared to other modes of childcare for toddlers, results in slightly worse cognitive outcomes when the children become 5 to 8 years old. They cannot rule out that this finding is caused by negative selection of fathers taking care of toddlers, or it may alternatively be related to the timing of paternal childcare.

A substantial fraction of empirical studies of child development uses different American datasets for the estimations. Exceptions are the studies by Gregg et al.

(2005) using British data, Wrohlich (2006) using German data, and Datta Gupta and Simonsen (2009) using Danish data. These non-U.S. studies offer information on other aspects of the relationship between parental decisions and children's development than the U.S. studies. Typically, non-U.S. datasets are richer in terms of information on modes of childcare, or part-time versus full-time employment. The different types of information of course mirror the institutional settings in the countries investigated. Among studies using U.S. data, the difference in results may be caused by different methods of estimation, different variables included in the estimations, and different age groups of the children in question.[2] The population in question and the institutional settings are in general the same. It is clearly problematic to compare results of studies using U.S. datasets with studies using non-U.S. datasets when the institutional settings differ, but not even among studies using U.S. datasets there is a clear conclusion regarding the effect on children of early maternal employment.

In summary, the empirical studies suggest that the quality and types of childcare may be important for child development. This is further investigated in the theoretical model in Section 4 and the empirical analysis in Section 5.

3 Theoretical Model Structures for Child Development

Theoretical models of child development often differ based on the age of the child. These distinctions are in part driven by the fact that the data available on development differs considerably by age of the child. For example, when short-term develop-

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[2]Studies which focus on young American children, i.e. studies that estimate the effect of parental employment (maternal in particular) on infants, toddlers and pre-school children, include Leibowitz (1977), Blau and Grossberg (1992), Baum (2003), Blau and Hagy (1998), Ruhm (2004), and Berger et al. (2005). Another group of studies focus on the longer term effects of early maternal employment, namely by looking at children who have started in school. Examples of this is Waldfogel et al. (2002), Ruhm (2008), and Averett et al. (2005).

ment is the focus of the model for child development, the roles of parental characteristics and the early home environment in producing cognitive skills are important to investigate. Models concerning short-term effects in production function setups are sometimes referred to as early childhood development models (ECD). If focus instead is on longer term effects, e.g. how school-age children develop, the productivity relationship between schooling inputs and test score outcomes are also relevant. Models with this focus are called education production function models (EPF) by Todd and Wolpin (2003). Finally, even longer term effects can be investigated, such as the final educational level, or the child's later income. This can e.g. be investigated in an intergenerational mobility context (Becker and Tomes (1986)) or in a static model setup as in Blau and Hagy (1998).

For ease of comparison, in the following sections models for child development are separated by whether they are static or dynamic.

3.1 Dynamic Models

A basis for many theoretical studies concerned with intergenerational mobility and transmission of earnings, assets, and consumption from parents to descendants is the work by Becker and Tomes (1976, 1979, 1986). They e.g. use a dynamic framework where the family is assumed to maximize a utility function spanning several generations, and where parents' utility depend on their consumption as well as the number and the "quality" of their children (Becker and Tomes (1979, 1986)). Parents compensate or reinforce differences between children by investing time and money in the children but parental time investments are not explicitly modelled.

Ermisch and Francesconi (2000) model a family with two parents and two children, and the children may differ with respect to endowments relevant for educational attainment. The model is limited to three time periods and describes parents' human

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capital investment in their children. The father's time is not directly included. An important identifying assumption is that children's endowments are not known in the child's first period of life, similar to the process of information revelation in Rosenzweig and Wolpin (1995). Further, a sibling difference estimator identifies the effect of mother's employment time on child educational attainment by differencing away the possible family fixed effect which may otherwise bias the results. It may for example be the case that children with the same parents have common components because they are raised in the same home environment.

Leibowitz (2003) sketches a comprehensive framework for building theoretical models where the behavior of both parents are included in a dynamic context. However, identification and structural relationships are not fully described. The focus is on expanding the household production framework to distinguish among time spent in the labor market, in leisure, in developing the human capital of children, and in other household production. Utility is a function of parental leisure, consumption of goods and services, and, importantly, human capital of the child. Leibowitz compares "in-home-training" to "on-the-job-training" since both are complementary to formal schooling. Thereby the household's production of child human capital is related to a firm's production of employees' human capital. As in Becker (1965), households are both consumers *and* producers, here producing children's human capital.

Ruhm (2004) models parents as allocating resources to maximize an objective function that includes the health and development of children as one argument. He follows Becker (1991) in emphasizing the role of non-market time in household production and defines a dynamic child production function where the child's father is considered along with the mother. In Ruhm's specification, total time depends on the number of parents and children in the household which implies that total time is endogenous.

When using dynamic models as a basis for empirical analyses, it is sometimes a problem that production function models are estimated without having a dataset with rich enough information on either family or school inputs. Furthermore, there is a lack of consensus over which variables to include in the different specifications. Thus, researchers working on the same data source sometimes find completely opposite effects, see Todd and Wolpin (2003).

3.2 Static Models

Many models for child development are static. They are easy to work with because they only consider one time period, but the time period is potentially very long.

Becker and Tomes (1976) establish a link between social interactions, family background, income and the relationship between demand for children and quality of children in a static framework. In particular, their models build on the study by Becker and Lewis (1973). Parental expenditures are related to children's endowments, and it is shown that parents tend to invest more human capital in better-endowed children and more non-human capital in lower-endowed children. These static models are the basis and reference point for many studies of child development.

Blau and Hagy (1998) investigate the demand for quality in childcare and their model is partly based on the quality-quantity literature, for example Becker and Lewis (1973) and Becker and Tomes (1976). In the model, a time- and budget-constrained household maximizes its utility function which among other things depends on child quality. Child quality is a function of mother's and non-parental childcare time, mother's employment status, the quality of non-parental care, other observed exogenous factors, and unobserved factors. Mother's childcare time is assumed to have an exogenously given quality and the mother chooses to spend time on either market work, childcare, or leisure. Employment decisions of the father are assumed given so

he is not the primary caregiver for the child. The child is either in mother's care or some sort of non-parental childcare arrangement. In this model, demand for quality-related attributes of childcare is estimated jointly with mother's labor supply, mode of childcare, and expenditure on and hours of care. Blau and Hagy's model is the first to incorporate all these features into the same framework so that childcare and labor supply are considered simultaneous decisions.

Besides the dynamic model, Ermisch and Francesconi (2000) have a static version of their model of parents' human capital investment in children. This model uses separable utility as described by Pollak (1971). It is assumed that the two children's earnings endowments are independent of the mother's time input and of the resources parents devote to human capital investment. Finally, identification is ensured by using a special sub-utility function of parental welfare which follows Behrman et al. (1982).

Ribar (1995) focuses on the structure and determinants of childcare costs and their relation to maternal employment. Benefits, direct costs, and opportunity costs of paid care utilization are modelled. The principal benefit of paid care is its contribution to overall child quality, and the opportunity cost of paid care is defined as the relative quality of available unpaid arrangements. The decision to utilize paid or unpaid care depends only on the absolute cost and relative quality of paid care. A feature of the model is that the relative attractiveness of paid care utilization may vary with hours worked. A fully structural, discrete-choice model of married mothers' care arrangements and labor supply is estimated based on the theoretical model. Ribar's model is the point of departure for the theoretical model presented in the Section 4.

