Incomes and Outcomes in Early Childhood

Beck A. Taylor
Eric Dearing
Kathleen McCartney

ABSTRACT

Prior research has identified statistically significant but small income effects for children's cognitive, language, and social outcomes. We examine the impact of family economic resources on developmental outcomes in early childhood, the stage of life during which developmental psychologists have suggested income effects should be largest. Using participants from the NICHD Study of Early Child Care, we estimate income effects that are comparable in absolute terms to those reported in previous research. Relative income effect sizes are found to have practical significance, however, both within our sample, and compared to participation in Early Head Start.

I. Introduction

The association between economic status and children's cognitive, language, and social development is a contentious issue among those who guide and direct economic and social policies affecting children. If family income has a substantial impact on child development, then transfers of income may play a significant

Beck A. Taylor is an associate professor of economics and the W. H. Smith Professor of Economics at Baylor University. Eric Dearing is an assistant professor of psychology at the University of Wyoming. Kathleen McCartney is a professor of education at the Harvard Graduate School of Education. *An earlier version of this paper was presented at the 2001 meetings of the Society for Research in Child Development. This research was funded in part by a grant from the National Institute of Child Health and Human Development (HD 25451). A portion of Beck Taylor's work was completed while a visiting scholar at the Harvard Graduate School of Education. The authors would like to thank David Blau, Erdal Tekin, two anonymous referees, and workshop participants at University of Richmond, University of Oregon, and Georgia State University for their valuable comments. The authors would also like to thank Kristen Bub for providing excellent research assistance. The data used in this article can be obtained beginning May 2005 through April 2008 from Beck A. Taylor, Department of Economics, Baylor University, Waco, TX 76798-8003. E-mail: Beck_Taylor@baylor.edu.*
[Submitted July 2001; accepted May 2003]
ISSN 022-166XE-ISSN 1548-8004

role in the development of children living in poverty. On the other hand, if there is little or no effect of family income on child development, then there may be more useful strategies for improving the well-being of poor children, for example, direct intervention programs such as Head Start.[1]

Developmental psychologists have written extensively on the links between economic resources and child outcomes, and most of what has been written concerns issues related to poverty (for reviews see Duncan and Brooks-Gunn 1997, 2000). Economists interested in understanding human capital formation, intergenerational links in economic status, and associated policy implications have recently entered the debate concerning whether poverty negatively impacts child development (see, for example, Blau 1999; Shea 2000; and Aughinbaugh and Gittleman 2001). The discussion among economists currently centers on the measurement of economic resources like income, the appropriate set of covariates used to explain variation in child outcomes, methods to control for the potential endogeneity of economic resources, and whether statistical estimates of the association between economic resources and child outcomes have practical importance.

The present study contributes to the existing literature in at least four ways. First, while previous researchers examine outcome measures most often associated with children aged 3–7 years and find that income effects are small, we focus on outcomes measured in early childhood (aged 15–36 months) for which income effects are expected to be larger (Duncan and Brooks-Gunn 1997).

Second, researchers in the past have generally relied upon abbreviated and survey measures of development found in large longitudinal data sets, such as the National Longitudinal Survey of Youth (NLSY) or Panel Study of Income Dynamics (PSID). The data we use, from the National Institute of Child Health and Human Development (NICHD) Study of Early Child Care (SECC), include complete, individually administered performance assessments of cognitive and language development that have superior psychometric properties (in other words, better reliability and validity) than the abbreviated and survey performance instruments found in large longitudinal samples (Sattler 1988; Conoley et al. 1995; Bradley et al. 2001).[2]

Third, we suggest alternative approaches than those used in previous research for assigning practical importance to estimated income effects. By estimating effect sizes, we present income effects that are large *relative* to other predictors, particularly for children who live in poverty. That is, we find that the effect of income is often comparable to, and sometimes larger than, the effect sizes of other important control variables, such as maternal verbal intelligence. Additionally, we compare our estimated effect sizes to those estimated for early childhood intervention programs, specifically Early Head Start. This comparison suggests that effect sizes associated with changes in family economic resources found herein are similar to those estimated for partici-

1. Note that the effectiveness of direct intervention programs is also debatable. See Currie (1998, 2001) for a review of the literature on early childhood intervention programs.

2. Survey methods generally involve a mail and/or telephone questionnaire to be completed by the subjects involved. Individually administered assessments, on the other hand, are completed by trained research assistants in either the home or laboratory setting.

pation in Early Head Start found elsewhere in the literature (see, for example, U.S. Department of Health and Human Services 2002).

Finally, we examine the potential mediation of the association between family economic resources and children's outcomes via the role income likely plays in impacting the child's home environment and maternal depression. In most instances, our results indicate that the home environment and maternal depressive symptoms account for some, but not all, of the variance in child outcomes explained by family income, supporting the notion that there exist other transmission processes through which higher income benefits children.

II. Previous Research

A large empirical literature attempts to estimate the association between family economic status and developmental outcomes.[3] We focus here on a small, recent set of studies that attempts to control for the potential endogeneity of parental income. Endogeneity of income arises when unobserved heterogeneity across families, parents, and children (and potentially other environmental factors, such as neighborhood characteristics) is correlated with both family income and child outcomes. For example, if unobserved maternal intelligence is correlated with maternal income and, through shared genes and a shared home environment, with child outcomes, then the estimated income coefficient will be biased and may not be policy relevant (Blau 1999).[4] The studies we cite here take important and unique approaches to control for this potential bias.

Using PSID sibling data, Levy and Duncan (2001) estimate the effect of family income on children's completed years of schooling. They use a family-level (sibling) fixed-effects estimator to control for omitted variables that might be correlated with family income and child outcomes. Although ordinary least squares (OLS) estimates of the effect of income on schooling are small and significantly positive, fixed-effects estimates yield income effects that are even smaller in magnitude and statistically insignificant. Important for our study, when Levy and Duncan extend the analysis to examine the timing of family income during childhood, they find that only family income during early childhood (years 0-4) has a positive and significant effect on schooling.

Ideally, one would test whether family income matters in determining child outcomes by placing money on the doorsteps of randomly selected parents, then tracking the subsequent development of their children. Using PSID data, Shea (2000) attempts to approximate such an experiment by isolating observable determinants of parents' income that arguably represent luck (for example, union status, indus-

3. In a related theoretical study, Weinberg (2001) develops a framework that predicts, among others things, that parents' ability to mold their children's behavior through pecuniary incentives is limited at low incomes, leading to lower outcomes and an increased reliance on nonpecuniary incentives such as corporal punishment.
4. "Policy relevant" means that the estimated model could serve as a guide to the likely effects on children of policies that exogenously change family income.

try, and job loss) and then uses these as instruments for parental income. Although OLS estimates indicate that father's income plays a significant and positive role in determining future child outcomes such as wages, income, and years of schooling, two-stage least squares estimates reveal that father's income has no impact on these measures.

Three recent studies are more closely related to our examination in that they examine children's cognitive, language, and social development rather than future labor market and educational outcomes. In an attempt to distinguish the effect of income from other characteristics, Mayer (1997) utilizes several different measures of income (from both the NLSY and PSID), including parental income earned after the outcome was assessed, in models of children's cognitive and behavioral development. Mayer's results indicate that future income has a small, positive, and significant effect on child outcomes, with more permanent measures of income (in other words, averages of income over the sample period) having larger effects. As Mayer notes, however, parents' investment behavior in child outcomes could be forward-looking, making this approach suspect.

Blau (1999) uses the matched mother-child subsample of the NLSY to estimate the impact of income on cognitive and language outcomes for children aged 3–7 years, and motor and social outcomes for children aged 0–3 years. Blau estimates a variety of empirical specifications, including OLS, discrete-factor random effects, and several levels of fixed effects. His findings indicate that OLS estimates of income effects are generally statistically significant and positive, but that the precision of the estimated effects diminishes dramatically when they are estimated using either random- or fixed-effects estimators. Similar to Mayer's findings, Blau reports that permanent income effects are generally larger in magnitude than contemporaneous income effects. In addition, for most measures examined, Blau does not detect discernable nonlinearities in the income effect—that is, while the marginal impact of an extra dollar of income is expected to be greatest at lower levels of income, this result does not emerge from the NLSY data.

