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DISCUSSION PAPER SERIES

IZA DP No. 16212

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ABSTRACT

Baby Bump? Birth Month, Family Income, and Early Childhood Development

Federal and state tax policies in the U.S. are save families with babies born just before the end of the year thousands of dollars in tax liability. Because this income windfall is realized during the first few months of a newborn's life, we assess whether babies born in December experience developmental advantages in early childhood compared to those born right after the New Year. Using data from the Child Development Supplement of the Panel Study of Income Dynamics and the Children of the National Longitudinal Survey of Youth we implement a regression discontinuity design that exploits variation in birth timing. We show that while children born in December have a weight disadvantage of 0.17 pounds at birth compared to those born in January, they have an average weight-gain advantage of between 0.6 to 1.2 pounds (0.07 to 0.14 standard deviations) during subsequent follow-up interviews. We also find that end-of-year babies reach early developmental milestones faster, but exhibit no advantage in memory, word recognition or applied problem solving. Finally, we illustrate the tax savings received by families with end of year babies are substantial and are consistent with the end-of-year birth developmental advantage.

JEL Classification: J13, D1

Keywords: child development, income, EITC

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Each year news outlets report on the first baby born after 12:00 am on January 1 in local hospitals as a human-interest story symbolizing and welcoming the New Year. While the newborn receiving the attention is a cause for celebration of the year to come, the baby's parents missed out on a small income windfall that they would have received in tax credits, deductions, and exemptions if the child had been born just a few minutes earlier. In 2021 a single parent with adjusted gross income below $112,500 was eligible for a non-prorated $3,600 tax credit for the first calendar year in which her baby was born. The family would also be eligible to claim the child as a full-year dependent for the purposes of tax deductions. Additionally, depending on family circumstances and state of residence, a child born in December can result in thousands of additional dollars in income from federal and state earned income tax credit (EITC) and child tax credit (CTC) programs. LaLumia et al. (2015) estimate that a married couple with an adjusted gross income of $16,000 would have received $3,692 in additional income from tax credits, deductions, and exemptions for a baby born on December 31, 2005, rather than January 1, 2006. Indeed, the financial benefit due to an end-of-year baby is sufficiently large that some parents induce delivery and schedule non-emergency Caesarian section births to receive them (Schulkind and Shapiro, 2014).

While income windfalls are welcome in any circumstance, for the parents of a newborn the extra income might afford better nutrition, improved living conditions, preventative healthcare, or the opportunity to stay at home with their child for longer periods before returning to work very early in the child's life. Previous work has found that income windfalls as small as $1,000-$2,400 during infancy and childhood reduce preventable hospitalizations, accidents, and respiratory-related emergency department visits; improve home environment quality; reduce child behavioral problems; and improve mother-assessed child health (Deutscher and Breunig, 2018; Averett and Wang, 2018; Hamad and Rehkopf, 2016; Rostad et al., 2020).

In this paper, we consider whether babies born just before the end of the year experience developmental advantages in early childhood, compared to those born right after the New Year, and whether any differences are consistent with financial benefits received by having an end-of-the-year baby. Our paper contributes to two strands of literature on early childhood development. First, we add to what is known about the impact of a child's month of birth on birthweight and early childhood outcomes. The month a child is born has long been known to be related to birthweight (Roberts and Tanner, 1963; Selvin and Janerich, 1971). Babies born in winter months are lighter on average than those born in other seasons. This pattern has been attributed to differences in weather and daylight while in utero (Gortmaker et al., 1997), seasonal variation in maternal nutrition and exposure to illness (Barker, 2001), and birth timing among more socioeconomically advantaged mothers with a preference for giving birth in summer months (Buckles and Hungerman, 2013). In addition to affecting birthweight, season of birth has also been linked to longer term outcomes, including educational attainment and life expectancy (Angrist and Krueger, 1991; Doblhammer et al., 2005). While this literature has established that babies born in winter months have worse outcomes across the lifecycle, we advance work on month-of-birth effects by assessing whether those born in December fare better in early childhood than those born in January.