The model in Wrohlich (2006) builds on Blau and Hagy (1998). Wrohlich looks at mothers' labor supply decisions and childcare choices in a model where the childcare market is rationed. The purpose of the study is to build (and estimate) a model that comes close to the institutional settings in Germany. The mother's utility function

depends on the quality of children among other things. Child quality depends on hours of maternal care, hours of formal (paid) care, and hours of informal (unpaid) care. The father is assumed not to be active in childcare and is therefore "exogenous" to child quality.

A general weakness in empirical studies based on static models is that most of them do not simultaneously model and estimate the mother's labor supply decision, the decision to pay for care, the mode choice, and the demand for childcare attributes. Also, information about quality of childcare is often not included. Instead it has been implicitly assumed that the mother's care is better than all other types of childcare, and the time fathers spend with their children is neglected in virtually all studies.

The theoretical model presented in the following section is static since static models to a higher degree seem to allow for the effect of childcare quality which is important for this study. Furthermore, it is possible to take more parameters into account in the static model. This is optimal when I want to estimate the model using the rich TUS dataset. Finally, dynamic models require data from several periods but the Danish time use survey is a cross-section dataset. Thus, it is not possible to get time use information from different points in the child's life, and a dynamic model is therefore not appropriate for this study.

4 Theoretical Model of the Relation between Parental Decisions and Child Development

The failure to find consistent results in the empirical literature may be attributable to flaws in the theoretical models. It may be that these models fail to capture all the major household attributes, for example when they ignore the effect of fathers on child development. This is problematic because it can be observed in many countries that

there is an increase in the number of families where both partners are employed, i.e. the mother is not at home full-time, and therefore both partners' time use becomes even more important for the child outcome. A theoretical model which links parental time use decisions to children's development, and where both parents are explicitly included along with childcare bought in the market, is to my knowledge not yet developed, and is therefore presented in this section.

This model aims to describe the relationship between mothers' and fathers' childcare time, the quality of market-provided childcare, and children's outcome. In particular, what is the relation between availability of paternal childcare and the mother's decision on how much time to spend on childcare? And, is parents' decision on how much time to spend on childcare affected by the quality of market-provided childcare?

The theoretical model presented in this section models households with one child, and there is equal focus on mothers and fathers. Both parents are assumed to be employed full-time and it therefore seems natural to hypothesize that the father is as important for children as the mother.[3] Households are considered both consumers and producers, and especially the household's production of child "quality" is in focus here. Fertility decisions are not considered, though they may also subsequently affect child quality. The model builds on the model in Ribar (1995), but childcare by both parents is included instead of only considering childcare by the mother. Both parents' labor supply decisions are considered predetermined since the focus is on families where both parents are employed full-time.

Assume that the household consists of two adults and one child. For simplification, it is assumed that there is only one child in the household since this eases the

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[3] Of course, not all employed individuals are employed full-time. OECD's labor force statistics for Denmark show that more women than men are part-time employed but that part-time employment as a percentage of the female employment is falling whereas the opposite is true for men. In 1987, 32% of the employed women were part-time employed, whereas 9% of employed men were part-time employed. In 2005, these numbers were 25% and 12%, respectively.

main goal of explaining how household decisions affect child development and how the household decisions interact. Further, it enables me to ignore the question of birth order effects. Parents' utility, U, depends on their own consumption of goods, their time spent in different activities, and the "quality" of their child. They maximize utility according to Equation (1) and since they care about their child's quality and well-being, child quality is one argument in the utility function and is defined separately in Equation (2). I will interpret quality as the child's cognitive development which in the empirical analysis is measured as enrollment in high school. Moreover, the household is budget constrained as shown in Equation (3), and parents and the child all face time constraints (normalized to 1) as shown in Equations (4) to (6).

The household's utility maximization problem is stated as follows

$$\max U = U(Q, y, T_{Om}, T_{Of}) \tag{1}$$

$$s.t.$$

$$Q = Q(T_{Cm}, T_{Cf}, X, P, G) \tag{2}$$

$$y + CCp_{CC} = T_{Wm}w_m + T_{Wf}w_f + Y \tag{3}$$

$$1 = T_{Wm} + T_{Cm} + T_{Om} \tag{4}$$

$$1 = T_{Wf} + T_{Cf} + T_{Of} \tag{5}$$

$$1 = T_{Cm} + T_{Cf} + CC \tag{6}$$

and subject to non-negativity constraints of all the variables.

Child quality, Q, is produced according to a production function for child development (Equation (2)), where $T_{C,i}$ is time inputs of the mother ($i = m$) and the father ($i = f$), and X is goods bought in the market and which are expected to promote child development, for example publicly provided childcare. P is characteristics of the parents thought to affect both the quality of parental childcare and also the par-

ents' perception of childcare quality, and G is the genetic inheritance (endowment) of the child. Time inputs from the child itself are ignored. To simplify, we can assume that X is equal to CC, which is the amount of time the child is in publicly provided childcare or similar childcare bought in the market. Thus, the only good bought in the market to promote child development is childcare. I assume that it is possible to buy childcare in the market at an exogenously given price, p_{CC}, assumed to be determined by the local municipality for example. Further, G and P are assumed exogenously given along with parents' time spent on market work. They are therefore regarded as fixed parameters in the maximization problem. Q is increasing in all arguments, but it seems plausible to assume that this is at a diminishing rate. The child quality function does not depend on the status of child quality in the previous period because, following Becker and Tomes (1976) and Ribar (1995), I consider one period of time. The child's "quality" in this model is therefore an outcome and not the process leading to the outcome.

Time constraints for each parent i, $i = m, f$ (Equations (4) and (5)), depends on T_W, time devoted to market work, T_C, time devoted to the child, and T_O, time spent in other activities than market work or with children, e.g. leisure time. The child is also time-constrained (Equation (6)). For simplicity I assume that parental time may not overlap. I ignore that some children are in informal unpaid care, e.g. care provided by family members or the parents' friends. This type of care is not prevalent in for example the Scandinavian countries, see Datta Gupta et al. (2008). On the other hand, informal unpaid care may be important in the U.S. as suggested in Ribar (1995). However, including informal care in the model and assuming that parents will use as much of it as provided will not change the results of the analysis since informal care can be treated as a fixed parameter.

The household budget constraint depends on w_i, individual i's wage rate, $i =$

m, f, Y, the household's non-labor income, y, the money value of parents' private consumption of goods, and p_{CC}, the price of market-provided childcare. I assume that the amount of market work is exogenously given since both parents are assumed to be full-time employed. Other exogenous determinants in the model are the price of market-provided childcare, parents' wage rates, non-labor income, and characteristics of the parents and the child. The model is a unitary type of model since it is assumed that the parents act as one unit to maximize the household's total utility. This assumption simplifies the model greatly but may be too restrictive, see e.g. Browning et al. (1994), Browning and Chiappori (1998), and Lundberg (2005). In this setting, where the focus is *not* on parents' private consumption but instead on modelling parental inputs to child development in the simplest possible framework, the unitary model seems appropriate, though.

The decision variables are the mother's and father's amount of childcare time and the amount of childcare purchased in the market. Deciding T_{Cm} leads to a value of T_{Om} from Equation (4) since T_{Wm} is assumed predetermined, and similarly is T_{Of} determined from Equation (5). Furthermore, deciding both parents' childcare time leads to the amount of childcare time bought in the market from Equation (6). Therefore, the only two decision variables we have to focus on are T_{Cm} and T_{Cf}. The outcome is maximized parental utility which encompasses child quality as one of the components.