Finally, Aughinbaugh and Gittleman (2001) follow Blau's research design and examine differences in the effect of income on children's cognitive, language, and social outcomes between children living in the United States and those living in Great Britain. Using the NLSY and Great Britain's National Child Development Study, Aughinbaugh and Gittleman find that the association between income and children's developmental outcomes is quite similar for both nations. Discrete-factor random-effects estimates reveal that higher levels of income are associated with better outcomes, but the absolute magnitude of the impact is small.

Thus, there are four general findings from the most recent literature concerning the link between income and child outcomes: (1) OLS estimates of income effects tend to be positive and statistically significant, yet small in absolute terms; (2) income effects tend to diminish in magnitude and significance when the potential endogeneity of income is recognized and controlled for in the estimation procedure; (3) the magnitudes of such estimates are greatest when using permanent, as opposed to contemporaneous, measures of income; and (4) when the effect of income is allowed to vary by timing, there is some evidence that family income earlier in a child's life appears to matter more than income later in life.

III. Data and Empirical Methodology

A. Data

We use data from the NICHD Study of Early Child Care (SECC). In 1991, 8,986 women from ten U.S. sites who had recently given birth were visited in hospitals.[5] Of the 5,151 families who were eligible, 2,352 were invited to participate using a conditional random sampling method that ensured that the sample was diverse and representative of the population with regard to ethnicity, education, and family structure. A total of 1,364 families enrolled in the study, 89 percent (1,216) of whom continued to participate through 36 months.[6]

The data analyzed here were collected from birth until children were 36 months of age. Demographic information, including child gender, family income data, mother's education and ethnicity, paternal education, and family structure (the number of adults and children living in the household and mother's marital status), was collected via mother's report during home visits when children were one month old.[7] Data on family income and family structure were then updated during home visits and telephone interviews when children were 6, 15, 24, and 36 months of age. In addition, when children were 36 months old, the mother's verbal intelligence was assessed using the Peabody Picture Vocabulary Test (PPVT; Dunn and Dunn 1981).[8] Within the SECC sample, mother's PPVT demonstrated high reliability as measured by Cronbach's index of internal consistency ($\alpha = 0.82$). The PPVT has also been validated via correlations with the revised Wechsler Adult Intelligence Scale's (WAIS-R) full scale and subscales (Mangiaracina and Simon 1986).

We measure family economic resources in several ways. Total annual family income, collected at 1, 6, 15, 24, and 36 months, represents income received from all sources, including mother, father/partner (if in the home), and other sources (including other in-home family members and any government assistance).[9] Alternatively, a variable measuring family income-to-needs divides total family income by the poverty threshold for the appropriate family size such that a family at the poverty line

5. The ten cities were Little Rock, Ark.; Irvine, Calif.; Lawrence, Kan.; Boston, Mass.; Philadelphia, Penn.; Pittsburgh, Penn.; Charlottesville, Va.; Morganton, N.C.; Seattle, Wash.; and Madison, Wis.

6. There were some demographic differences between families who dropped out of the study and those who continued to participate. Mothers in families who dropped out were less likely to be married and had fewer years of education. Additionally, children in families who withdrew were more likely to be Black (Dearing et al. 2001). Detailed information concerning how the NICHD SECC sample compares with city and U.S. averages is available from the authors upon request.

7. Maternal and paternal education is measured in years of schooling, and maternal ethnicity is measured using dummy variables indicating whether the mother is Black and/or Hispanic.

8. Thus, gender, education, ethnicity, mother's age at birth, and mother's PPVT are time invariant in the analyses that follow. Child's age, number of children and adults living in the home, and mother's marital status can vary through time.

9. All income measures are in \$10,000s and are converted to 1991 dollars using the CPI. Respondents placed their income into one of 18 income ranges, and the midpoint of the selected range was used as the reported income level. Subjects were asked to report income on either a monthly or annual basis. Monthly incomes were then converted to annual. Though some assessments take place as little as five months apart, the average time between assessments is 8.75 months. The average within-family standard deviation in annual income is \$14,683.

has an income-to-needs ratio of unity (U.S. Bureau of the Census 1999). Income-to-needs may represent a more accurate picture of the family's available economic resources as it adjusts income for the living needs of the family.

Both total family income and income-to-needs are measured contemporaneously and as a simple average over the sample period.[10] Consistent with the previous literature, this averaging of income yields a variable that may represent the family's "permanent" income. Because our panel is short (only 36 months) relative to other longitudinal studies that examine distinctions between permanent and contemporaneous income, our measure of permanent income is likely better interpreted as simply a less noisy measure of income than a true measure of permanent income. We continue to use the term, however, to facilitate comparison across studies.

At 15 and 24 months, children's cognitive development was measured using the Mental Development Index (MDI) from the Bayley Scales of Infant Development II (Bayley 1993). The MDI has been validated via strong correlations with other measures of children's intelligence, such as Stanford-Binet IQ (Bayley 1993). The measure is also highly reliable: $\alpha = 0.80$ (Bayley 1993). At 36 months, children's cognitive development was assessed using the School Readiness composite from the Bracken Basic Concept Scale (Bracken 1984). This 51-item measure assesses children's abilities in the areas of color recognition, letter identification, number and counting skills, comparisons, and shape recognition. This school readiness composite has demonstrated excellent validity with intelligence measures and academic performance in kindergarten (Laughlin 1995; Zucker and Riordan 1988). In the SECC sample, the internal consistency of the measure is excellent ($\alpha = 0.93$).

During laboratory visits at age 36 months, children's language performance was assessed using the Reynell Developmental Language Scale (Reynell 1991). This 67-item measure is divided into two subscales. The Receptive Language (language comprehension) subscale assesses children's behavioral responses to verbal requests to identify and manipulate a set of objects—for example, "Put all of the white buttons in the cup." The Expressive Language subscale assesses children's speech (for example, the use of complex sentence structure) and the ability to name and define objects, words, and activities presented pictorially. The Reynell subscales have demonstrated both concurrent and predictive validity via associations with other language measures and intelligence scores (Silva 1986). In the SECC sample, both subscales were internally consistent: $\alpha = 0.93$ for the receptive subscale and $\alpha = 0.86$ for the expressive subscale.

During laboratory visits at 24 and 36 months, children's social behavior was assessed via maternal report. Specifically, mothers completed both the Child Behavior Checklist (CBCL; Achenbach et al. 1987) and the Adaptive Social Behavior Inventory (ASBI; Hogan, Scott, and Bauer 1992). Both of these measures have proven to be valid assessments of children's behavior via correlations with other behavioral measures and each has demonstrated good internal consistency (Achenbach et al. 1987; Hogan et al. 1992). Based on factor analysis, child behavior composites representing behavior problems (negative behavior) and prosocial behavior (positive

10. Averages on income variables were calculated ignoring missing values, which occurred in approximately 3 percent of our usable sample (see Table 2). Excluding subjects for whom we have missing income values from subsequent analyses does not qualitatively change the results reported herein.

behavior) were formed by summing standardized scores from the subscales of the CBCL and ASBI.[11]

It should be noted that social scientists have recognized at least two pathways through which income can be transmitted to child outcomes. First, economic resources can be used to invest in opportunities and environments that foster positive outcomes (Blau 1999). Second, economic hardship can translate into parental stress and depression that may in turn adversely affect parent-child interactions (Conger et al. 1997; Elder et al. 1985). To capture environmental effects, the quality of the home environment was assessed at 6, 15, and 36 months using the Home Observation for Measurement of the Environment (*HOME*; Caldwell and Bradley 1984). Using maternal responses to questions and interviewer observations, this 55-item measure assesses a variety of household characteristics from the quality of parent-child interactions to the level of cognitive stimulation available and provided in the home. The *HOME* measure has been validated via correlations with family social status and maternal IQ (Caldwell and Bradley 1984). Further, the measure has demonstrated excellent reliability ($\alpha = 0.93$). Although the *HOME* score is not a child outcome measure, estimating the responsiveness of the *HOME* score to changes in income may yield insights into the elasticity of parents' input demand with respect to changes in income. Thus, we will estimate income effects for not only child outcome measures, but also for the *HOME* score.

