Purchased Inputs versus Time Inputs in Child Development

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Abstract

This study considers the question: Does participating in daycare outside the home put the child at a future disadvantage? However, there appears to be two forces at work which may result in two different answers to this question. One or two possibilities may happen when a child participates in daycare. First, the child loses nurturing time with his or her parents. This effect, the lost time effect, should hinder a child's development. The second effect is the purchased input effect. A child who is in daycare spends less time with his or her parents, but that parent is able to spend that time earning income. This income can then be used to purchase inputs to improve the child's development. However, it is unclear, a priori, which effect dominates. The goal of this study is to determine whether the lost time effect or purchased input effect is stronger. Therefore, by looking at the net effect of these two competing forces the question of whether or not a child is adversely affected by daycare will be answered.

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Introduction

The composition of the workforce today is changing. Women and minorities are finding increased opportunities in the workplace. Further, these opportunities are becoming more attractive as the glass ceiling which has kept these groups out of top jobs is being broken. Since women are finding more attractive opportunities in the workforce, they are spending less time in the home performing what has been typically held as female duties. These responsibilities have included housekeeping, cooking, and child rearing. As gender roles continue to be deconstructed in the workforce, they are simultaneously changing in the home.

Child rearing is an activity that must occur regardless of the work choices of the parents. However, the consequences of who provide this key role in the child's life are receiving increased study in light of the trends of increased female participation in the workforce.

This study considers the question: *Does participating in daycare outside of the home put the child at a future disadvantage?* However, there appears to be two forces at work which may result in two different answers to this question. One or two possibilities may happen when a child participates in daycare. First, the child loses nurturing time with his or her parents. This effect, the lost time effect, should hinder a child's development. The second effect is the purchased input effect. A child who is in daycare spends less time with his or her parents, but that parent is able to spend that time earning income. This income can then be used to purchase inputs to improve the child's development. However, it is unclear, a priori, which effect dominates. The goal of this study is to determine whether the lost time effect or purchased input effect is stronger. Therefore, by looking at the net effect of these two competing forces the question of whether or not a child is adversely affected by daycare will be answered.

Addressing this issue is important because it affects human capital accumulation. Thus the better one is developed and the more human capital one possesses, the more successful he or she will be in the workforce. Therefore, any opportunity to improve human capital or understand why it is deficient is worthy of study.

This paper develops as follows. Section I provides a review of the literature on this subject. Section II provides the theory that is used as a basis for the empirical testing of my hypothesis. Section III presents the empirical model to be used in this study along with the data used. Section IV provides the results. The paper then closes with section V which discusses policy implications and conclusions of the study.

I. Review of Literature

Previous studies offer conflicting results on whether professional daycare adversely affects a child's future development. Further, the concept of development and its degree is also subject to argument. Also, the period of childhood where the individual is not in the care of a parent may be of importance. Because of the vast variety of measurements, this may be why there is disagreement over results. Often times a single study may produce different results for different time periods in the child's life.

Paul Gregg (2003) examined the development of children in the UK during various stages of their early life according to the work

choices of the child's parent. His study uses data from the Avon Longitudinal Study of Parents and Children, which contains approximately 12,000 children born in the Avon area. The measures used for development are two different exams that the child takes in school which test writing, math, and language skills. Gregg finds that a mother who returns to work full time within the first 18 months of her child's life negatively affects the child's development, however any type of work after these first months do not result in negative development.

Charles L. Baum (2003) also finds similar results. He assesses the development of children according to Peabody tests that measure a child's reading, vocabulary, and math skills. Using data from the National Longitudinal of Youth (NLSY) Baum finds that hours worked in child's first year of life significantly reduce the scores on tests of reading, vocabulary, and math skills. However, the author finds that increased income, which may come from workforce participation, does not lower a child's scores by as much as it would without the increased income (Baum, 2003). Therefore, while a working mother may reduce a child's a tests scores, the income that she receives may lessen the effect.