The derivation of the first order conditions for mother's and father's childcare time is shown in Appendix A. The first order conditions are symmetric. The choice of an optimal amount of parental childcare time depends on marginal utility of leisure time, price of market-provided childcare as well as the marginal developmental effect from parental childcare and market-provided childcare. Rewriting the first order conditions, it can be seen that each parent's disutility of lost consumption caused

by costs to market-provided childcare is given as the marginal utility of leisure time in addition to the marginal child development cost or benefit from market-provided childcare compared to parental childcare. Thus, each parent's decision about time spent on childcare crucially depends on the relationship between the quality of the parent's childcare compared to the quality of market-provided childcare. It does not directly depend on the quality or amount of the other parent's childcare.

The trade-off between marginal child development caused by either parental or market-provided childcare seems to be an important determinant of parental decisions in the model. On the other hand, availability of paternal childcare does not directly affect the mother's childcare decision or vice versa. One explanation for this result is that both parents are decision-makers, in contrast to other models of household decision making, and they are symmetrically included in the model. Their childcare decisions are therefore not directly related to the other parent's decision.[4] Also, I allow for the possibility of a heavy use of market-provided childcare.

Childcare is taken into account as something you purchase in the market at an exogenously given price, and it is assumed to be a real alternative to parental childcare. It can be assumed to be relatively cheap because of e.g. a public subsidy. The price of childcare will therefore not be the same as the mother's cost of time, i.e. her hourly wage rate if employed.[5] Furthermore, the amount of childcare purchased in the market is not restricted in the model. Such assumptions are reasonable for Scandinavian countries (Datta Gupta et al. (2008)), but may be more questionable for example in the U.K., Southern Europe and the U.S.

Finally, if I assume that the quality of the three alternatives of childcare is the same, i.e. that $\frac{\partial Q}{\partial T_{Cm}} = \frac{\partial Q}{\partial T_{Cf}} = \frac{\partial Q}{\partial CC}$, then parents can substitute between parental and

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[4]It could instead be assumed that mother's and father's childcare time directly depended on each other so that $\frac{\partial T_{Cf}}{\partial T_{Cm}} \neq 0$ and likewise $\frac{\partial T_{Cm}}{\partial T_{Cf}} \neq 0$, but this would complicate the model considerably.

[5]This may be important since it has been shown that family labor supply responds to childcare costs and childcare quality, see Blau and Robins (1988), Ribar (1995), and Wrohlich (2006).

market childcare without consequences for child development. This implies that the disutility of lost consumption caused by costs to market-provided childcare is exactly the same as parents' marginal utility of leisure time which makes sense intuitively and economically.

The actual effect of parental childcare on child development is an empirical question which is addressed in the next section.

5 Empirical Analysis

5.1 Data

The data used in the empirical analysis is the Danish 1987 time use survey (TUS) coupled with administrative register information. With this combined dataset I have information about parental time use and children's educational outcomes.

Individuals participating in TUS have filled out a time diary of what they did on either a weekday or a weekend day in 1987. All 39 main activities are coded into 15 minutes intervals (Bonke et al. (2005)), and it is also recorded whether individuals were alone or with somebody else, e.g. their child, during the activity. It is therefore possible to generate a measure of the amount of daily childcare time from activities reported in the diary. I define two main types of childcare; '*direct childcare*' which is childcare reported as the main activity by the parent, and '*indirect childcare*' which is defined as an activity where the child is present while the parent is doing e.g. housework, but the main activity is not directly aimed at the child.[6] In most of the analysis, focus is on the total amount of daily direct and indirect childcare time.

The time use survey consists of an initial random sample of about 3600 Danish

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[6]Time in which the child is sleeping and the parents are thus 'supervising' is not included in the indirect childcare time. The question of how to define *care time* is discussed in detail in Folbre et al. (2005).

people aged 16 to 76 in 1987. The response rate in the survey is above 60% which is satisfying and indicates that there are no serious sample selection problems. Only one adult from each household is interviewed for the time use survey and the interview relates to only one day; a weekday or a weekend day.

Information from the survey is coupled with information from the Danish tax and income register collected by Statistics Denmark. The registers contain yearly information from 1987 to 2006 on parents and children if they have not left the country or died. There is information on marital status, residence, education, income, labor market activities, children, and the partner if one is present. It is possible to follow the same individuals over time and this enables me to determine children's long-term educational outcomes.[7] The measure of educational outcome used in the empirical analysis is whether the child is enrolled in or has completed academic high school.[8] In the following, I refer to both completed high school and currently enrolled in high school as 'enrolled in high school' in short.

To investigate child development in a framework similar to the theoretical model described in the previous section, certain restrictions are placed on the data. First, the dataset is restricted to include respondents who have children between ages 1 and 12 at the end of 1987. Children younger than 1 year at the end of 1987 are removed from the sample because their parents (mother) most likely spent the greater part of the year on maternity or parental leave. Only respondents who report having a spouse or cohabitor when he/she filled out the time diary in 1987 are kept in the dataset. Families with only one child are rather rare in the dataset so to avoid losing too many observations the dataset is restricted to families who have one or more children younger than 12 in 1987. This is a weaker restriction than in the theoretical

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[7]Instead of using educational outcomes as the measure of child quality, one could use income as Becker and Tomes (1979).

[8]Thus, this does not include all types of secondary education. In 2005, about 50% of all children had enrolled in academic high school by the age of 20, see Rasmussen (2009).

model, but I do take into account that parents may treat their children differently by separately analyzing time spent with the youngest and second youngest child. I only keep the two youngest children in the family in the sample for several reasons. First, these children probably need the most attention from the parents; second, I am only able to identify parental time with youngest, second youngest, and third youngest child; and third, this almost corresponds to the age restriction of the child being 12 years old.

Following the theoretical model, the sample is restricted to families where the parents report being employed in 1987. The spouse is not required to be employed in the empirical analysis since this information is not available from the questionnaire. Using register information about spouse employment will not be accurate since register information is provided at the end of the year and the questionnaire and time diary are filled out in the beginning of the year. Finally, all analyses of the effect of time use are made separately by interview day. For the sample interviewed regarding a weekday, I require the parent to work at least 1.5 hours on the diary day. This restriction reduces the sample only slightly. The final sample size is 576 (392) observations on children for weekdays (weekend days).[9] These children all have a parent who participated in the TUS. Some of the children come from the same family but only the amount of childcare time relevant for the child in question is assigned to the child. This assignment is based on birth order and parents' information about who they spent time with during the different activities.