Mothers completed the Center for Epidemiological Studies Depression Scale (CES-D; Radloff 1977) at 1, 6, 15, 24, and 36 months. The CES-D is a 20-item checklist measuring the presence and frequency of depressive symptoms in the previous week. Response categories range from zero (rarely or none of the time; in other words, less than once a week) to three (most or all of the time; in other words, 5–7 times a week). One of the most widely used measures of depressive symptoms, the CES-D, has been extensively tested for validity and reliability (Cho et al. 1993). In the SECC sample, reliability ranged from 0.85 to 0.90. The *HOME* measure described above and maternal depressive symptoms will be used in later analyses that investigate the mediating role these variables play in the context of the investment and family stress pathways described above.

Table 1 summarizes the various measures we use in the analyses to follow. Descriptive statistics for all variables in the SECC sample are reported in Table 2.[12] Additionally, we report in Table 2 available sample characteristics from similar studies using the NLSY (Blau 1999) and PSID (Levy and Duncan 2001). Inspection of Table 2 reveals that the SECC sample, as compared to the NLSY and PSID samples,

11. In a principal components factor analysis, the two subscales from the CBCL (Internalizing and Externalizing behavior problems) and three subscales from the ASBI (Comply, Express, and Disrupt) loaded on two factors that cumulatively explained more than 77 percent of the variance in these measures. The loadings for the first factor, negative behavior, were 0.88 (CBCL: Externalizing), 0.80 (CBCL: Internalizing), and 0.82 (ASBI: Disrupt). The loadings for the second factor, positive behavior, were 0.94 (ASBI: Express) and 0.78 (ASBI: Comply). See NICHD Early Child Care Research Network (1999) for a more detailed description.

12. Because sample sizes vary considerably depending on the outcome and specification, we report in Table 2 descriptive statistics based on the sample of observations that contain nonmissing mother's PPVT score. Sample statistics do not change radically across the different subsamples examined in the empirical analysis.

Table 1
Selected Child, Mother, and Home Measures from the NICHD SECC Data

Variable	Measure
Child outcomes	
Cognitive	
Mental development	Bayley II Mental Development Index (MDI; Bayley 1993) at 15 and 24 months
School readiness	School readiness subscale from the Bracken Basic Concept Scale (Bracken 1984) at 36 months
Language	
Language comprehension	Receptive language subscale from the Reynell Developmental Language Scale (Reynell 1991) at 36 months
Expressive language	Expressive language subscale from the Reynell Developmental Language Scale (Reynell 1991) at 36 months
Behavior	
Positive social behavior	Mean composite of Express and Comply subscales from the Adaptive Social Behavior Inventory (ASBI; Hogan, Scott, and Bauer 1992) at 24 and 36 months
Negative social behavior	Mean composite of Externalizing and Internalizing subscales from the Child Behavior Checklist (CBCL; Achenbach et al. 1987), as well as the Disrupt subscale from the ASBI at 24 and 36 months
Mother and home measures	
Maternal verbal intelligence	Peabody Picture Vocabulary Test – Revised (PPVT; Dunn and Dunn 1981) at 36 months
Maternal depression	Center for Epidemiological Studies – Depression Scale (CES-D; Radloff 1977) at 1, 6, 15, 24, and 36 months
Home environment	Home Observation for Measurement of the Environment (*HOME*; Caldwell and Bradley 1984) at 6, 15, and 36 months

is more affluent, contains a smaller proportion of minorities, and has a higher level of parental education, on average. It should be noted that the SECC was not designed to be nationally representative and some low-income groups were deliberately excluded. The liberal use of sample exclusion criteria in the SECC (for example, excluding families from unsafe neighborhoods and mothers not fluent in English) is

Table 2
Comparative Descriptive Statistics from the NICHD SECC, NLSY, and PSID

Variable	NICHD SECC	NLSY[a]	PSID[b]
Permanent family income	4.37	2.20	3.19
	(2.66)		
	[6,672]		
Permanent family income tiers (quintiles)			
Tier-1 dummy	0.14		
	(0.34)		
	[6,672]		
Tier-2 dummy	0.20		
	(0.40)		
	[6,672]		
Tier-3 dummy	0.21		
	(0.41)		
	[6,672]		
Tier-4 dummy	0.23		
	(0.42)		
	[6,672]		
Tier-5 dummy	0.22		
	(0.42)		
	[6,672]		
Permanent family income-to-needs	2.52		
	(1.75)		
	[6,672]		
Contemporaneous family income	4.49	2.80	
	(2.99)		
	[6,486]		
Contemporaneous family income tiers (quintiles)			
Tier-1 dummy	0.18		
	(0.38)		
	[6,486]		
Tier-2 dummy	0.22		
	(0.41)		
	[6,486]		
Tier-3 dummy	0.19		
	(0.39)		
	[6,486]		
Tier-4 dummy	0.18		
	(0.39)		
	[6,486]		
Tier-5 dummy	0.23		
	(0.42)		
	[6,486]		

Table 2 (*continued*)

Variable	NICHD SECC	NLSY[a]	PSID[b]
Contemporaneous family income-to-needs	3.11		
	(2.34)		
	[6,486]		
Poverty dummy (poor)	0.17		
	(0.38)		
	[6,486]		
Poverty dummy (ever poor in sample period)	0.32		
	(0.47)		
	[6,672]		
MDI	100.20		
	(16.49)		
	[2,224]		
School readiness	8.95		
	(2.87)		
	[1,104]		
Language comprehension	97.44		
	(15.75)		
	[1,103]		
Expressive language	96.74		
	(14.58)		
	[1,078]		
Negative behavior	0.00		
	(3.05)		
	[2,187]		
Positive behavior	0.00		
	(1.81)		
	[2,191]		
HOME	37.26		
	(4.67)		
	[3,274]		
Child is male	0.52	0.51	0.52
	(0.50)		
	[6,672]		
Mother is Hispanic	0.04	0.36	
	(0.20)		
	[6,672]		
Mother is Black	0.11	0.22	0.41
	(0.32)		
	[6,672]		

Table 2 (*continued*)

Variable	NICHD SECC	NLSY[a]	PSID[b]
Mother's PPVT	98.39		
	(18.17)		
	[6,672]		
Mother's depression	9.52		
	(8.42)		
	[6,672]		
Number of children in household	3.25	2.49	
	(1.54)		
	[6,672]		
Mother's age at child's birth	28.22	27.68	24.35
	(5.53)		
	[6,672]		
Mother's education in years	14.29	11.81	11.75
	(2.44)		
	[6,672]		
Mother is married	0.64	0.61	
	(0.48)		
	[6,672]		
Mother is widowed, separated, or divorced	0.02	0.19	
	(0.15)		
	[6,672]		
Father's education in years	14.45	12.26	
	(2.60)		
	[6,672]		
Number of adults in household	2.11	2.33	
	(0.67)		
	[6,672]		

Note: Statistics reported are the mean, (standard deviation), and [sample size]. The SECC descriptive statistics are reported for those observations with nonmissing data on mother's PPVT score. Both permanent and contemporaneous income are measured in 10,000s of 1991 dollars. Income quintiles (tiers) were estimated prior to eliminating observations with missing values for mother's PPVT score, thus the resulting tiers are not uniformly spaced. Descriptive statistics differ slightly across the usable samples for child outcomes and the *HOME* score. Permanent family income and income-to-needs are averages over all available observations of contemporaneous family income and income-to-needs for a given family. In the regression analysis, child outcomes and the *HOME* score have been divided by their standard deviations.

a. Reported by Blau (1999) and inflated to 1991 dollars.

b. Reported by Levy and Duncan (2000) and deflated to 1991 dollars.

likely responsible for the disparities noted in Table 2 between the SECC, NLSY, and PSID.

B. Empirical Methodology

Consistent with the previous literature, we estimate reduced-form models that can be written

(1) $y_{ijt} = X_{jt}\,\alpha_i + I_{jt}\,\beta_i + \varepsilon_{1ijt}$,

where y_{ijt} is the *j*th child's score on the *i*th assessment in month *t*, *X* is a vector of regressors, *I* is a measure of income, ε_1 is the disturbance, and α and β are parameters to be estimated.[13] Our six child outcome measures and the *HOME* score, which will serve as our dependent variables, are rescaled by dividing each by its standard deviation (SD) to make regression results across outcomes more easily comparable.