Susanne James-Burdumy (2005) also tests NLSY data with Peabody tests. Contrary to Baum's finding's, Burdumy finds only math scores to be negatively affected by the amount of weeks worked in the child's first year of life. Even though the results are small, she finds that math scores are positively affected by the number of weeks worked in the third year of a child's life (James-Burdumy, 2005). This may be due to the increase in income that the household may have.

These studies offer differing results for different periods in a child's life. Thus, I will test for the dominance of the lost time effect or purchased input effect during all parts of a child's life.

II. Theory

The theory behind my analysis rests on a number of different models. These include: the human capital function, the home production function, and a budget constraint as suggested by David Blau (1999).

Child development is a factor in the human capital function. The degree of this development and its quality affects the child's behavior, which has an impact on further development of the individual. This development is one input in determining the quantity and quality of the human capital that one possesses. If an individual develops very well in his or her childhood, he or she will likely succeed in other development issues that the person encounters (Ashenfelter et. al., 1986). This is because of the solid base that the person possesses, which was created early on. The person will then accumulate more human capital than someone else who does not have that solid base. The individual with more human capital to offer in the job market will be more competitive, and therefore he or she has increased chances of success.

A child's development is also affected by the home production function. In addition to being a consumption unit, the home may also be considered a production unit. It is true that family characteristics influence what paths a child takes in his or her learning. Therefore the decisions a family makes may produce human capital. The family must decide how much of its scarce resources such as time, energy, and money it will devote to the child or children within the unit. These decisions must be balanced by the allocation of resources to other desires the family may have which include leisure and entertainment.

Parental attention may be considered an input of the home production function that produces human capital in a child. This attention may come in the form of reading a book to the child or correcting his or her homework. Regardless, it is likely that the child will benefit from time spent with the parent. In another instance, a household may decide that one parent will work while the other devotes much of his or her attention to child rearing. In this case, the child may be receiving

parental attention at nearly all hours of the day. This attention, *ceteris paribus*, may increase the amount of human capital a child will eventually possess.

Finally, household decisions are limited by a budget constraint. A family must decide how to allocate all of its income. A family decides on how much money to allocate to food, shelter, clothes, entertainment, savings, and other expenses. A family also decides on how much time to allocate to work (both in the job market and in the home) and leisure.

A family may decide that both parents will work, which limits the amount of time spent with children. However, this option increases the income that is available to allocate towards family resources such as educational materials for the children. A family may also decide that one parent will work while the other takes care of the children. This approach does not allow for as much income as in the first scenario, however it provides more time to spend with the child.

Thus, a budget constraint limits home production of outputs as its inputs cost money. A product of the home production function will be human capital in the child. This output then affects the quantity and quality of human capital that the child will eventually possess. Together these three models relate the work choices of parents to the development and future success of their children.

This combination of theories can be illustrated graphically. In a typical production model labor is measured on the horizontal axis while capital is represented on the vertical axis. Isoquants are "curves showing all possible combinations of inputs that yield the same output" and are concave to the origin (Pindyck and Rubinfeld, 2001). The different isoquants represent the different levels of production that are available. The production unit is limited from achieving higher isoquants by its budget constraint. The budget constraint represents the cost per

unit of labor. The point of tangency between the budget constraint and the isoquant represents the maximization point of efficient production for the producer *ceteris paribus*. This is represented by point A in Figure 1.