The Danish 1987 time use survey shows that there is great variation in mothers' and fathers' total childcare time both on weekdays and on weekend days as seen in Figures 1 and 2 (and Figures 3 and 4 in Appendix B). Figure 1 shows the distribution of the total daily amount of time fathers spend with their youngest child on either

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[9]More than 97% of the children are observed in 2006 but if the child is not present in the data in 2006, I use the last available observation given that the child is at least 19 years old in that year.

a weekday or a weekend day. Time is shown in one-hour intervals, i.e. 0 hours of childcare in the figure corresponds to childcare between 0 and 1 hours, etc. On weekends, where the flexibility of parental time is highest, the distribution is relatively flat suggesting a big variation between fathers. On weekdays, there is a greater share of fathers that spend less time with their child than during weekend days but this is most likely due to the employment restriction.[10]

Figure 2 shows the distribution of childcare time with the youngest child for mothers. The distribution is very similar for time spent with youngest and second youngest child but the amount of time differs as more time is spent with the youngest child (see also Table 1). The distribution for weekend days is similar to that of fathers but the percentage of individuals spending from 0 to 1 hours on childcare is higher for fathers than for mothers. Mothers tend to spend more time with their children on weekdays than fathers, and mothers' distribution is more flat. These figures suggest that fathers are not that different from mothers in the way they spend time with their children, especially not in the weekend. However, fathers on average spend significantly less time with their children than mothers.

Mean values for all variables included in the estimations are presented in Table 1. Except for household gross income, which apparently is smaller for individuals responding on weekdays than for individuals responding on weekend days, there are not statistically significant differences between the explanatory variables for weekdays and weekend days if we do not take time use variables into account. Thus, there are not systematic differences between individuals responding on a weekday compared to a weekend day. As expected, the time use variables often differ between weekdays and weekend days. A few exceptions are in the amount of direct childcare time, i.e. when childcare is reported as the main activity, but the daily direct childcare time is

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[10]For fathers (mothers), there are 314 (262) observations on weekdays and 195 (197) observations on weekend days. The sample depicted in the figures is the estimation sample.
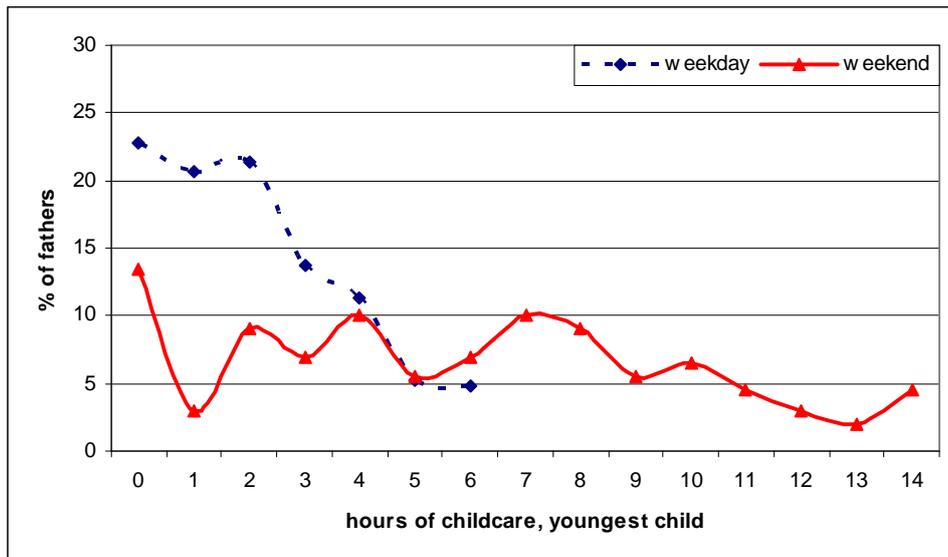
Figure 1: Distribution of fathers' hourly daily time with their youngest child on weekdays and weekend days in Denmark, 1987.
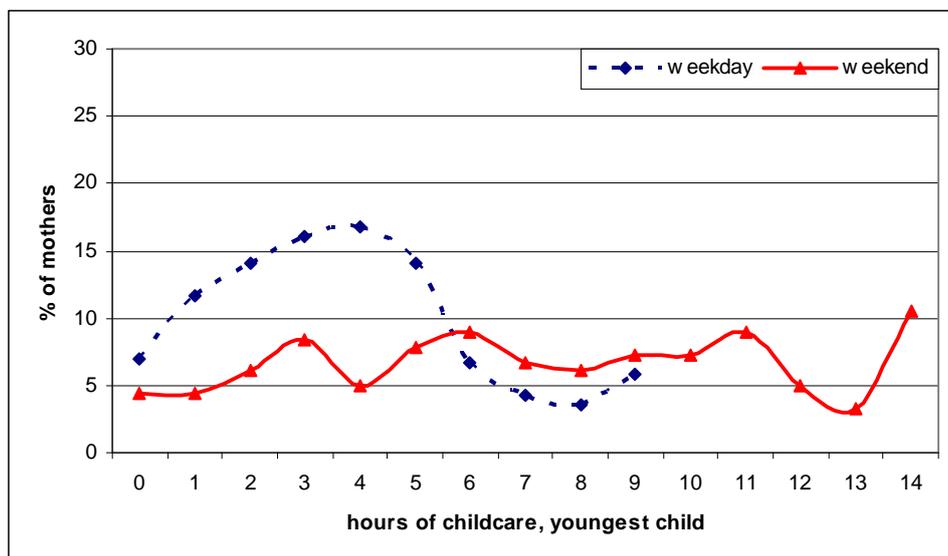

Figure 2: Distribution of mothers' hourly daily time with their youngest child on weekdays and weekend days in Denmark, 1987.

	weekday		weekend day		total	
	mean	std.dev.	mean	std.dev.	mean	std.dev.
High school enrollment (0/1)	0.65	0.48	0.65	0.48	0.65	0.48
Child's age (1987)	6.57	3.46	6.35	3.56	6.48	3.50
Age squared/100	0.55	0.46	0.53	0.47	0.54	0.46
Gender of the child is boy (0/1)	0.51	0.50	0.53	0.50	0.51	0.50
Birth order (1: youngest, 2: sec. youngest)	1.31	0.46	1.29	0.46	1.30	0.46
F's hours of childcare, youngest	2.49*	1.12	6.30	2.34	4.03	2.54
F's hours of childcare, sec. youngest	2.34*	0.76	5.70	1.50	3.70	1.99
M's hours of childcare, youngest	4.35*	1.58	8.06	2.61	5.85	2.75
M's hours of childcare, sec. youngest	4.00*	0.92	7.34	1.60	5.36	2.08
F's childcare, direct, youngest	0.30	0.40	0.31	0.49	0.30	0.44
F's childcare, direct, sec. youngest	0.26	0.31	0.20	0.30	0.24	0.31
F's childcare, indirect, youngest	2.19*	1.06	6.00	2.27	3.73	2.50
F's childcare, indirect, sec. youngest	2.08*	0.70	5.50	1.50	3.47	2.00
M's childcare, direct, youngest	0.56	0.47	0.57	0.69	0.56	0.57
M's childcare, direct, sec. youngest	0.51*	0.34	0.38	0.40	0.46	0.37
M's childcare, indirect, youngest	3.79*	1.47	7.48	2.66	5.29	2.72
M's childcare, indirect, sec. youngest	3.49*	0.89	6.96	1.60	4.90	2.12
F's childcare, individual time, youngest	0.39	0.51	0.45	0.72	0.41	0.61
F's childcare, individual time, sec. youngest	0.11	0.14	0.38	0.39	0.22	0.30
F's childcare, family time, youngest	2.10*	1.07	5.85	2.29	3.62	2.49
F's childcare, family time, sec. youngest	2.23*	0.73	5.32	1.49	3.49	1.88
M's childcare, individual time, youngest	0.95	0.94	0.96	1.25	0.95	1.07
M's childcare, individual time, sec. youngest	0.31	0.37	0.36	0.60	0.34	0.48
M's childcare, family time, youngest	3.40*	1.43	7.10	2.61	4.90	2.69
M's childcare, family time, sec. youngest	3.68*	0.89	6.98	1.64	5.03	2.06
F's education, high school, 1987 (0/1)	0.30	0.46	0.26	0.44	0.29	0.45
M's education, high school, 1987 (0/1)	0.27	0.45	0.30	0.46	0.28	0.45
F's occ., self-employed, 1987	0.17	0.37	0.15	0.36	0.16	0.37
F's occ., high/medium salaried worker, 1987	0.37	0.48	0.31	0.46	0.34	0.48
F's occ., low salaried or skilled, 1987	0.29	0.45	0.31	0.46	0.30	0.46
F's occ., unskilled, 1987	0.18	0.38	0.22	0.42	0.20	0.40
M's occ., self-employed, 1987	0.08	0.27	0.07	0.26	0.08	0.27
M's occ., high/medium salaried worker, 1987	0.22	0.41	0.22	0.42	0.22	0.41
M's occ., low salaried or skilled, 1987	0.40	0.49	0.39	0.49	0.40	0.49
M's occ., unskilled, 1987	0.31	0.46	0.31	0.46	0.31	0.46
Household total gross inc., 1987 (/DKK 100,000)	3.80*	1.61	3.58	1.70	3.71	1.65
Share fathers	0.55	0.50	0.50	0.50	0.53	0.50
Share mothers	0.45	0.50	0.50	0.50	0.47	0.50
Obs	576		392		968	