Three of our outcome measures (MDI, negative behavior, and positive behavior) and the *HOME* score have multiple assessments for each child in the SECC data. For the remaining three outcomes (school readiness, language comprehension, and expressive language) we have only one assessment per child. To control for the potential endogeneity of income that is a potential issue for each child outcome and the *HOME* score, regardless of the assessment frequency, we estimate Equation 1 using a discrete-factor model which produces a semi-parametric maximum-likelihood random-effects estimator identical to that found in Blau (1999) and Aughinbaugh and Gittleman (2001).[14,15] Although there is sufficient within-family variation in income

13. As stated in Blau (1999), an alternative approach to specifying the reduced-form equation above is to estimate a structural model in which the household maximizes utility by choosing consumption, leisure, and child achievement. A production function that translates inputs of time and other resources into achievement levels could be specified. Estimation of such a model would require strong assumptions given that the SECC data contain no information on family purchases of inputs, such as health care and books, or how outside time is spent.

14. The standard instrumental-variables approach is not feasible in this case because the child outcome equations are reduced form and contain all of the exogenous variables in the model, leaving no instruments to identify the income effect.

15. The discrete factor model requires that income and child outcome equations be estimated jointly, and it will yield consistent estimates of the income effect if income is the only endogenous variable on the right-hand side of the equation. We specify income equations of the form

$$I_{jt} = X_{jt}\gamma + \varepsilon_{2jt},$$

and an error structure given by

$$\varepsilon_{1ijt} = v_j + \eta_{1ijt}$$
$$\varepsilon_{2jt} = \rho_i v_j + \eta_{2jt},$$

where *v* and the η's are independently distributed errors with mean zero, and ρ is a factor-loading parameter to be estimated. The common factor, *v*, is defined as the only source of the correlation between *I* and ε_1 and is integrated out of the model using a full-information maximum-likelihood random-effects estimator. The distribution of the common factor, *v*, is assumed to be given by the step function

$$Pr\left(v = \mu_k\right) = \pi_k,\ k = 1,\dots, K;\ \pi_k \geq 0;\ and\ \sum_{k=1}^{K} = 1,$$

where the μ's and π's are parameters to be estimated, and *K* is the number of points of support assumed for to estimate a fixed-effects model, the inability to estimate the impact of permanent family income limits this approach.[16]

We also estimate Equation 1 using ordinary least squares (OLS), with the standard error estimates associated with our repeated measures of child outcomes adjusted by the Huber-White method to account for nonindependence due to multiple observations per child. Recall that previous researchers have consistently found a reduction in the absolute size (and, in many cases, statistical significance) of estimated income effects when controlling for the potential endogeneity of family income. A comparison of OLS and random-effects estimates will allow us to identify such changes in the SECC sample if they are present. Regardless of estimation technique, however, we place more faith in estimates of income effects obtained from our repeated measures of child outcomes (MDI, negative behavior, and positive behavior) and the *HOME* score than in those estimates obtained from our one-time assessments (school readiness, language comprehension, and expressive language).

Because researchers have often disagreed over the appropriate set of covariates to include when estimating the effect of income on child outcomes, for each of our child outcome measures, as well as for the *HOME* score, we estimate three specifications. First, we define a "core" set of regressors that are arguably exogenous. This core set of regressors includes child gender, maternal ethnicity, and child's age at the time of the assessment. This first specification is guided by the rationale that the policy-relevant, exogenous effect of income is most appropriately estimated when potentially endogenous variables that are influenced by, or jointly chosen with, income are excluded from the regression (Blau 1999).

In our second specification, a measure of maternal verbal intelligence (PPVT) is included in addition to predictors from the core set. Including this measure likely controls for the influence of mother's intelligence on income as well as child outcomes. The PPVT score may, however, capture both innate intelligence (ability) as well as endogenous decisions concerning human capital investment (achievement), and, as such, is not included in the core set of regressors exclusively used in the first specification.

In our third specification, in addition to those variables in our second specification, we include a broader set of covariates commonly found in the child development literature (Duncan and Brooks-Gunn 1997). These include the number of children and adults in the household, mother's age at the child's birth, maternal and paternal education, and mother's marital status. This specification is guided by the rationale that the size of income effects may be overestimated if the variance in child outcomes attributed to income is actually due to conditions, such as education, that are collinear with family economic resources.

the distribution. Because of the lack of identifying instruments, identification is achieved via covariance restrictions, specifically that v is the only source of correlation between I and ε_1, and by setting the factor-loading parameter in ε_1 equal to unity. For more details, see Heckman and Singer (1984), Mroz and Guilkey (1992), Mroz (1999), Blau (1999), and Aughinbaugh and Gittleman (2001). Other studies to use this approach include Blau and Hagy (1998), Hu (1999), and Mocan and Tekin (2003).

16. Child-level fixed-effects estimates of Equation 1 are available from the authors upon request.

IV. Results

A. *Estimated Income Effects*

Estimated income effects from Equation 1 are reported in Table 3. For the *HOME* measure and for each of our six child outcome measures, we report estimated income effects using both permanent income (upper half of Table 3) and contemporaneous income (lower half). Two measures of income, total family income and income-to-needs, are examined. For each of these measures of income, we report estimates from three separate specifications using the core independent variables, then adding mother's PPVT score, and finally including other potentially omitted variables commonly used in the child development literature. Both random-effects and OLS [in brackets] estimates are reported.

The first row in Table 3 reveals that in a random-effects model using only our core variables, a $10,000 increase in permanent annual income is associated with an average improvement in child outcomes of 7.3 percent of an SD (recall that lower scores for negative behavior are interpreted as better outcomes), with the largest effect being a nine percent of an SD improvement for school readiness, and the smallest effect being a 5.9 percent of an SD improvement for mental development (MDI). Similarly, a $10,000 increase in permanent annual income is associated with a 10.6 percent of an SD increase in the *HOME* score, larger than any income effect estimated across the six child outcomes. OLS estimates of income effects in the same specification are always larger in absolute magnitude. Specifically, the average income effect across the six outcome measures increases to 9.3 percent of an SD, while the *HOME* income effect increases to 13.3 percent. That OLS estimates are larger than random-effects estimates is generally consistent throughout the analyses that follow.

The fourth row of Table 3 reports income effects using the same core model, but replaces permanent family income with permanent income-to-needs as our measure of family economic resources. Random-effects estimates reveal that, on average, a one-point increase in the ratio of income to needs leads to a 12.6 percent of an SD improvement across the six child outcome measures, and a 17.8 percent improvement in the *HOME* score. The largest income effect estimated for child outcomes using income-to-needs is 17.3 percent for language comprehension, and the smallest is 9.1 percent for negative behavior. To facilitate a comparison with results generated using permanent family income, we first calculate the average needs in our data to be $17,600 and then multiply each income effect by ($10,000/$17,600). Using the income-to-needs coefficients in this way across the six child outcomes, a $10,000 increase in permanent income translates into an average 7.2 percent of an SD improvement in outcomes and a 10.1 percent of an SD increase in the *HOME* score. Thus, using permanent family income and permanent income-to-needs yields similar estimates of the impact of additional income on developmental outcomes and the home environment.

Again, examining only the upper half of Table 3, as one adds more variables to the right-hand side of the equation, income effects diminish in size, but not always in significance. Using permanent family income as our income variable, adding the mother's PPVT score as a regressor results in income effects across the six outcomes that are on average 67.6 percent as large as those estimated when using only the core

Table 3

Estimated Random-Effects and OLS Coefficients on Linear Income Measures[a]

		Cognitive		Language		Behavior		
Income Measures	Model	MDI[b]	School Readiness[c]	Language Comprehension[c]	Expressive Language[c]	Negative Behavior[d]	Positive Behavior[d]	*HOME*[e]
Permanent income measures								
Total family income	Core	0.059*	0.090*	0.089*	0.069*	−0.071*	0.061*	0.106*
		[0.085*]	[0.109*]	[0.116*]	[0.090*]	[−0.082*]	[0.078*]	[0.133*]
Total family income	Core + mother's PPVT	0.044*	0.062*	0.053*	0.048*	−0.051*	0.037*	0.073*
		[0.069*]	[0.076*]	[0.073*]	[0.060*]	[−0.071*]	[0.060*]	[0.094*]
Total family income	Core + mother's PPVT + others	0.028*	0.018*	0.021*	0.030*	−0.019	0.025*	0.006
		[0.050*]	[0.024*]	[0.029*]	[0.033*]	[−0.033*]	[0.031*]	[0.019]
Income-to-needs	Core	0.099*	0.168*	0.173*	0.131*	−0.091*	0.096*	0.178*
		[0.123*]	[0.195*]	[0.192*]	[0.150*]	[−0.111*]	[0.125*]	[0.213*]
Income-to-needs	Core + mother's PPVT	0.076*	0.111*	0.099*	0.084*	−0.057*	0.059*	0.129*
		[0.096*]	[0.149*]	[0.127*]	[0.103*]	[−0.083*]	[0.094*]	[0.187*]