Figure 1
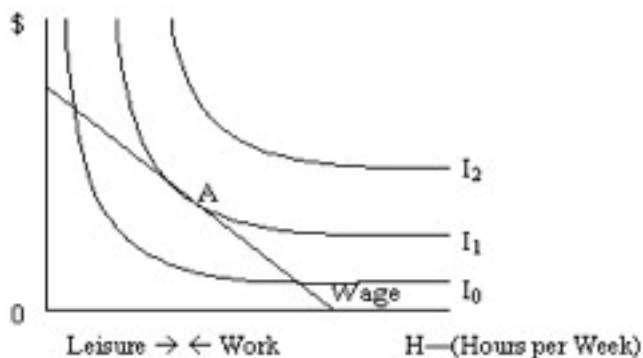
Source: Rima

In order for this model to illustrate my analysis certain modifications need to be made. Instead of measuring hours of leisure, the horizontal axis will measure hours spent at home with the child while the hours not spent in the home represent hours spent at work. Hours of home production of the individual are measured by moving horizontally away from the origin. Conversely, one can measure the hours the individual works by moving towards the origin along the horizontal axis. One may choose to not work at all and have 24 hours at home—the limit—and have zero dollars in income. On the other hand an individual may choose to work 24 hours thus not having any hours at home and earn maximum income. It is assumed that the total hours of work and hours at home add up to 24 hours or one day. Disposable income is on the vertical axis, and the budget constraint still represents wage. However this model represents allocation decisions made by the household as opposed to the individual. Further, the isoquants no longer represent a consumption basket of goods and services, but they are possible Peabody tests scores the child in the household may earn. They will be referred to as iso-Peabody curves. These test scores will be further explained in the empirical model section of the paper, but for now it is sufficient to know that these Peabody scores are

measures of child development. The household's position on the budget constraint indicates the highest possible test score given the household's combination of hours spent at home and income ceteris paribus. The major implication of this model is that a household may choose the child's Peabody score by coordinating income and work allocation decisions. This model is illustrated in Figure 2.

Figure 2   Disposable Income


Source: Author
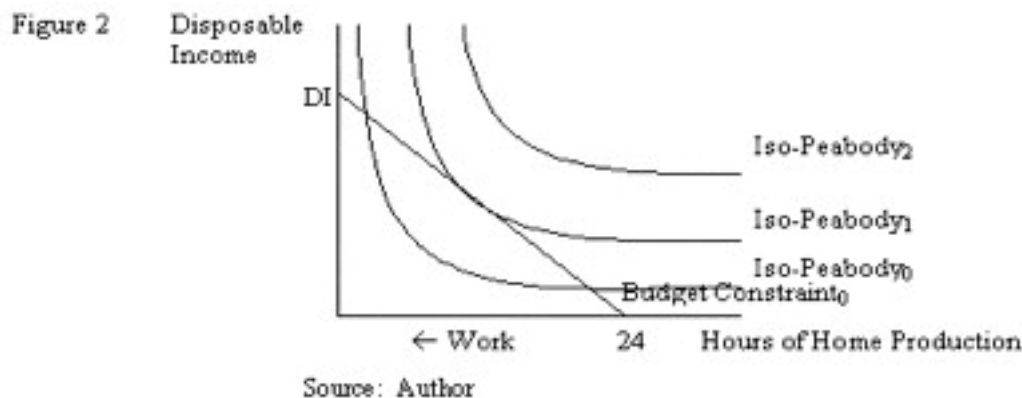
My study will benefit from applying this model. First, the model suggests that it is possible for a child to achieve a sub-optimal iso-Peabody curve by being at one of the two extremes; maximum income with no time with parent(s) or all time with the parent(s) and no income. However, these scenarios are not possible because a child needs some parental nurturing and some level of income in order to develop at all.

Wage along with income has an effect on a child's development according to this model. As wage fluctuates the budget constraint may shift inward or outward, and the highest possible iso-Peabody curve will change accordingly. The budget constraint is expected to pivot on the horizontal intercept according to how many wage earners there are in the household.

The budget constraint pivots at the 24 hour mark because it is not possible for more hours than this to be allocated in a given day. Therefore, the budget constraint cannot shift from the y axis intercept; it may only become shallower or steeper (Figure 3). The budget constraint will be shallower if the wage falls and therefore the vertical intercept will fall indicating a smaller income. On the other hand, if wage increases a higher income will be achieved, and the budget constraint will become steeper to illustrate this. A budget constraint for a household with two or more working parents is anticipated to be steeper than a budget constraint for a household with only one working parent. In the latter case the second parent may spend his or her time staying at home with the children or may not even be present.