*: Mean is significantly different at a 5% level between weekdays and weekend days

Table 1: Sample statistics. Children aged 1 to 12 in 1987 and whose parent filled out a time diary in the Danish time use survey in 1987. Separately for weekdays and weekend days.

fairly low for both mothers and fathers, weekdays and weekend days, ranging from about 15 minutes to half an hour. Most of the time parents spend with their children is time where they also do other things at the same time.

There is also no significant difference between weekdays and weekend days in the amount of time parents spend on 'individual time' with the child. Individual time, contrary to 'family time', is defined as time where the parent is alone with the child, i.e. the other parent or siblings are not present. Individual time constitutes at most 20% of the total childcare time so most of the childcare time is what I have defined as family time. It is also clear from Table 1 that parents spend more time with their youngest child than their second youngest child. With an average age of children in the sample in 1987 of 6.5, this is not surprising since the youngest child often will need a lot of parental supervision. On average, the youngest child is approximately 6 years old whereas the second youngest child is around 8 years old.

The outcome variable for children, academic high school enrollment, seems to be slightly higher in the sample than the Danish 2006-average of 57% for the same age group. This is not surprising because the parents' level of education is also a bit higher than the Danish 1987-average for adults.

The time parents do not work in the market or spend time with their children is referred to as 'other time' (or leisure time) in the theoretical model. On weekdays the parents have about the same amount of leisure time (80 minutes spent outside the house and 160 minutes spent inside) whereas fathers have 60 minutes more leisure time on weekend days than mothers. This extra leisure time is spent outside the household and primarily on sports and visits. Both mothers and fathers have about 240 minutes of leisure time at home during weekends. Calculations regarding leisure time are not shown in Table 1 but are available from the author upon request.

5.2 Empirical Evidence

I now take a closer look at how parental time use affects children's long-term development, that is, children's ability to complete a certain level of education. In other words, I estimate Equation (2) from the theoretical model using the TUS data described above. In the analysis, mothers' and fathers' time use is separately included since the effect of mothers' and fathers' childcare time is potentially different and since information from only one of the parents is available in the survey. If I have information about the mother's time use, I set father's time use to the mean value for fathers, and vice versa if I have information about fathers' time use. In studies of childcare, it is sometimes assumed that mothers' time with the child is "better" than fathers' time in the sense that time with the mother reinforces the child's later development but time with the father does not. I do not assume anything about the effect of parents' childcare time. Instead, the empirical analysis in this paper may give an indication of the degree of substitutability between parents' childcare time.

I use a probit analysis to control for family and background characteristics at the same time as I address the relationship between child development, Q, and the parent's time input on the diary day, T_{Cf} or T_{Cm}. On average, the diary day is assumed to be representative for the time parents and children spend together. Parental childcare time may be endogenous and I will return to this later but just note here that the possibility of having an endogenous explanatory variable implies that the results cannot be interpreted as causations but merely as correlations. I measure Q as academic high school enrollment, i.e. Q is a binary variable taking the value 1 if the child is currently enrolled in or has completed high school, and 0 if the child is not and has not been enrolled in high school.

The estimations take place in a static production function framework as described by Todd and Wolpin (2003) where it is assumed that Q is represented as a linear

function of the inputs. As in the theoretical section, I assume that P, parental perception of childcare quality, and G, the genetic endowments of the child, are exogenously given. In the theoretical model I assumed that X, goods bought in the market, was equal to CC, childcare bought in the market. Unfortunately, I do not have information about the amount or price of childcare bought in the market, so for simplicity I assume that X is exogenous as well. This corresponds to assuming that parents can only buy a fixed amount of childcare in the market, and that this amount is decided by the municipality, for example. It is also implicitly assumed that parents buy childcare in the market because I focus on families with full-time employed parents. The following equation is estimated by probit

$$Q_j = \alpha + \beta \left(T_{Ci} \right)_j + \gamma F_j + \varepsilon_j,$$

where α is a constant, and ε_j is child j's unobserved "error" term. F_j is a child-specific vector of family and background characteristics and F_j includes the child's age and age squared in 1987,[11] birth order, a dummy for interviewed parent being the father, a dummy for whether the child's gender is boy, both parents' length of education, both parents' occupation, and parents' total gross income in 1987 DKK. The variables in F_j are included step-wise to control for different effects of family and background characteristics. The child's age, age squared, birth order, and the dummy indicating whether the interviewed parent is the child's father are included in all specifications but are not shown in the tables. In almost all specifications, the coefficients for these variables are highly insignificant. β is the main parameter of interest, but also the effect of family and background characteristics are of interest. Assuming that all the ε_j's are normally distributed random variables, I can estimate

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[11]Including dummy variables for different age groups (0-3, 4-6, 7-9, and 10-12) instead of age and age squared does generally not change results.

the parameters β and γ by using a probit.

The effect of parental childcare time is analyzed separately for weekdays and weekend days since time use differs a lot between weekdays and weekend days as shown in Bonke et al. (2005) and Table 1. In some specifications, I split childcare time into subcategories such as individual and family time, but I also focus on whether the activities took place inside or outside the household.[12]

Tables 2 and 3 summarize the probit estimation results for weekdays and weekend days, respectively. The dependent variable is children's enrollment in high school, and the childcare variables in Tables 2 and 3 are defined as the total amount of childcare time, direct and indirect pooled together. Fathers' and mothers' childcare time is included separately for the youngest and second youngest child.

As more background information is included in specifications (1) to (5), the model fit improves. It is for example important to include the gender of the child since boys have significantly lower outcomes than girls. Furthermore, parental education affects the child's education so if the parents have a high school degree, it improves the probability that the child will also get one. When including information about the household's total gross income, the effect of parental education is reduced, but father's education remains an important factor for the child's enrollment in education in specifications for weekdays, whereas mothers' educational level is more important in specifications for weekend days. Also parents' occupation affects child outcomes on weekends but not on weekdays. The baseline occupational group is unskilled workers.