Our work is also relevant to the literature on family resources and early childhood outcomes. Household income is positively associated with early childhood outcomes, including child health, behavior, and cognitive development (Kuehnle, 2014; Propper, Rigg, and Burggess, 2007; Case, Lubotsky, and Paxson, 2002; Yeung, Linver, and Brooks-Gunn, 2002). There are many potential pathways through which income is related to childhood outcomes, including parental health (particularly maternal mental health) and investments in child development, family socioeconomic status (SES), neighborhood and home environment, and healthcare access (Kuehnle, 2014; Propper, Rigg, and Burggess, 2007; Yeung, Linver, and Brooks-Gunn, 2002). Recent work has sought to examine the relationship between family income and early childhood outcomes by estimating the causal effect of cash transfers on child health and development as well as on parental behaviors and investments. This work has shown that relatively small positive income shocks can result in improved prenatal care, reduced smoking among pregnant women, longer gestation and higher birthweight, improved food security, higher long-run family income, fewer accidents and preventable hospital and emergency room visits, fewer child behavioral problems and better child mental health, increased time spent on child enrichment activities, improved test scores, and increased subjective measures of child health (Barr et al., 2022; Hoynes, Miller, and Simon, 2015; Markowitz et al., 2017; Deutscher and Breunig, 2018; Averett and Wang, 2018; Hamad and Rehkopf, 2016; Rostad et al., 2020; Milligan and Stabile, 2011; Rehkopf, Strully, and Dow, 2014; Morrissey, 2022). Though the evidence in these areas is encouraging, estimates of the magnitude and duration of the benefits vary widely. Further, evidence is unclear on whether the effects of additional income on child outcomes vary with the age of the child. Our paper focuses on the effect of positive income shocks received in the first year of life on measures of early child development (before age five), which have received less attention than income transfers during pregnancy and school age.

In this paper, we examine the role that month of birth, and any subsequent income windfalls associated from having a child born at the end of the tax year, play in improving early child development as measured by weight gain and cognitive skills. Although long-term effects of these income shocks have been considered by past research (Barr et al., 2022), no identified studies have assessed how these shocks affect the early childhood outcomes that precede these later life effects. Recently, Barr et al. (2022) have exploited similar variation in early childhood income due to birth timing to assess impacts on later child outcomes. They estimate that income gains due to these tax windfalls result in better reading and math test scores for children in elementary school, a higher likelihood of high school graduation, and a one to two percent increase in young adult earnings. However, this study does not examine how child development is affected by tax windfalls in the short-run and, thus, the mechanisms through which tax windfalls improve later child and later life outcomes remain unclear. Building on this work, our paper augments understanding of how early income shocks immediately alter child development.

We use data from two sources that enable us to track children from birth through early childhood, providing data on month and year of birth along with repeated measures of growth during infancy and early childhood along with limited measures of cognitive development after the age of three. One of our sources of data comes from the 1997 and 2014 cohorts of the Panel Study of Income Dynamics (PSID) Child Development Supplement (CDS). We also use data from the Children of the National Longitudinal Survey of Youth – 1979 cohort (NLSY79). We estimate comparable models for both data sets in which we exploit variation in child month of birth to estimate the effect of birth timing on child development. Specifically, we assess whether children born at the end of the year develop faster than their peers born just after the New Year. We then examine the effect of birth timing on household resources using data on all children born to families in the PSID sample from 1993 to 2018 by assessing whether families of children born at the end of a year have lower tax liabilities compared to families with children born just after the New Year.

Background

Seasonality of Birthweight

It has long been recognized that season of birth is related to birthweight. Historically, babies born in late spring and summer months are heavier than those born in winter (Roberts and Tanner, 1963; Selvin and Janerich, 1971). In a recent study of births in Korea, Sohn (2016) finds that seasonal variation in birthweight has been waning over time. Nonetheless, in the US, the magnitude of seasonal differences in birthweight remains substantively important; for example, Buckles and Hungerman (2013) find that babies born in April weigh 23.3 grams more, on average, than those born in January - about three-fourths of the effect size for participation in a cash welfare program.