The effect of multiple children in a household on a given child's development is

Figure 3   Disposable Income

Source: Author
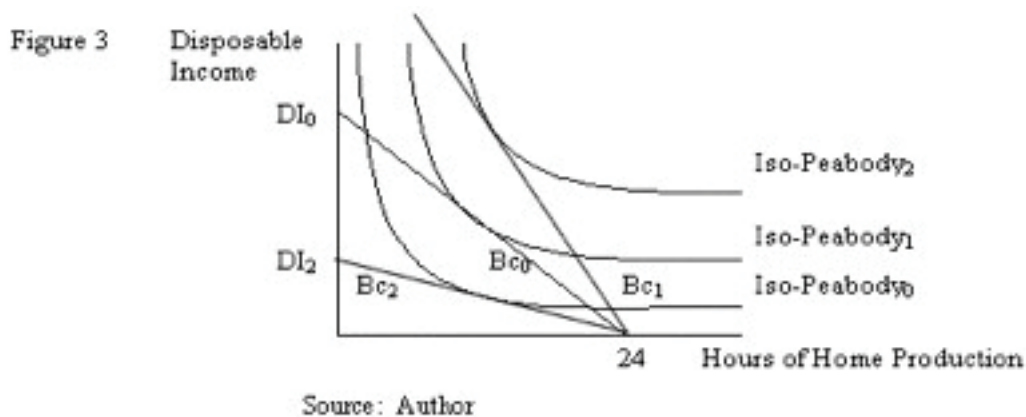
worth noting. The more children there are in the household, the more competition there is for resources by each child. Situations will arise where the resources can be spent by a parent or parents simultaneously on all the children. However, there will be other times where an individual child will get some resources exclusively. There will then

be fewer resources for the remaining children. Still, this effect may be dulled by the experience of an older sibling. This sibling may take the experience he or she has and use it to benefit the younger sibling. In this case, resources from the parent or parents are transferable; they were spent on the older child who then in turn spends it on the younger child. The magnitude and significance of this multiple child effect is unknown, but it deserves a mention in the theory. In terms of the model, the addition of more children can influence the position of the iso-Peabody mapping, but the direction of change is ambiguous.

Finally, it is worth noting that maximizing a child's Peabody score may not be of chief concern for the family. The family unit has many other demands on its scarce resources. Some may be necessary such as rent, mortgage, or food. Still others may vary according to taste. A family may prefer to go on vacations or eat at fancy restaurants. Child development may not always, if at all, be a family's top priority. Thus, from the family's perspective the optimal Peabody score may not be at the tangency, but at some other point on the budget constraint.

This model illustrates how the theories of human capital, home production, and budget constraints interact. Further it relates the interactions to the development of a child measured by Peabody test scores. As the budget constraint in the model indicates income and hours at home are inversely related. Therefore, while a child may spend time in daycare because the parents work the household will earn more income. This is the purchased input effect. However, the lost time effect is present. This can be minimized by the parent spending less time working and more with the child at the cost of increased income. The choices of the parent or parents in the household

thus affect the development of the child.

III. Empirical Model

This empirical model will evaluate two hypotheses. The first hypothesizes that *ceteris paribus*, an increase in hours worked will have a negative effect on Peabody scores. This depends on the new position's location on the budget constraint in relation to the old position.

If an individual is working below the optimal point where a Peabody score is maximized, then an increase will improve the child's score. This is illustrated as a movement from point C to B in Figure 4. This is because the family moves to a new iso-Peabody curve. However, an individual may move too far left on the budget constraint, which causes the child to fall to a lower iso-Peabody curve as in Figure 4.