According to Table 2, there is a positive association between mothers' childcare

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[12]I have also investigated the difference between direct and indirect childcare, and detailed categories of childcare time such as meals and cooking, practical activities as cleaning and doing laundry, transportation time, relaxation such as reading or watching tv, visits inside and outside the household, parental market work, and finally other activities not defined in the 39 main activities. The results for inside/outside the household, direct/indirect childcare, and the detailed categories of childcare are not shown in the paper but are available upon request. Due to the relatively small number of observations, especially in the detailed subgroups, many of the coefficients turn out to be insignificant in these specifications.

time and high school enrollment for both the youngest and second youngest child on weekdays, whereas there is not a significant association between fathers' childcare time and child outcomes. In the final specification in column 5, the effect of mothers' childcare time is significant at a 5% level for the youngest child and at a 10% level for the second youngest child. The effect of fathers' childcare time is insignificant but actually negative. In weekends, the picture is opposite. Fathers' childcare time has a significantly positive association with the second youngest child's high school enrollment, whereas there is no significant effect of mothers' childcare time for neither of the children. The effect of fathers' childcare time for the youngest child is not significant. It is interesting that if there is an effect of parental education, there is not an effect of parental childcare time, which indicates some kind of "compensating" effect. In summary, results from Tables 2 and 3 suggest that mother's time with children has a more positive effect on the children on weekdays, whereas the father's time with children seems to be more beneficial for the children than mother's time on weekend days.

Time in which the parent and the child are alone together (individual time) may have a different effect on child outcomes than time where other family members are also present (family time). This is investigated in Table 4. When focusing on individual time, it is possible directly to determine how parental childcare time affects child outcomes since there are no other channels the potential effect can go through. The estimation results for these types of childcare are similar to the general results for total childcare time in Tables 2 and 3. Fathers' childcare time is not significantly related to child high school enrollment on weekdays, and mothers' childcare time is not on weekends. The relation between mothers' childcare time and children's outcomes is not as precisely determined in the detailed specification as in the more general specification. However, it can be seen that mothers' time alone with the youngest

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Weekday	(1)	(2)	(3)	(4)	(5)
F's hours of childcare, youngest	-0.0118	-0.0102	-0.0290	-0.0009	-0.0071
F's hours of childcare, sec. youngest	-0.0397	-0.0452	-0.0938	-0.0702	-0.0740
M's hours of childcare, youngest	0.0451	0.0542	0.0608	0.0678*	0.0768**
M's hours of childcare, sec. youngest	0.0858	0.0716	0.0952	0.1126*	0.1110*
Gender of the child is boy		-0.6073**	-0.6618**	-0.6762**	-0.6772**
F's education, high school			0.7288**	0.6265**	0.5219**
M's education, high school			0.3978**	0.3166*	0.0521
Household gross inc. /DKK 100,000				0.2041**	0.1977**
F self-employed					-0.0905
F high/medium salaried worker					0.2639
F low salaried or skilled					0.1646
M self-employed					-0.1817
M high/medium salaried worker					0.3560
M low salaried or skilled					0.0327
R-squared	0.03	0.07	0.14	0.16	0.17
obs	576	576	576	576	576

**: Significant at a 5% level, *: Significant at a 10% level

Table 2: Probit estimation results for weekdays, childcare time consists of total direct and indirect childcare.

Weekend day	(1)	(2)	(3)	(4)	(5)
F's hours of childcare, youngest	0.0177	0.0172	0.0082	0.0056	-0.0008
F's hours of childcare, sec. youngest	0.1072**	0.1030**	0.1016**	0.1081**	0.1201*
M's hours of childcare, youngest	0.0018	0.0082	0.0139	0.0197	0.0193
M's hours of childcare, sec. youngest	0.0276	0.0052	0.0157	0.0133	0.0089
Gender of the child is boy		-0.6762**	-0.7775**	-0.7976**	-0.8136**
F's education, high school			0.6831**	0.5926**	0.2962
M's education, high school			0.6742**	0.6598**	0.6973**
Household gross inc. /DKK 100,000				0.1685**	0.1147**
F self-employed					0.6430**
F high/medium salaried worker					0.8236**
F low salaried or skilled					0.3690*
M self-employed					-0.5094*
M high/medium salaried worker					0.0198
M low salaried or skilled					0.3965**
R-squared	0.02	0.07	0.15	0.17	0.22
obs	392	392	392	392	392

**: Significant at a 5% level, *: Significant at a 10% level

Table 3: Probit estimation results for weekend days, childcare time consists of total direct and indirect childcare.

	weekday	weekend
F's childcare, individual time, youngest	0.0504	0.0402
F's childcare, individual time, sec. youngest	-0.2803	1.1419*
F's childcare, family time, youngest	-0.0168	-0.0045
F's childcare, family time, sec. youngest	-0.0662	0.1053**
M's childcare, individual time, youngest	0.0984*	-0.0819
M's childcare, individual time, sec. youngest	-0.0121	-0.0525
M's childcare, family time, youngest	0.0704*	0.0320
M's childcare, family time, sec. youngest	0.1231*	0.0032
Gender of the child is boy	-0.6868**	-0.8360**
F's education, high school	0.5381**	0.3344
M's education, high school	0.0312	0.7164**
Household gross inc. /DKK 100,000	0.1980**	0.1200**
F self-employed	-0.0955	0.6234**
F high/medium salaried worker	0.2555	0.8084**
F low salaried or skilled	0.1627	0.3330*
M self-employed	-0.1926	-0.4838
M high/medium salaried worker	0.3631	0.0551
M low salaried or skilled	0.0429	0.4290**
R-squared	0.18	0.24
obs	576	392

**: Significant at a 5% level, *: Significant at a 10% level

Table 4: Probit estimation results, childcare separately by individual and family time.

child on weekdays significantly increases the child's probability of enrolling in high school. This also holds for family time with both the youngest and second youngest child. On weekends, the time fathers spend with the second youngest child both as individual time and family time increases the child's probability of enrolling in high school. The positive relation is significant at a 10% level for individual time but at a 5% level for family time. In summary, there does not seem to be a huge difference in the effect of individual and family time, respectively. The main results from the more general specification in Tables 2 and 3 carry over to the more detailed specification in Table 4.

One could argue that only the actual childcare time, i.e. direct childcare time, affects children. However, as shown in Table 1, direct childcare accounts for a very small fraction of the total time parents spend with their children. It is therefore not

surprising that splitting childcare into direct and indirect childcare turns out not to be very informative. Only mothers' indirect childcare with the youngest child on weekdays and fathers' time with the second youngest child on weekend days turn out to have positive, significant coefficients at a 10% level. Thus, the results are similar but less precisely estimated as compared to the results for the general measure of childcare. When instead focusing at activities taking place inside or outside the household I do not find a strong association between parental childcare time and child outcomes. Mothers' childcare time inside the household is the only type of childcare that is significantly related to child outcomes. The association is again positive.

I have finally looked at different types of childcare activities to check if certain activities seem to be more beneficial or detrimental for children than others. These results confirm the general picture of fathers' childcare in weekends having an effect on children, and mothers' mainly having an effect on weekdays. The most remarkable new result is that some of the coefficients for activities are significant for mothers on weekend days. There is no clear pattern with respect to which activities are most beneficial for children but this is perhaps due to the relatively small number of observations with positive values.