There are several hypotheses for why babies born in spring and summer months weigh more. The first is that intake of nutrients and calories among pregnant women varies over the calendar year in ways that affect fetal development. A recent meta-analysis of nutrition studies concludes that human energy intake increases in winter months, as does the consumption of certain fruits and vegetables, while alcohol consumption declines in the winter relative to warm months (Stelmach-Mardas, et al., 2016). Since maternal nutrition is a key determinant of fetal development, these seasonal patterns in maternal nutrition might affect development in utero in ways that favor babies born in summer (Wu et al., 2004; Watson and MacDonald, 2007). A different explanation related to seasonal patterns of external factors during gestation is that fetal growth during the third trimester is not as rapid due to diminished exposure to sunlight and subsequent vitamin D deficiency among women giving birth in the winter (Chodick et al., 2009; Day et al., 2015).

A different explanation for the birthweight advantage of summer babies has nothing to do with seasonal variation in vitamins or nutrients. Rather, there is evidence that selective birth timing on the part of higher-SES mothers means that the average baby born in summer months is more likely to be born to a married mom with more than a high school education and a higher income. Accordingly, the birthweight advantage for summer babies may be due the fact that they are more likely to be born to women who have better information, resources, and agency. Buckles and Hungerman (2013) show that in the US, women giving birth in summer are more educated, more likely to be married, and less likely to be teenagers. The implication here is that higher-SES women are more likely to time childbirth for summer months, perhaps to coincide with school calendars and work schedules. They find that seasonal differences in mothers' characteristics account for a sizeable share of the relationship between month of birth and birthweight.

There is much less work on whether birthweight varies by month within seasons. Roberts and Tanner (1963) find that male babies born in May to September are slightly heavier than comparable babies born in other months but observe no variation in birthweight between these months. Similarly, Day et al. (2015) note that babies born in June, July, and August have higher birthweights, on average, than those born in all other seasons, but they do not report differences in birthweight by month. The only evidence of month-to-month differences in birth outcomes within the same season appears to be between babies born in December compared to January, with December babies born with lower weight due to parents' manipulation of birth timing in response to financial incentives. Using data on all births in the US over a 10-year period, Schulkind and Shapiro (2012) estimate that larger tax benefits hasten delivery, with births just before the New Year leading to younger gestational age at birth among full-term pregnancies. They find this effect to be driven by women with scheduled (rather than emergency) Caesarian sections and inductions. Their estimates suggest that an additional $1,000 in tax benefits shifts one in 75 Caesarian sections and one in 72 inductions from January to December. Consequently, Schulkind and Shapiro (2012) find that babies born in late December have lower birthweight and APGAR scores (a common measure of baby health and vitality at birth) (American Academy of Pediatrics, 2015).

Incentives and Selection

Several studies have examined the role of tax policy in determining birth timing at the margin. Prior to Schulkind and Shapiro (2012), Dickert-Conlin and Chandra (1999) used data from the children of the National Longitudinal Survey of Youth (NLSY) and found that the likelihood a baby is born in December rather than January is correlated with tax savings and credits due to childbirth. They estimate that an additional $500 in tax savings (proposed in the 1997 Tax Relief Act) increases the probability of having baby in the last week of December, rather than the first week of January, by 26.9 percent. In a different setting, Gans and Leigh (2009) study the impact of a one-time bonus paid to Australian parents of babies born on or after July 1, 2004. The payment was over $2,000 (US) and was announced in May of 2004, during the third trimester for some newly eligible moms. Gans and Leigh (2009) estimate that more than 1,000 births were shifted to after July 1 to take advantage of the bonus payment, with most of this due to changes in the timing of inductions and Caesarian sections. For comparison, there were about 670 births per day in Australia at the time of Gans and Leigh's study.