Figure 4

Source: Author
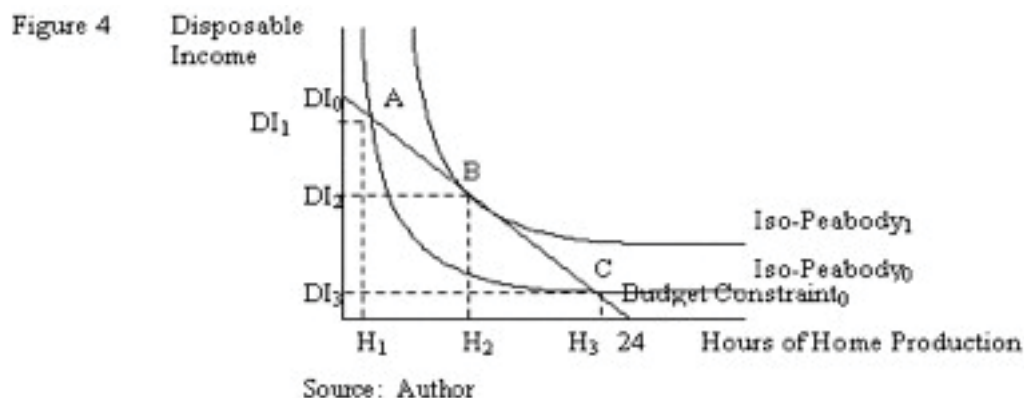
The second hypothesis states that an increase in income has a positive effect on Peabody scores *ceteris paribus*. In the model the budget constraint represents a household unit's wage, and the maximum income the household can achieve is the vertical intercept. In order for this value to change, the wage must change. Thus, the budget constraint pivots on the horizontal intercept of 24 hours since there are only that many in a day. This allows for income to fluctuate. Whether or not a child rises to a higher iso-Peabody curve due to an increase in income depends on where the family was previously on the budget constraint. An increase in income may result in no change in iso-Peabody curves, falling to a lower iso-Peabody

curve, or rising to a higher iso-Peabody curve as is illustrated earlier in Figure 3.

In order to test my hypotheses, I measure child development through four standardized tests. I look at the percentile scores of the Peabody Individual Achievement Tests (PIAT) which has subsections for math (PIAT-M), reading comprehension (PIAT-RC), and reading recognition (PIAT-RR). The PIAT tests are useful because they cover a variety of material and are able to detect trends of under development for a test taker (Friedman, Hatch, Jacobs, Lau-Dickinson, Nickerson, and Schnepel, 2003). The fourth measure is the Peabody Picture Vocabulary Test (PPVT), which measures a child's vocabulary. Vocabulary aquistion is a very useful measure of development by young children which makes the PPVT valuable (Friedman et al., 2003).

In order to determine if the input effect is stronger than the lost time effect, or vice versa, my models will control for single parent households, daycare participation, parental education, and the number of other children present in the household.

A household with a single parent is more likely to be a household where the child or children participate in daycare because the parent must work to earn an income. Therefore the child or children may be at risk for suffering from the lost time effect while not being able to benefit from the added input effect that could be afforded by two working parents. In order to include this in my analysis I needed to construct this variable due to limitations in the NLSY dataset. I created two dummy variables which determined if the biological mother and father live together, and the second determined if the child lived with the mother. Next I built one last dummy variable to combine the previous two. The dichotomous variable would have a value of one if the child lived with both biological parents or a value of zero if this was not the case. However, all observations in my sample hold a value of zero for this variable. Thus, this variable completely controlled for children living with only one biological parent

and is dropped from my model.