There are some endogeneity issues to deal with in the empirical analysis. Parents' childcare time is endogenous since the decision of whether to spend time with a child is likely to be related to the child's endowment. Some parents may for example spend more time with a "weak" child to help the child with homework, whereas a more gifted child does not need help from parents to do the homework. On the other hand, some parents might choose to spend more time with a gifted child because the child will benefit relatively more from the time spent with parents. Therefore, it is impossible to predict in which direction the bias goes and since there is no information

on children's ability in the dataset, it is not possible to include such controls.[13]

The endogeneity problem can be dealt with by finding a good instrument for parents' childcare time. This is not an easy task as no good candidates for instruments emerge in the dataset. I have tried to use the local unemployment rate in 1987 for men and women separately to instrument for fathers' and mothers' childcare time. These instruments turned out to be very weak. I can therefore not claim to investigate causal effects in the probit analysis but instead interpret the results as correlations between child outcome and parental time use.

In addition to investigating Equation (2) from the model, i.e. the relationship between children's outcomes and childcare time, I have also taken a closer look at what determines father's and mother's childcare time, respectively. Substituting between Equations (3) to (6), it can be seen that a parent's childcare time among other things depends on the parent's time spent on paid work and also depends on both parents' wages. Therefore, I use OLS to analyze the following equation with the time use data

$$T_{Ci} = \alpha_1 + \beta_1 T_{Wi} + \gamma_1 F_i + \delta_1 w_i + \delta_2 w_j + \varepsilon_i, \tag{7}$$

where j defines the other parent in the household, and F is parental background information.

An OLS analysis of Equation (7) shows that parents' time with their children is strongly negatively related to the time parents spend on paid work, see Tables 5 and 6 in Appendix C. This holds for weekdays and weekend days and for both mothers and fathers but is not completely in line with Bianchi (2000) and Zick and Bryant (1996). They report that working mothers seem to substitute leisure and sleep for work time instead of childcare time. That is, according to their studies, children spend almost

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[13]There is neither information on children's grade point average in primary school nor information on birthweight. Birthweight is used in some studies as a proxy for child endowment, e.g. Behrman et al. (1994).

as much time with a working mother as with a non-working mother. The decision to spend time on childcare and paid work are simultaneous decisions, however.

The OLS results further show that if the father has at least a high school degree, it positively affects the time he spends with his children on weekdays. The father's gross income has a negative effect on the time he spends with his youngest child on weekdays, whereas his occupation is important on weekend days. His occupation is also important for the time he spends with the second youngest child on weekdays. The father spends more time with his second youngest child if he has a high school degree. For mothers, the partner's occupation influences the time she spends with her children. If the father is self-employed, she spends more time with the youngest child on a weekday. If the father is a medium or high salaried worker, this has a positive effect on the mother's childcare time for the second youngest child on weekdays.

On the other hand, the parent's age, the child's gender and whether the parent is employed in the public or private sector is not related to the amount of time parents choose to spend with their children. Also, the child's age is unimportant in most specifications which is quite surprising. It is somewhat surprising that there is no effect on mothers' childcare time from being employed in the private or public sector because the public sector is generally known to be more family-friendly, and women in Denmark tend to self-select into the public sector when they expect to have children, see Nielsen et al. (2004). More research is definitely needed to determine accurately the factors that affect parental childcare choices.

6   Conclusion

Economic studies of children's well-being and development often focus on the effect of mothers' employment on the child's cognitive development. Recently, research started

focussing also on the effect of fathers on children. Generally, researchers have mostly looked at the cognitive development of pre-school children but here I have instead investigated the cognitive outcomes for grown-up children.

This study includes both mothers and fathers directly in theoretical and empirical analyses of children's long-term development in households with two full-time employed parents. New to the model is that both parents' childcare time is taken explicitly into account as well as childcare bought in the market. The model shows that both parents care about the quality of childcare and they respond to the difference in marginal child development given by parental and market-provided childcare. According to the model, the availability of paternal childcare does not directly affect the mother's childcare decision. This result may be attributed to the symmetrical setup in the model and the fact that I allow for a potentially heavy use of childcare bought in the market.

In the empirical analysis, I use Danish time use data and register data to investigate the equations from the model. Focus is mainly on the relation between long-term outcomes of children and parental childcare time in 1987, i.e. estimation of the child development production function. Child outcome is measured as the child's high school enrollment in 2006. I analyze the effect of parental childcare time on the youngest and second youngest child in the family for children younger than 12 in 1987. Opposite of the theoretical analysis, market-provided childcare is not included in the empirical analysis as I do not have information on the amount or price of market-provided childcare. The empirical analysis is restricted to looking at two-parent households with at least one child and where the parent participating in the time use survey reports being employed. Controlling for family and background variables in a probit analysis, I find that mother's childcare time on weekdays and father's childcare time on weekend days are positively correlated with child outcome.

When splitting childcare time into more detailed groups, I again find the general result that mother's childcare time seems to be most beneficial for children on weekdays whereas father's is more beneficial on weekend days. In summary, this suggests that mother's and father's childcare time cannot be directly substituted on either weekdays or weekend days. The theoretical model suggests that the amount of parental childcare time is related to the trade-off between the quality of market-provided childcare and the childcare parents provide themselves. This cannot be directly assessed in the empirical analysis because information on market-provided childcare is not available in the dataset. However, it is shown that parental childcare time is positively related to child outcomes.

Finally, looking at which factors determine parental childcare time, I find that the more time parents spend on paid work, the less time they spend on childcare time. Parents' educational level also seem to affect their childcare time. Furthermore, in some specifications parental income and parents' occupation are related to the amount of childcare time.

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A   Appendix

Substituting for CC from Equation (6) into Equations (3) and (2), and for T_{Om} and T_{Of} from Equations (4) and (5) into the utility function, the utility maximization problem faced by parents is rewritten to

$$
\begin{aligned}
\max\ U \ &= \ U(Q\left(T_{Cm}, T_{Cf}, 1 - T_{Cm} - T_{Cf}\right), \\
&\qquad \sum T_{Wi} w_i + Y - (1 - T_{Cm} - T_{Cf})\, p_{CC}, \\
&\qquad 1 - T_{Wm} - T_{Cm}, 1 - T_{Wf} - T_{Cf})
\end{aligned}
$$

The first order conditions are then given as

$$
\begin{aligned}
\frac{\partial U}{\partial T_{Cm}} \ &= \ 0 \Longrightarrow \frac{\partial U}{\partial Q}\frac{\partial Q}{\partial T_{Cm}} - \frac{\partial U}{\partial Q}\frac{\partial Q}{\partial CC} + \frac{\partial U}{\partial y} p_{CC} - \frac{\partial U}{\partial T_{Om}} = 0 \\
\frac{\partial U}{\partial T_{Cf}} \ &= \ 0 \Longrightarrow \frac{\partial U}{\partial Q}\frac{\partial Q}{\partial T_{Cf}} - \frac{\partial U}{\partial Q}\frac{\partial Q}{\partial CC} + \frac{\partial U}{\partial y} p_{CC} - \frac{\partial U}{\partial T_{Of}} = 0,
\end{aligned}
$$

and by collecting terms this can be rewritten to

$$
\begin{aligned}
\frac{\partial U}{\partial y} p_{CC} \ &= \ \frac{\partial U}{\partial T_{Om}} + \frac{\partial U}{\partial Q}\left(\frac{\partial Q}{\partial CC} - \frac{\partial Q}{\partial T_{Cm}}\right) \\
\frac{\partial U}{\partial y} p_{CC} \ &= \ \frac{\partial U}{\partial T_{Of}} + \frac{\partial U}{\partial Q}\left(\frac{\partial Q}{\partial CC} - \frac{\partial Q}{\partial T_{Cf}}\right)
\end{aligned}
$$