Income-to-needs	Core + mother's PPVT + others	0.049* [0.077*]	0.042* [0.055*]	0.032* [0.057*]	0.027* [0.046*]	–0.012 [–0.031*]	0.038 [0.041*]	0.017 [0.053]
Contemporaneous income measures								
Total family income	Core	0.032* [0.072*]	0.074* [0.090*]	0.075* [0.094*]	0.047* [0.060*]	–0.037* [–0.059*]	0.033* [0.056*]	0.072* [0.110*]
Total family income	Core + mother's PPVT	0.021* [0.045*]	0.049* [0.065*]	0.039* [0.062*]	0.022* [0.035*]	–0.026* [–0.037*]	0.020* [0.044*]	0.048* [0.081*]
Total family income	Core + mother's PPVT + others	0.003 [0.028*]	0.011 [0.023*]	0.018* [0.030*]	0.002 [0.006]	–0.011 [–0.019]	0.010 [0.026*]	0.005 [0.015]
Income-to-needs	Core	0.050* [0.097*]	0.117* [0.140*]	0.112* [0.135*]	0.075* [0.090*]	–0.045* [–0.066*]	0.047* [0.071*]	0.097* [0.127*]
Income-to-needs	Core + mother's PPVT	0.035* [0.066*]	0.084* [0.108*]	0.077* [0.092*]	0.042* [0.057*]	–0.029* [–0.042*]	0.029* [0.065*]	0.068* [0.098*]
Income-to-needs	Core + mother's PPVT + others	0.007 [0.015]	0.021* [0.039*]	0.024* [0.045*]	0.001 [0.003]	–0.014 [–0.023]	0.015 [0.029*]	0.003 [0.026]

Note: * indicates statistical significance, $p \leq 0.05$. Sample size varies by outcome and specification.

a. Both random-effects and OLS [in brackets] coefficients are reported.

b. MDI assessed at 15 and 24 months (average sample size = 2,090).

c. School readiness (average sample size = 1,055) and language outcomes (average sample size = 1,057) assessed at 36 months only.

d. Behavioral outcomes assessed at 24 and 36 months (average sample size = 2,142).

e. *HOME* assessed at 6, 15, and 36 months (average sample size = 3,266).

set of regressors. The corresponding income effect associated with the *HOME* score is 68.9 percent as large. Including the other variables commonly included in the developmental literature results in coefficients that are 49.9 percent as large as those estimated using the core set and mother's PPVT, and an income effect for the *HOME* score only 8.2 percent as large (and insignificant). A similar pattern is observed when using income-to-needs. Contrary to several other studies, however, most estimates of the income effect remain statistically significant even after including variables that may be determined simultaneously with income.

Estimates of the effect of changes in contemporaneous income are reported at the bottom of Table 3. As found in previous research, income effects are smaller when current income measures are used. For example, comparing the core model using current family income to the core model using permanent family income, the average income effect associated with child outcomes decreases by 34.2 percent, and the income effect associated with the *HOME* score decreases by 32.1 percent. Additionally, for both current total income and current income-to-needs, as one adds more variables to the core model, income effects diminish dramatically and, at times, become insignificant.

Summarizing the results from Table 3, we confirm much of the previous research that estimates income effects associated with child outcomes. Specifically, we report statistically significant effects of income on both child outcomes and the *HOME* measure, though our estimates are small in absolute size. For instance, using the core model, the estimated (random-effects) income effect for MDI indicates that a $10,000 increase in permanent family income generates a less than one point increase in child IQ. Not surprisingly, including variables that are potentially jointly determined with income reduces the absolute magnitude of the income effect, though our estimates generally remain precise. Income effects associated with permanent income measures are generally greater in magnitude than income effects estimated using contemporaneous income measures. Finally, OLS estimates of income effects are larger than their random-effects counterparts, suggesting that endogeneity is a concern when estimating the association between economic resources and developmental outcomes.

B. Nonlinearities

A common prediction in the child development literature is that economic resources will have smaller marginal impacts on outcomes as these resources increase (Duncan and Brooks-Gunn 1997). Surprisingly, this predicted nonlinearity in the income effect has not been demonstrated robustly in previous findings.[17] Table 4 presents income effects estimated using two nonlinear specifications. Each model is estimated using the core set of regressors, including mother's PPVT score, along with the family's permanent annual income (top portion of Table 4) or the family's contemporaneous annual income (bottom portion) as the income variable. First, for each outcome meas-

17. Note that Aughinbaugh and Gittleman (2001) find some evidence of nonlinearities in the NLSY when the sample was split depending on income levels that were above and below one- half of the median income level in the sample.

ure and the *HOME* score, we report in Table 4 estimated random-effects and OLS [in brackets] income effects over the poor and nonpoor subsamples through the use of an interaction between a poverty dummy variable and the income measure.[18] Second, we report income effects estimated across income quintiles in the SECC sample (labeled Tiers 1–5, with Tier 5 being the highest quintile), cutoffs that are arguably less arbitrarily defined than the poverty threshold utilized in the first specification.

Random-effects results reported in Table 4 from the poverty interaction using the permanent measure of income (upper half of Table 4) reveal that changes in income have larger effects within the poor subsample. The average differential impact of a $10,000 increase in permanent income on child outcomes between children living in and out of poverty is 9.1 percent of an SD, with the *HOME* score associated with a 15.3 percent differential. Because a $10,000 increase in income would likely push most in our poor subsample across the poverty threshold, a comparison of proportional changes is also warranted. Using the coefficients in Table 4 and means of the poor and nonpoor subsamples to estimate point elasticities, we calculate the percentage improvement in child outcomes and the *HOME* score associated with a ten-percent increase in permanent income. For each child outcome and for the *HOME* score, the estimated income elasticity for the poor subsample exceeds that for the nonpoor subsample, and in all but one case (language comprehension) this difference is statistically significant. For example, a ten-percent increase in permanent income for those in poverty yields a 0.12 percent increase in school readiness, but only a 0.07 percent increase for those out of poverty. The largest disparity between income elasticities occurs for negative behavior. A ten-percent increase in permanent income generates a decline in negative behavior of 1.43 percent and 0.91 percent for the poor and nonpoor groups, respectively. Finally, note that with the exception of negative behavior, we do not detect statistically significant differentials for the poor and nonpoor subsamples when using contemporaneous income measures (bottom half of Table 4). The precision of these estimates is likely influenced by the large measurement error associated with contemporaneous income relative to the permanent income measure.

With respect to the income-quintile specifications in Table 4, we again see significant nonlinear effects of permanent (but not contemporaneous) income. The effects of increases in permanent income diminish as one moves up the income ladder, but the point at which diminishing returns begin differs across outcomes. For example, an increase in permanent income does not begin to have a significant differential effect on language comprehension until approximately $61,000 (the 80th percentile), but for both behavioral outcomes, diminishing returns manifest more quickly at approximately $17,000 (the 20th percentile). Point elasticities also suggest diminishing returns to proportional increases in permanent income across the income quintiles.

In summary, both nonlinear specifications reveal that income effects are larger for children living in homes with lower family income, though this relationship is most evident when using a measure of permanent income.

18. The poverty dummy variable is equal to unity for those families whose financial needs are greater than total income, zero otherwise. Specifications that included a quadratic term yielded significant diminishing returns, but are not reported for brevity.