Birth timing also appears to be responsive to non-tax policies that affect family finances. For example, the German government expanded the generosity of maternity benefits for mothers of babies born after January 1, 2007. Since this maternal leave policy only benefited employed women, it provided an incentive for these women to postpone delivery but had no bearing on birth timing among expectant women not in the labor force. Neugart and Ohlsson (2013) exploit this policy introduction and distinction between never-treated vs. newly treated groups in a triple-difference framework. They find strong evidence of shifting birth dates to benefit from the new policy, estimating that the births of at least five percent of babies due the last week of December were shifted to the first week of January.

In the US, the potential tax advantages for having an end-of-year baby are not trivial. December marks the end of the calendar and tax year, so parents of a child born on or before December 31 can immediately claim tax credits and deductions to reduce their tax liability when filing taxes in the New Year. This can mean a boost in income during the early part of the year when tax refunds are received. LaLumia et al. (2015) estimate that a married couple with an adjusted gross income (AGI) of $16,000 would have received $3,692 in additional income from tax credits and exemptions for a baby born on December 31, 2005, as compared to a baby born on January 1, 2006. The tax savings due to a December birth would decline if the family's AGI were higher to just under $2,000 for incomes up to about $112,000 in 2005 and falling to just under $1,000 if the family's AGI exceeded about $140,000. LaLumia et al. (2015) use the universe of all US tax returns filed between 2001 and

2010 to assess whether parents time the delivery of their children to take advantage of these tax savings. Like Schulkind & Shapiro (2012), they find evidence of a small, positive effect of tax incentives on the likelihood of a December rather than January birth, estimating that an additional $1,000 of tax benefits is associated with about a one-third percentage point increase in the probability of a December birth.

Evidence on Longer-term Effects

Unlike the German and Australian policies, US tax policy provides incentives for parents to hasten delivery, reducing birthweight at the margin. The importance of birthweight on neonatal health is well-known. Low birthweight is an important risk factor for infant mortality, congenital anomalies, developmental delays, and other health problems in early childhood (Institute of Medicine, 1985). There is also evidence that the effects of birthweight persist into early childhood and beyond. Using data on birth certificates matched to school records, Figlio et al. (2014) find that the impact of birthweight on cognitive performance as measures by school assessments is approximately constant through children's schooling, even among twin pairs. Figlio et al. (2014) show that the effects of birthweight on cognitive development persists regardless of family background and school quality. They conclude that the effects of birthweight on downstream outcomes are set very early, raising questions about whether birthweight has direct effects on later outcomes or can be moderated through other early childhood factors.

Since birthweight is an important determinant of child health and development, parents who hasten delivery to take advantage of tax savings do so with some risk. This may be offset by advantages enjoyed by these families. For example, parents who have scheduled c-sections are more likely to have health insurance and have higher incomes (Aron et al., 2000). Because the risk of low birthweight is higher among low-income parents (Starfield et al., 1991), selection of higher income parents into December rather than January births may offset some of the weight differences at birth due to slightly shorter gestational periods.

Income and Early Childhood Development

Indeed, income and family SES are highly important determinants of a child health and development following birth. Early evidence on the role income plays in child health largely comes from cross-sectional data on income and measures of parent-reported child health. Case, Lubotsky, and Paxson (2002) report that the family income to child health gradient is positive and robust. Importantly, they find that the impact of family income on child health increases with child age so that the relationship is weakest among the very youngest children. Currie and Stabile (2003) point out that using cross-sectional data on this question can confound income with incidence of illness. Using data from Canada, they report that children from lower income families are more likely to suffer from chronic conditions, such as asthma, and experience more health shocks, but conditional on illness, they recover or respond in ways that are comparable to children from higher income families. This may be because of universal access to health care in the Canadian setting. In this US context, Condliffe and Link (2008) use data from the Panel Study of Income Dynamics and find that children from low-income families experience more health shocks, and their health status recovers more slowly than their peers from higher income families.