The intent of this study is to look at the effect of daycare participation in the beginning of a child's life on his or her future development. However, babies of this age are not good candidates for qualitative tests like the Peabody ones. Further, the NLSY does not have scores for these individuals until they are about five years old. In order to determine if these five year olds were in daycare during the earliest part of their lives I created a variable that determined if they participated in daycare when they were one year old by checking their response to the question of whether or not they had ever participated in daycare which was administered at that age. Unfortunately, when the five year olds were one year old, the question was not asked. Therefore, I use the dummy variable of whether or not the child has ever participated in daycare which was asked at the age of five. If the child has been in daycare then the response is one and zero otherwise. I use this measure because if the child is in daycare by the young age of five, it is likely that the child has been in daycare during his or her infancy as well.

Education of the parents is also of importance in the development of the child. A parent who has a high education is likely to emphasize its importance to the child. A parent without much of an education is also less likely to emphasize the value of education to that child. Therefore, I expect this variable to have a positive coefficient because additional years of schooling will increase the emphasis of education on the child. This variable includes the highest grade completed by the mother. For instance if the mother only completed high school then the highest grade she completed would be 12, and this would be the value for this variable. However, if she completed college then the value would be 16; an additional 4 years to high school. The variable allows up to four additional years of education from this point. Due data limitations any education above the 20th year or grade is all lumped together in the value of 20. The mother's education is used because it is believed that her educational achievement has

more of an impact on the child's education (De Serf, 2002). Also in my study it is more relevant than the father's education because the children studied do not live with the biological father.

The last variable describes how many other children are present in the household. I believe as this number increases, each child must compete for the scarce resources available to the family. Each child must compete for quality time with the parent, and they must compete for purchased inputs. Most of these scarce resources are assumed to be exclusive. However, in some instances the resources may be transferable as mentioned earlier.

The data used in my analysis comes from the NLSY. The cohort used studies the children of the mothers who were surveyed in the 1979 cohort, and I use data from the 2002 survey year. I picked this data set because of its vast information on the child, home, and parents. However I found linking cohorts to be difficult, and I was therefore able to find only limited data on the child's parents and household. For instance, household income was difficult to determine. I therefore use the mother's education as a proxy for this.

The descriptive statistics are presented in Table 1, and the equations that I use to test my hypotheses follow.

$$(1)\ \text{PIAT-M} = \beta_1 - \beta_2 \#ofChildren + \beta_3 MomEducation + \beta_4 Daycare + \varepsilon_1$$

$$(2)\ \text{PIAT-RR} = \beta_1 - \beta_2 \#ofChildren + \beta_3 MomEducation + \beta_4 Daycare + \varepsilon_2$$

$$(3)\ \text{PIAT-RC} = \beta_1 - \beta_2 \#ofChildren + \beta_3 MomEducation + \beta_4 Daycare + \varepsilon_3$$

$$(4)\ \text{PPVT} = \beta_1 - \beta_2 \#ofChildren + \beta_3 MomEducation + \beta_4 Daycare + \varepsilon_4$$

IV. Results

The results from the models are presented in Table 2.

The regression with the dependant variable of PIAT-M did not lead to any surprises. Additional children in the household reduce the scores on math sections. Participation in daycare at any point up in the child's five years of life is also negatively related to the child's performance on the math section. Mother's education is positively correlated with higher math scores, perhaps because the mother values education more. The significance of each variable in this regression

Table 1: Variables and Descriptions

Variable	Description	Expected Sign (+/-)	N	Minimum	Maximum	Mean	Standard Deviation
PIAT-M	Test of Math Skills		131	2	99	61.35	29.818
PIAT-RR	Test of Reading Recognition Skills		131	1	99	72.98	26.445
PIAT-RC	Test of Reading Comprehension Skills		33	75	99	90.79	8.659
PPVT	Test of Vocabulary Skills		109	1	99	47.63	31.439
#ofChildren	Number of Other Children in the Houschold	-	149	1	9	2.6	1.262
MomEducation	Highest Grade Completed by Mother	+	150	7	20	14.39	2.938
Daycare	Dummy Variable: (1) If Child Has Ever Been in Daycare (0) If Not		148	0	1	0.43	0.497