Table 4

Estimated Random-Effects and OLS Coefficients on Nonlinear Income Measures[a]

Income Measures	Cognitive				Language				Behavior					
	MDI[b]		School Readiness[c]		Language Comprehension[c]		Expressive Language[c]		Negative Behavior[d]		Positive Behavior[d]		*HOME*[e]	
Permanent income measures														
Income	0.020	0.081*	0.043*	0.121*	0.041*	0.079*	0.026*	0.096*	–0.022	–0.158*	0.011	0.081*	0.021*	0.160*
	[0.031]	[0.092*]	[0.049*]	[0.123*]	[0.052*]	[0.090*]	[0.034*]	[0.111*]	[–0.039]	[–0.171*]	[0.026]	[0.086*]	[0.045*]	[0.172*]
Income ×	0.090*		0.088*		0.049		0.076*		–0.165*		0.075*		0.153*	
poverty	[0.112*]		[0.099*]		[0.067]		[0.086*]		[–0.171*]		[0.090*]		[0.165*]	
Income ×		–0.006		–0.015		0.013		–0.005		0.021*		–0.017*		–0.046
tier-2		[–0.011]		[–0.019]		[0.019]		[–0.009]		[0.029*]		[–0.020*]		[–0.059]
Income ×		–0.020		–0.033*		–0.009		–0.021*		0.016		–0.021*		–0.093*
tier-3		[–0.022]		[0.040*]		[–0.013]		[–0.029*]		[0.021*]		[–0.026*]		[–0.107*]
Income ×		–0.079*		–0.065*		–0.024		–0.083*		0.123*		–0.071*		–0.132*
tier-4		[–0.081*]		[–0.069*]		[–0.032]		[–0.092*]		[0.134*]		[–0.074*]		[–0.133*]
Income ×		–0.095*		–0.105*		–0.061*		–0.091*		0.186*		–0.079*		–0.162*
tier-5		[–0.099*]		[–0.112*]		[–0.070*]		[–0.102*]		[0.199*]		[–0.083*]		[–0.169*]

Contemporaneous income measures														
Income	0.010	0.022	0.038*	0.042*	0.035*	0.040*	0.011	0.018	–0.016*	–0.143*	0.011	0.013	0.029*	0.035*
	[0.025]	[0.028]	[0.049*]	[0.036*]	[0.048*]	[0.059*]	[0.012]	[0.020]	[–0.021*]	[–0.156*]	[0.019]	[0.016]	[0.041*]	[0.038*]
Income ×	–0.015		–0.107		–0.056		0.008		–0.153*		–0.090		0.016	
poverty	[0.006]		[–0.141]		[–0.143]		[0.013]		[–0.164*]		[–0.096]		[0.019]	
Income ×		0.001		–0.010		–0.001		0.005		0.016		0.001		–0.008
tier-2		[0.009]		[–0.010]		[–0.003]		[0.005]		[0.018]		[0.001]		[–0.009]
Income ×		–0.006		–0.007		0.005		0.003		0.008		0.006		–0.011
tier-3		[–0.006]		[–0.009]		[0.004]		[0.005]		[0.010]		[0.008]		[–0.011]
Income ×		–0.007		–0.034		–0.010		–0.010		0.088*		–0.076		–0.019
tier-4		[–0.008]		[–0.038]		[–0.012]		[–0.011]		[0.092*]		[–0.081]		[–0.021]
Income ×		–0.019		–0.005		–0.031*		–0.009		0.182*		–0.101		–0.017
tier-5		[–0.020]		[–0.012]		[–0.033*]		[–0.012]		[0.191*]		[–0.112]		[–0.020]

Note: * indicates statistical significance, $p \leq 0.05$. All models are estimated using the core set of regressors, mother's PPVT score, and main effects of the various categorical income or poverty variables. Sample size varies by outcome and specification. Tiers 2–5 represent the top four income quintiles, with Tier-5 being the highest.

a. Both random-effects and OLS [in brackets] coefficients are reported.
b. MDI assessed at 15 and 24 months (average sample size = 2,090).
c. School readiness (average sample size = 1,055) and language outcomes (average sample size = 1,057) assessed at 36 months only.
d. Behavioral outcomes assessed at 24 and 36 months (average sample size = 2,142).
e. *HOME* assessed at 6, 15, and 36 months (average sample size = 3,266).

C. Relative Effect Sizes

Studies to date that have examined the association between income and child developmental outcomes have consistently estimated income effects that are small in absolute terms. Our results confirm this finding. When interpreting the magnitude of such estimates, however, it is important to consider that the estimated effects associated with other important predictors of child outcomes are also small in absolute terms. Thus, a potentially useful exercise would be to compare relative effect sizes within the same data set (McCartney and Rosenthal 2000). Unfortunately, economists often give this exercise little attention and dismiss, out of hand, estimates of the income effect on child outcomes as small. When a comparison of relative effects is attempted, previous researchers have not always taken into account the quantitative units in which other predictors of child outcomes are measured. Failing to do so results in the proverbial apples and oranges problem.[19] Without taking into account the distribution of all predictors, one cannot accurately assess the relative impact of one variable over another.

To estimate more accurately the relative impact of changes in a family's economic status on children's development, we repeated the analyses reported in Tables 3 and 4 by regressing child outcomes on *z*-scores of the predictors in the models. Thus, the resulting standardized coefficients can be interpreted as the effect of a one SD change in the independent variable on our measures of child outcomes. More importantly, estimated coefficients can more easily be compared across regressors in the same model, and relative effects can be correctly determined. Additionally, because among developmental psychologists and statisticians partial correlations are the preferred method of estimating effect size in regression (McCartney and Rosenthal 2000), we also report partial correlations associated with each variable.

Standardized coefficients from a random-effects model and partial correlations [in brackets] using the core set of regressors, including mother's PPVT and our measure of permanent family income, are reported in Table 5. Given the nonlinearities reported in Table 4, particularly those associated with the poverty threshold, in addition to reporting estimates from the entire sample, we have broken the sample into those children who live in poverty and those who do not. Additionally, to examine the potential mediating impact of more proximal determinants of development, like the home environment and maternal depression, we include in Table 5 a second specification that includes these variables on the right-hand side of the estimating equation.[20] The extent to which income effects are reduced from the first to the second specification will provide some indication of the intervening roles that the home environment (the investment pathway) and maternal depression (the family-stress pathway) play in transmitting the effects of income to children (Baron and Kenny 1986). Significant

19. To emphasize that income effects are small relative to other predictors, researchers have in the past compared estimated coefficients associated with, for example, changes in a child's age or differences in gender to the estimated coefficient associated with an increase in income. These are simply not comparable.

20. Note that the timing of the outcome assessments and assessments of *HOME* and maternal depression forced us to use only one assessment from each outcome measure when considering mediation effects, even for those outcomes measured on multiple occasions. The assessments in this analysis include MDI at 15 months, and school readiness, language comprehension, expressive language, and negative and positive behavior at 36 months.

income effects still present after accounting for *HOME* and maternal depression would indicate the existence of additional transmission processes through which higher incomes benefit children, such as neighborhood, school, and childcare quality.

Examining first the specifications in Table 5 that do not include the potential intervening variables, for the entire sample of children in the SECC data, the effect of permanent family income on child outcomes and the *HOME* score is comparable to other predictors in the estimation. For example, the effect of permanent family income on child outcomes as measured by the standardized coefficients is, on average, 73.5 percent as large as the effect of maternal verbal intelligence (PPVT), a strong predictor of child developmental outcomes, and 86 percent as large as maternal PPVT for the *HOME* score.[21,22] More striking is the relative strength of the income effect for the poor subsample. Again, comparing the effect of permanent income on child outcomes to the effect of mother's verbal intelligence, the effect size of permanent income is 73.7 percent as large, on average, as maternal PPVT for children living in poor families, while for the *HOME* score, the effect of income is 30.3 percent *larger* than maternal PPVT for poor families.[23] For MDI and negative behavior, the estimated effect size of income is *larger* than that of maternal PPVT, though only significantly so for MDI. That is, for one measure of children's cognitive development, the effect of permanent family income is greater than that of an accepted determinant (both genetic and environmental) of child outcomes, mother's verbal intelligence (Ceci et al. 1997; Scarr 1997). For the nonpoor subsample, on the other hand, the income effect is on average 50.1 percent of the effect of mother's PPVT, while the effect of income is 49.9 percent that of mother's verbal intelligence for the *HOME* score.[24,25]

When considering in Table 5 the impact of more proximal determinants of outcomes, like the home environment and maternal depression, we see that in many cases the effect size of permanent income decreases, but remains statistically significant and large relative to maternal verbal intelligence. In addition, the effect of income often compares favorably to either the *HOME* score or maternal depression. When considering the full sample, for example, only income effect sizes for MDI and positive behavior are statistically indistinguishable from zero, and the average income effect size remains 52.7 percent as large as maternal PPVT even after controlling for the home environment and maternal depression. Using the poor and nonpoor subsamples, the average effect size of permanent income is approximately 155 percent larger (driven primarily by the disparity in effect sizes when examining MDI) and 47.2 percent smaller than mother's verbal intelligence, respectively.