The impact of family income on child development as measured by cognitive performance on assessments administered by survey administrators or schools is unequivocal. The cross-sectional correlations are large and well established. There is also good evidence that changes in family income lead to better learning outcomes for children. Dahl and Lochner (2012) use data from the NLSY and changes in the size of the EITC over two decades and find that a policy-induced family income change of $1,000 raises math test scores by 2.1 percent and reading test scores by 3.6 percent of a standard deviation. Using a regression discontinuity design that exploits the December 31 birth cut off, Barr et al. (2022) use administrative tax data to show that among low-income single-child families, a December birth results in an income boost of about $1,300 or 10 percent during the child's first year of life, relative to a January birth. They estimate that this windfall results in better reading and math test scores, a higher likelihood of high school graduation, and a one to two percent increase in young adult earnings, which may be explained by the effects of family liquidity during infancy on long-run family income.

In a variety of settings, researchers have exploited similar natural experiments to shed light on how income shocks like those from the EITC or tax savings due to an end-of-year birth affect family behavior in ways that benefit child health and development. For example, using the Australian baby bonus as a natural experiment, Deutscher & Breunig (2018) find that the cash transfer decrease preventable hospitalizations and emergency department visits for respiratory problems during the child's first year of life. They conclude that parents spent the extra income on electricity and private insurance, suggesting that these investments improve early childhood health. However, Gaitz & Schurer (2017) use the same natural experiment and determine that children's learning, socio-emotional, and physical outcomes and parental wellbeing and behavior did not change because of the transfers.

In the U.S., several authors have used EITC expansion and state variation to show that a relatively small increase in income positively affects child health and parental behaviors and investments in child development. Specifically, EITC payments have been shown to improve prenatal care, decrease low birthweight, reduce maternal smoking, increase term birth, improve health status for school age children, reduce the likelihood of childhood accidents, and reduce childhood behavioral problems (Averett and Wang, 2018; Baughman and Duchovny, 2016; Hamad and Rehkopf, 2015, 2016; Hoynes et al., 2015). However, there is also evidence that the EITC does not affect child mental or physical health, particularly in the short run (Batra and Hamad, 2021; Hamad et al., 2018). Improvements in parental behavior and investments in child health in the form of reduced food insecurity, increased prenatal care, improvements in insurance quality, reduced smoking and alcohol use, increased breastfeeding, and improvements in home environment have also been found as a result of EITC receipt (Averett and Wang, 2018; Batra and Hamad, 2021; Baughman and Duchovny, 2016; Hamad and Rehkopf, 2016; Hoynes et al., 2015; Markowitz et al., 2017). The CTC has been used similarly to examine how cash transfers affect parental behavior and childhood health. In a longitudinal study, Rostad et al. (2020) find that CTC eligibility is associated with a decrease in likelihood of injuries requiring medical attention and fewer behavioral problems among children but only when the tax credit is partially refundable for families making $3,000 or less in annual income.

In sum, birth month is a predictor of a child's birthweight, and income is an important determinant of early childhood development but also plays a modest role in affecting birth timing for a small number of births. We seek to shed light on a question that has received no attention: Does birth month predict a child's rate of growth beyond birth? In particular, do children born in December (whose families are eligible for tax benefits from the addition of the child shortly after their birth), rather than children born in January (whose families cannot take advantage of these tax benefits until later in their life) develop faster in early childhood? In doing so, we seek to fill a gap in the literature concerning the immediate effects of positive income shocks on development in very early childhood.

Analytic Strategy

Data

To estimate the impact of a December rather than January birth on early childhood outcomes we require data with information on mothers' characteristics, babies' birth timing and health at birth, along with subsequent measures of child growth and development over the first few years of childhood. Few data sets meet these criteria. Two data sets that do in the U.S. are the Child Development

Supplement of the Panel Study of Income Dynamics, and the Child Survey of the National Longitudinal Survey of Youth 1979 (NLSY79).[1] We describe both of these survey data sets as they relate to our empirical strategy, in turn.