Table 2: Regression Results

	PIAT-M	PIAT-RR	PIAT-RC	PPVT
Constant	22.416***	51.092***	59.572***	13.042
	-2.931	-7.312	-7.49	-1.33
#ofChildren	-2.402**	-2.978***	-1.938	-.4835***
	(-2.144)	(-2.923)	(-1.472)	-3.103
MomEducation	3.316***	1.827***	1.427***	3.318***
	-7.112	(-4.299)	-2.858	-5.358
Daycare	-4.998*	1.752	-3.685	1.549
	(-1.848)	-0.713	(-1.359)	-0.691
Adjusted R^2	0.127	0.07	0.031	0.146

t-statistics appear in parenthesis
* indicates significance to the .10 level
** indicates significance to the .05 level
*** indicates significance to the .01 level

indicates that the lost time effect dominates the purchased input effect in relation to math skills.

The tests for reading and vocabulary do not present such clear results as those for the math test. The number of children in a household is significant in all but the reading comprehension test, and it is negative in all models.

Daycare as measured by the child care variable is significant in only the math test model. This may be due to the opportunities available at daycare. One such opportunity is an emphasis on reading. Daycare providers often have a reading or story time where the children are read a story or have the opportunity to read quietly to themselves. Books may be readily available during play time as well. In my personal experience in working in daycare for the past five years, I have observed the emphasis on reading time. Every day all the children are expected to quietly spend time with a book. The child may be read to by a staff member if the child is very young, or the child may make up his or her own story. The importance placed on reading in a daycare may explain its positive coefficient. However, an equal emphasis on math in daycare seems to be lacking which would

explain for its negative coefficient.

V. Policy Implications & Conclusions

A priori it is not clear whether or not a child's development is adversely affected or benefited by participating in daycare at a young age. The child may benefit from working parents because the household may purchase more inputs that help the child develop academically. However, the child may be harmed by the loss of time that the parent sacrifices with the child in order to work. The question that remains is "is the parent's time better spent working or with the child?"

According to my research, a parent's time is better spent with the child rather than working in order to develop math skills. However, my study is inconclusive in regards to reading and vocabulary skills. My models fail to establish daycare as a significant variable in predicting such scores. Perhaps there are other variables that need to be considered. Future studies may choose to include income even though I omitted it due to data set limitations and likely multicollinearity with the mother's education. Future studies may

also consider quality and other characteristics of daycare. Differences such as who is in charge may also make a difference. A daycare run through a school by teachers may provide better development opportunities for the participants as opposed to one by an entrepreneur through one's home.

My results partially agree with the cited literature. I support Gregg's claim that work early in a child's life adversely affects that child's development. However, my models can only support this negative effect on math skills. The same analysis applies to Baum's findings. Burdumy's results also partially agree with mine. I find that math scores are negatively affected by daycare participation in any of the child's first five years, while she finds that there is only a negative relationship in the child's first year with a small positive affect by participation later. Differences in results are likely to be due to my inability to isolate daycare participation in the child's first year of life. Instead I am limited to only knowing whether or not the child has participated in daycare in any of his or her first five years of life.

Daycare participation appears to be a growing occurrence as the traditional household fades from view. It is no longer the case where a home is comprised of two biological parents where the father is the sole income earner and the mother is in charge of the domestic duties. Many of today's homes are comprised of single parents and dual career parents as well. Women are placing an increased emphasis on their education and are finding increased opportunities in the workforce. Because of this, they are reluctant to give up their careers in order to raise a family. Children, however, are still being born, but are being raised increasingly by caregivers. It is worthwhile to consider the effects of this movement. Thus, daycare may be more helpful if it added an emphasis on math as there is often an emphasis on reading. This may counteract the lost time input.

Children are growing up in a society with different standards for their upbringing than their parents' and grandparents' time. Because of this,

a study of the effects is important. In the end, the change must be worthwhile because those in charge of the next generation depend on their development today.

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