B Appendix
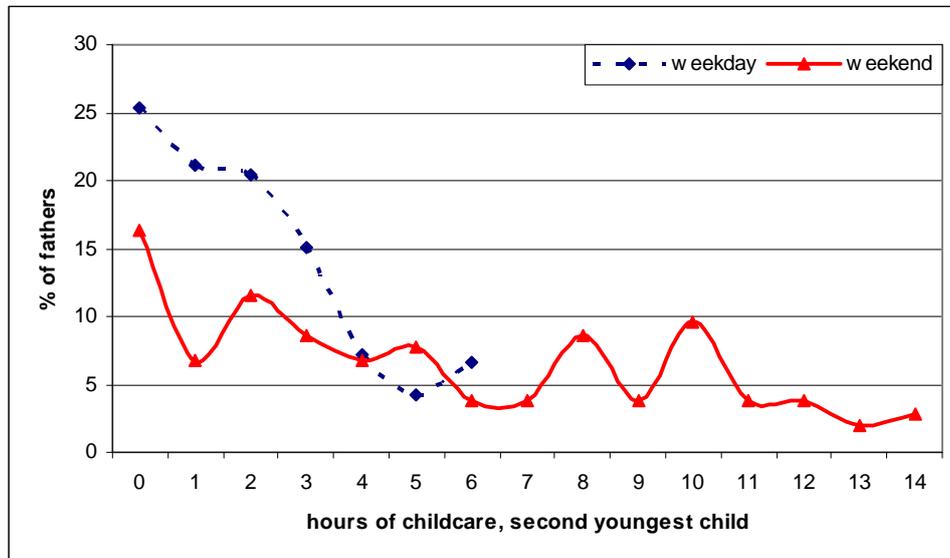
Figure 3: Distribution of fathers' hourly daily time with their second youngest child on weekdays and weekend days in Denmark, 1987.
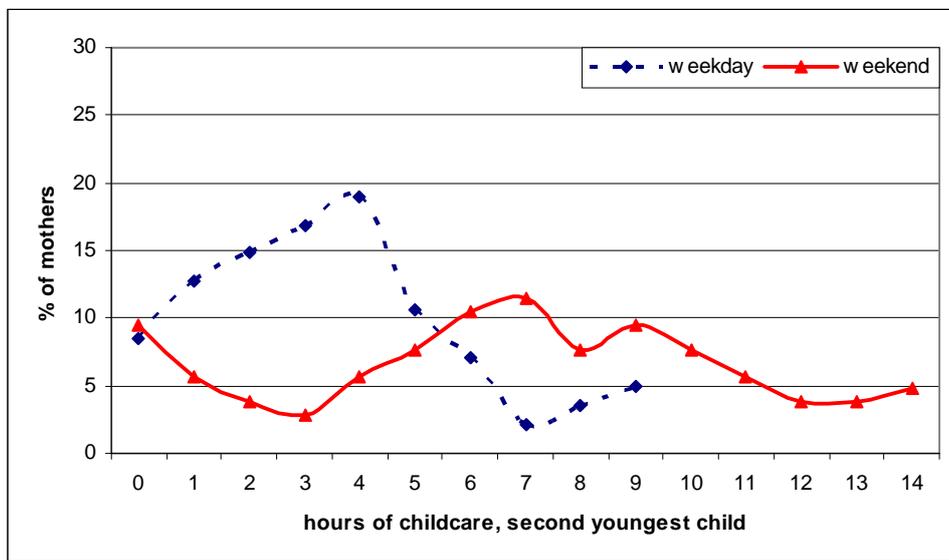
Figure 4: Distribution of mothers' hourly daily time with their second youngest child on weekdays and weekend days in Denmark, 1987.

C   Appendix

	Youngest		Second youngest	
Father's time spent on childcare	weekday	weekend	weekday	weekend
F's hours of paid work	-0.2423**	-0.4366**	-0.2203**	-
F's education, high school	0.6754*	0.0268	1.0436**	-
M's education, high school	-0.1893	1.8420*	-1.2885	-
F's gross income /DKK 100,000	-0.1981**	0.1753	-0.1655	-
M's gross income /DKK 100,000	-0.0049	0.3337	0.0234	-
F self-employed	0.2359	-0.5269	1.1847**	-
F high/medium salaried worker	0.2159	-0.5147	1.0425*	-
F low salaried or skilled	0.3521	-1.8171**	1.2072**	-
M self-employed	-0.3044	-1.7360	-0.6309	-
M high/medium salaried worker	-0.1177	-2.2144	0.1253	-
M low salaried or skilled	-0.1805	0.6973	-0.6516	-
Child's age 4-6	0.3256	-0.3166	-1.0125	-
Child's age 7-9	0.5328	-0.3910	-0.8396	-
Child's age 10-12	0.6665	-1.4867	-0.8512	-
Controls†	yes	yes	yes	yes
R-squared	0.14	0.24	0.19	-
obs	207	131	100	54

**: Significant at a 5% level, *: Significant at a 10% level

†: Parent's age, child gender, dummy for working in the private sector, constant

Table 5: OLS estimation results, father's time spent on childcare.

In Table 5 the specification for 2nd youngest child on weekend days is not included since the few observations made the model inappropriate.

	Youngest		Second youngest	
Mother's time spent on childcare	weekday	weekend	weekday	weekend
M's hours of paid work	-0.3952**	-0.5222**	-0.4117**	-0.4720**
F's education, high school	0.3431	0.5714	0.6011	-1.1742
M's education, high school	0.1318	-0.9491	-0.7116	-2.9215
F's gross income /DKK 100,000	-0.2990	-0.2564	-0.5561	0.0395
M's gross income /DKK 100,000	-0.1443	0.1369	-0.7006	-0.3256
F self-employed	1.7523**	-1.9140	0.1259	-0.6959
F high/medium salaried worker	0.7033	-0.9626	1.5869*	0.7384
F low salaried or skilled	0.4113	-0.3236	0.3372	-1.6280
M self-employed	-0.6491	1.0038	0.5039	4.3834
M high/medium salaried worker	-1.2560	1.0168	-0.8894	5.7639**
M low salaried or skilled	-0.7284	0.6557	-0.9283	2.3933
Child's age 4-6	-0.3892	-0.1559	-0.8788	4.7326
Child's age 7-9	-1.6647**	-1.7421	-1.1502	5.9835
Child's age 10-12	-1.8251**	-0.8685	-2.1037	2.7115
Controls[†]	yes	yes	yes	yes
R-squared	0.15	0.07	0.29	0.15
obs	183	134	72	57

**: Significant at a 5% level, *: Significant at a 10% level

[†]: Parent's age, child gender, dummy for working in the private sector, constant

Table 6: OLS estimation results, mother's time spent on childcare.

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