1: PSID CDS

The PSID is a long-running panel survey of US families, begun in 1968. The main PSID family data file collects detailed economic, social, and demographic information on sample families and their descendants. Since the original survey, families have been added to the main interview sample as they age and begin their own families. In 1990 the sample was augmented with a supplement to include Latino households (McGonagle et al., 2012). Until 1997, families were interviewed annually. Since then, main family interviews have been conducted biennially. As of 2019, the PSID sample includes more than 26,000 people living in more than 9,000 families.[2]

Beginning in 1997, the PSID began the Child Development Supplement (CDS) to collect additional information on sample children who were then between the ages of 0 and 12 to study the health and development of young children. The 1997 CDS, sometimes called the CDS I, established a cohort of children who were followed with

[1] The Early Longitudinal Childhood Survey – Birth Cohort (ECLS-B) also provides information about birthweight and early childhood development for a nationally representative survey of children (born in the year 2001). In addition to information about the family and child at the time of birth, the ECLS-B collected follow-up information about children's health and development at around nine months, two years, and four years of age (Snow et al., 2007). It later collected information as children age into elementary school. However, since ECLS-B children are all born in 2001, the comparison of children born at the end of a calendar year to those born at the beginning necessarily requires comparing children born 11 months apart. So, it is not possible to use our RD framework to differentiate between end-of-year-birth and age effects.

[2] https://psidonline.isr.umich.edu/Guide/Brochures/PSID.pdf

supplemental interviews in 2002 (CDS II) and 2007 (CDS III) (PSID, 2022). In 2014, the CDS began surveying a new panel of young children. The supplemental CDS interviews were conducted with the primary and secondary caregivers (if applicable) of young children, along with interviews and assessments of sample children at an appropriate age.

In our main analytic models, our focus is on early childhood development. For these analyses we restrict our sample to children in the 1997 and 2014 CDS surveys who were under the age of 5 at the time of assessment. We measure development in early childhood in two ways. First, we rely use measures of weight (in ounces) net of birthweight as a measure of growth during infancy. Weight gain has several advantages in our context. First, the CDS measures the weight of all sample children in all survey years and is the only universal measure of a child's physical growth. Second, unlike reported health, measures of weight gain do not require a physician's visit and the endogeneity issues associated with such measures. Third, weight gain during infancy has been associated with various measures of child development, including cognitive development and educational attainment. "Failure to thrive" or slow weigh gain has received particular attention.[3] A meta-analysis of data on from retrospective and prospective studies concluded that failure to thrive in infancy is associated with adverse intellectual outcomes (Corbett and Druitt, 2004). There is also evidence that weight gain during infancy other than at the lower tail is associated with some measures of development (Corbitt et al., 2007), but whether this

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[3] Failure to thrive is variously defined, including weight for age measured in the 5th percentile on multiple occasions, or weight deceleration that crosses two major percentile lines.

association persists into school age is less clear (Belfort et al., 2008). In addition to data on weight at interview, the CDS administers a subtest of the Woodcock-Johnson Psycho-Educational Battery-Revised (WJ-R). PSID children who were at least three years old at the time of their CDS assessment administered a subtest WJ-R (Woodcock and Mather, 1989). We make use of age-standardized scores on letter/word recognition tests portions of the WJ-R tests. Note these scores measure a combination of cognitive ability and achievement, because they are affected by parent and/or teacher investments in learning. It is also important to recognize that the letter/word recognition assessments are only relevant for older children, so we conduct this supplementary analysis on a subset of our sample.

For analyses that focus on tax liability, we use data from all children born into PSID families in or after 1993 to exploit the additional years of data that are available when we do not require data on early childhood outcomes. The annual/biannual family survey also collects detailed information on family characteristics and income by source. We measure family income as the total income received from all sources by all family members, including income from work, transfer income, and investment income. In years where the family income data is not collected, we estimated family income by taking the average of the previous year and the following year.