Another method of evaluating the salubrious effects of income is to compare the relative impact of additional income with interventions for children in poverty. The

21. Results are similar using partial correlations.
22. Effect sizes for mother's PPVT and permanent income estimated from the entire sample are significantly different for MDI, school readiness, language comprehension, positive behavior, and *HOME*.
23. Using the poor subsample, only negative behavior yields statistically indistinguishable effect sizes for mother's PPVT and permanent income.
24. From results not reported, we found that permanent income-to-needs is an equally strong predictor of child outcomes and the *HOME* score relative to other control variables (particularly mother's PPVT) for children living in poverty.
25. Effects sizes for mother's PPVT and permanent income are significantly different for each outcome and the *HOME* score when evaluating the nonpoor subsample.

Table 5
Comparison of Standardized Coefficients and Relative Effect Sizes[a]

Income Measures	Cognitive				Language				Behavior				
	MDI[b]		School Readiness[c]		Language Comprehension[c]		Expressive Language[c]		Negative Behavior[d]		Positive Behavior[d]		*HOME*[e]
All children													
Permanent family income	0.119*	0.013	0.198*	0.137*	0.185*	0.131*	0.150*	0.102*	–0.139*	–0.058*	0.100*	0.011	0.197*
	[0.130*]	[0.012]	[0.208*]	[0.144*]	[0.208*]	[0.145*]	[0.153*]	[0.099*]	[–0.125*]	[–0.055*]	[0.096*]	[0.010]	[0.206*]
Mother's PPVT	0.138*	0.062*	0.239*	0.146*	0.315*	0.230*	0.218*	0.147*	–0.153*	–0.084*	0.190*	0.144*	0.229*
	[0.136*]	[0.055*]	[0.243*]	[0.145*]	[0.320*]	[0.234*]	[0.208*]	[0.133*]	[–0.131*]	[–0.075*]	[0.170*]	[0.129*]	[0.236*]
HOME		0.155*		0.317*		0.289*		0.238*		–0.077*		0.152*	
		[0.136*]		[0.311*]		[0.299*]		[0.219*]		[–0.071*]		[0.140*]	
Mother's depression		–0.009		–0.017		–0.021		–0.034		0.343*		–0.209*	
		[–0.009]		[–0.020]		[–0.026]		[–0.036]		[0.340*]		[–0.216*]	
Poor children													
Permanent family income	0.148*	0.110*	0.179*	0.127*	0.166*	0.111*	0.142*	0.091*	–0.199*	–0.147*	0.076*	0.006	0.417*
	[0.186*]	[0.099*]	[0.198*]	[0.141*]	[0.193*]	[0.126*]	[0.149*]	[0.093*]	[–0.197*]	[–0.149*]	[0.082*]	[0.007]	[0.279*]
Mother's PPVT	0.111*	0.017	0.278*	0.186*	0.302*	0.188*	0.250*	0.159*	–0.192*	–0.153*	0.258*	0.180*	0.320*
	[0.129*]	[0.015]	[0.287*]	[0.184*]	[0.308*]	[0.187*]	[0.244*]	[0.143*]	[–0.176*]	[–0.138*]	[0.242*]	[0.168*]	[0.199*]
HOME		0.205*		0.367*		0.347*		0.279*		–0.062		0.202*	
		[0.183*]		[0.362*]		[0.347*]		[0.259*]		[–0.060]		[0.198*]	
Mother's depression		–0.060		–0.023		–0.038		–0.062		0.264*		–0.204*	
		[–0.060]		[–0.027]		[–0.045]		[–0.065]		[0.268*]		[–0.217*]	

Nonpoor children													
Permanent	0.049	0.030	0.119*	0.115*	0.110*	0.104*	0.089*	0.073*	–0.070*	–0.045	0.045	0.016	0.072*
family	[0.054*]	[0.029]	[0.139*]	[0.123*]	[0.139*]	[0.119*]	[0.092*]	[0.074*]	[–0.066*]	[–0.048]	[0.045]	[0.017]	[0.087*]
income													
Mother's	0.123*	0.082*	0.185*	0.129*	0.289*	0.244*	0.166*	0.129*	–0.103*	–0.057	0.120*	0.120*	0.145*
PPVT	[0.125*]	[0.079*]	[0.202*]	[0.132*]	[0.315*]	[0.260*]	[0.172*]	[0.124*]	[–0.092*]	[–0.057]	[0.113*]	[0.115*]	[0.173*]
HOME		0.089*		0.251*		0.239*		0.168*		–0.057		0.087*	
		[0.086*]		[0.258*]		[0.262*]		[0.166*]		[–0.059]		[0.086*]	
Mother's		–0.024		–0.030		–0.003		–0.003		0.377*		–0.208*	
depression		[–0.025]		[–0.034]		[–0.004]		[–0.003]		[0.373*]		[–0.209*]	

Note: * indicates statistical significance, $p \leq 0.05$. Sample size varies by outcome and specification. For all specifications that include *HOME* and maternal depression, only 36-month outcomes are included, except for MDI which includes only 15-month outcomes. Not included for brevity are standardized coefficients and partial correlations for age of child, child's gender, and mother's ethnicity.

a. Both random-effects coefficients and partial correlations [in brackets] are reported.

b. MDI assessed at 15 and 24 months (average sample size = 1,411).

c. School readiness (average sample size = 716) and language outcomes (average sample size = 733) assessed at 36 months only.

d. Behavioral outcomes assessed at 24 and 36 months (average sample size = 1,458).

e. *HOME* assessed at 6, 15, and 36 months (average sample size = 2,183).

U.S. Department of Health and Human Services (HHS 2002) reports effect size estimates from an experimental evaluation of Early Head Start. This evaluation is a useful comparison for our analyses, primarily because children were enrolled from birth through 36 months at which time child outcomes were assessed. HHS examines two outcomes that appear in the SECC data: MDI and negative behavior.[26] HHS reports that children who participate in Early Head Start experience, on average, a 12.0–14.9 percent of an SD increase in MDI and a 10.2–10.8 percent of an SD decline in negative behavior compared with similar children who did not participate. Our results in Table 5 for poor children, the appropriate comparison group, reveal comparable effects of increases in permanent income. Specifically, a one SD increase in permanent income results in a 14.8 percent of an SD improvement in MDI and a 19.9 percent of an SD decline in negative behavior. Thus, it appears, at least within the SECC sample, that the effects of redistributional policies designed to permanently increase the financial resources of poor families by approximately $13,108 per year (equivalent to a one SD increase in permanent annual income for poor families) would likely be similar to those effects associated with intervention, particularly participation in Early Head Start. Interestingly, the 2002 per-child program cost of Early Head Start, in 1991 dollars, was approximately $13,970 (HHS 2002), only slightly greater than our poor subsample's standard deviation in permanent annual income.[27]

In conclusion, although estimates of the impact of family economic resources on child outcomes are small in absolute magnitude, they are large in relative magnitude, both within our study and across studies that examine the effectiveness of intervention for children living in poverty. When nonlinearity in, and effect sizes for, the income effect are evaluated, the association between family economic resources and developmental outcomes appears to have practical importance.

V. Conclusion

Economists and developmental psychologists are interested in assessing the practical importance of child, family, and neighborhood characteristics in determining children's cognitive, language, and social development. This paper focuses on the absolute and relative importance of family economic status in the determination of child outcomes and the quality of the home environment for young children. Using a data set from the NICHD Study of Early Child Care that contains state-of-the-art measures of child development, we find that economic resources are important when properly compared with other well-established determinants of developmental outcomes in children, particularly maternal verbal intelligence, and when compared with established interventions, such as Early Head Start. The relative strength of the income effect is even more dramatic for children living in poverty.

26. More specifically, HHS examines only the CBCL as a composite instrument.
27. The Administration for Children and Families Head Start Bureau *(http://www.acf.hhs.gov)* reports the 2002 per child annual cost of Early Head Start to be $10,544. The $13,970 program cost we calculate adjusts for inflation and takes into account the 1.75-year average enrollment in Early Head Start (HHS 2002).

With respect to public policy, many have used the small absolute size of estimated income effects to argue that redistributional policy designed to generate enough additional resources to elicit significant improvement in developmental outcomes is prohibitive. While this may be the case, mandates concerning the allocation of such additional income that would restrict families in their use of these additional resources (for example, vouchers for high-quality childcare) could yield much larger gains in developmental outcomes than have been measured. Additionally, we argue that researchers should place more emphasis on measuring the relative importance of income, both within and across studies. Although income effects estimated in this study are similar to those estimated by previous researchers, a reasonable accounting of the relative importance of family economic resources, both within our study and compared with Early Head Start, yields far different conclusions.

References

Achenbach, Thomas M., Craig Edelbrock, and Catherine T. Howell. 1987. "Empirically Based Assessment of Behavioral/Emotional Problems of 2- and 3-Year-Old Children." *Journal of Abnormal Child Psychology* 15(4):629–50.

Aughinbaugh, Alison, and Maury Gittleman. 2001. "Does Money Matter? A Comparison of the Effect of Income on Child Development in the United States and Great Britain." Unpublished.

Baron, Reuben M., and David A. Kenny. 1986. "The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations." *Journal of Personality and Social Psychology* 51(6):1173–82.

Bayley, Nancy. 1993. *Bayley II Scales of Infant Development*. New York: Psychological Corporation.

Blau, David M. 1999. "The Effect of Income on Child Development." *Review of Economics and Statistics* 81(2):261–76.

Blau, David M., and Alison P. Hagy. 1998. "The Demand for Quality in Child Care." *Journal of Political Economy* 106(1):104–46.

Bracken, Bruce A. 1984. *Bracken Basic Concept Scale*. San Antonio, Tex.: Psychological Corporation.

Bradley, Robert H., Robert F. Corwyn, Harriette P. McAdoo, and Cynthia Garcia Coll. 2001. "The Home Environments of Children in the United States Part I: Variations by Age, Ethnicity, and Poverty Status." *Child Development* 72(6):1844–67.

Caldwell, Betty, and Robert Bradley. 1984. *Home Observation for Measurement of the Environment*. Little Rock, Ark.: University of Arkansas at Little Rock.

Ceci, Stephen J., Tina Rosenblum, Eddy de Bruyn, and Donald Y. Lee. 1997. "A Bio-Ecological Model of Intellectual Development: Moving Beyond H2." In *Intelligence, Heredity, and Environment*, ed. R. J. Sternberg and E. Grigorenko, 303–22. New York: Cambridge University Press.

Cho, Maeng J., Eve K. Moscicki, William E. Narrow, and Donald S. Rae. 1993. "Concordance between Two Measures of Depression in the Hispanic Health and Nutrition Examination Survey." *Social Psychiatry and Psychiatric Epidemiology* 28(4):156–63.

Conger, Rand D., Katherine J. Conger, and Glen H. Elder. 1997. "Family Economic Hardship and Adolescent Adjustment: Mediating and Moderating Processes." In *Consequences of Growing Up Poor*, ed. Greg J. Duncan and Jeanne Brooks- Gunn, 288–310. New York: Russell Sage Foundation.

Conoley, Jane C., James C. Impara, and Linda L. Murphy, eds. 1995. *The Twelfth Mental Measurements Yearbook*. Lincoln, Neb.: Buros Institute of Mental Measurements.

Currie, Janet. 1998. "The Effect of Welfare on Child Outcomes." In *Welfare, the Family, and Reproductive Behavior: Research Perspectives*, ed. Robert A. Moffitt, 177–204. Washington, D.C.: National Academy Press.

———. 2001. "Early Childhood Education Programs." *Journal of Economic Perspectives* 15(2):213–38.

Dearing, Eric, Kathleen McCartney, and Beck A. Taylor. 2001. "Change in Family Income-to-Needs Matters More for Children With Less." *Child Development* 72(6):1779–93.

Duncan, Greg J., and Jeanne Brooks-Gunn. 1997. "Income Effects across the Life Span: Integration and Interpretation." In *Consequences of Growing Up Poor*, ed. Greg J. Duncan and Jeanne Brooks-Gunn, 596–610. New York: Russell Sage Foundation.

———. 2000. "Family Poverty, Welfare Reform, and Child Development." *Child Development* 71(1):188–96.

Dunn, L.M., and L.M. Dunn. 1981. *Peabody Picture Test—Revised Manual for Forms L and M*. Circle Pines, Minn.: American Guidance Service.

Elder, Glen H., Tri V. Nguyen, and Avshalom Caspi. 1985. "Linking Economic Hardship to Children's Lives." *Child Development* 56(2):361–75.

Heckman, James J., and Burton Singer. 1984. "A Method for Minimizing the Impact of Distributional Assumptions in Economic Models for Duration Data." *Econometrica* 52(2):271–320.

Hogan, Anne E., Keith G. Scott, and Charles R. Bauer. 1992. "The Adaptive Social Behavior Inventory (ASBI): A New Assessment of Social Competence in High-Risk Three-Year-Olds." *Journal of Psychoeducational Assessment* 10(3):230–39.

Hu, Wei-Yin. 1999. "Child Support, Welfare Dependency, and Women's Labor Supply." *Journal of Human Resources* 34(1):71–103.

Laughlin, Timothy. 1995. "The School Readiness Composite of the Bracken Basic Concept Scale as an Intellectual Screening Instrument." *Journal of Psychoeducational Assessment* 13(3):294–302.

Levy, Dan, and Greg J. Duncan. 2001. "Using Sibling Samples to Assess the Effect of Childhood Family Income on Completed Schooling." Unpublished.

Mangiaracina, John, and Michael J. Simon. 1986. "Comparison of the PPVT-R and WAIS-R in State Hospital Psychiatric Patients." *Journal of Clinical Psychology* 42(5):817–20.

Mayer, Susan. 1997. *What Money Can't Buy: Family Income and Children's Life Chances*. Cambridge, Mass.: Harvard University Press.

McCartney, Kathleen, and Robert Rosenthal. 2000. "Effect Size, Practical Importance, and Social Policy for Children." *Child Development* 71(1):173–80.

Mocan, H. Naci, and Erdal Tekin. 2003. "Nonprofit Sector and Part-Time Work: An Analysis of Employer-Employee Matched Data of Child Care Workers." *Review of Economics and Statistics*, Forthcoming.

Mroz, Thomas A. 1999. "Discrete Factor Approximation in Simultaneous Equation Models: Estimating the Impact of a Dummy Endogenous Variable on a Continuous Outcome." *Journal of Econometrics* 92(2):193–232.

Mroz, Thomas A., and David Guilkey. 1992. "Discrete Factor Approximations for Use in Simultaneous Equation Models with both Continuous and Discrete Endogenous Variables." Published.

NICHD Early Child Care Research Network. 1999. "Child Outcomes When Child Care Center Classes Meet Recommended Standards for Quality." *American Journal of Public Health* 89(7):1072–77.

Radloff, Lenore S. 1977. "The CES-D Scale: A Self-Report Depression Scale for Research in the General Population." *Applied Psychological Measurement* 1(3):385–401.

Reynell, Joan. 1991. *Reynell Developmental Language Scales* (U.S. ed.). Los Angeles: Western Psychological Service.

Sattler, Jerome M. 1988. *Assessment of Children* (3 ed.). San Diego, CA: Sattler.

Scarr, Sandra. 1997. "Behavior-Genetic and Socialization Theories of Intelligence: Truce and Reconciliation." In *Intelligence, Heredity, and Environment*, ed. R. J. Sternberg and E. Grigorenko, 3–41. New York: Cambridge University Press.

Shea, John. 2000. "Does Parents' Money Matter?" *Journal of Public Economics* 77(2):155–84.

Silva, Phil A. 1986. "A Comparison of the Predictive Validity of the Reynell Development Language Scales, the Peabody Picture Vocabulary Test and the Stanford-Binet Intelligence Scale." *British Journal of Educational Psychology* 56(2):201–04.

U.S. Bureau of the Census. 1999. *Poverty Thresholds*. Washington, D.C.: U.S. Census.

U.S. Department of Health and Human Services. 2002. *Making a Difference in the Lives of Infants and Toddlers and Their Families: The Impacts of Early Head Start: Executive Summary*. Washington, D.C.: HHS.

Weinberg, Bruce A. 2001. "An Incentive Model of the Effect of Parental Income on Children." *Journal of Political Economy* 109(2):266–80.

Zucker, Steven, and Jean Riordan. 1988. "Concurrent Validity of New and Revised Conceptual Language Measures." *Psychology in the Schools* 25(3):252–56.