2: NLSY79 Child Sample

The NLSY79 cohort began with a nationally representative sample of 12,686 men and women whose ages ranged from 14 to 22 in 1979. The original sample included an oversample of Hispanics and economically disadvantaged non-black youth.[4] The NLSY79 cohort was surveyed annually in person or by telephone until 1994, and then biennially since then. Beginning in 1986, the Child Sample was added, providing detailed information on all children born to female NLSY79 respondents. The NLSY79 respondents who were mothers were surveyed in even numbered years and provided supplemental information on their children's prenatal history and birth, early childhood health and health care, among other items.

As with the PSID-CDS, we restrict our sample to children who were under the age of 5 at the time of assessment. While the PSID-CDS follows two cohorts of children (beginning in 1997 and 2014), the NLSY79 interviewed new and established mothers biennially, and new mothers/babies were added in each wave.[5] As with the PSID-CDS, we use the NLSY79 not as a panel, but each observation is a baby/mother pair, and we measure outcomes at the first relevant interview.

As with the PSID, we use two types of measures of early childhood development from the NLSY79. First, for all the reasons described above, we use a child's weight at follow-up interview. At interview, NLSY mothers were asked "I'd like to find out (CHILD)'s weight. Would you prefer to weigh (him/her) yourself or shall I do it?" We use the weight recorded from this measurement (in ounces), net of birthweight as a measure of growth during infancy. Second, we two measures of cognitive development administered to young children as part of the NLSY follow up

[4] There was also an oversample of those serving in the military, but this was discontinued after the 1984 survey. https://www.bls.gov/nls/nlsy79.htm
[5] While the PSID follows cohorts of babies born to the inclusive sample of PSID mothers, the NLSY79 is an inclusive sample of babies born to a cohort of women (those ages 21 to 29 in 1986).

interviews. The first of these is an age-standardized measure of motor and social development. The NLSY79 MSD assessment include components that a mother completes contingent on her child's age. (NLSY, 1993). One component is appropriate for infants up to three months old, including questions about whether a baby followed a moving object from one side to the other, or has smiled at someone in response to a person talking with or smiling at the child. Mothers interviewed when a child is between 8 and 20 months are asked questions such as whether their child has ever said his or her first and last name with no help. Responses from various components of mothers' assessments are reported in are in age-standardized summary measures of a child's motor and social development (MSD).

We also use a measure administered directly to children between 8 and 24 months old by NLSY researchers in the 1986 and 1988 interviews. Based on Kagan's (1981) theory of development in the second year, children's memory for locations was assessed by having the child watch as an object is placed under one of two to six cups. The cups are then screened from a child's view, and then the child is then asked to find the location of the object. The task is made more difficult with age by increasing the number of cups and/or the length of time during which the cups are hidden. During these waves, the NLSY surveyors also collected data using an assessment intended to measure a child's ability to correctly identify parts of the body. This "parts of the body" measure was validated as a means to assess a one- or two-year-old child's vocabulary knowledge of orally presented words as a means of estimating verbal intellectual development.

Empirical Models

Using these data, we examine whether children born in December develop at a faster rate than their peers born in January. Our empirical models draw on three lessons from the literature. First, birth month affects birthweight, so any early developmental differences associated with birth month could be mediated by birthweight. Second, family characteristics such as parents' marital status, education, and income also affect birthweight and early childhood outcomes. These characteristics also affect the value of any tax savings a family receives because of a December birth. Finally, birth timing is at least partly determined by maternal characteristics and potential tax savings.

To examine the impact of birth timing on early childhood development, we estimate models of a child's weight at the follow-up interview, conditional on weight at birth and age at the time of interview. While we harmonize control variables, we estimate these models separately for the PSID and NLSY samples. We control for various demographic characteristics of the child and mother and family income during the child's year of birth. We estimate end-of-year birthday effects on child's subsequent weight at follow-up interview in a regression discontinuity (RD) framework. To motivate our empirical model, consider that for children born during a 12-month period from July through December in year Y and January through June of the next calendar year (Y+1), we could estimate a model of the following form:

$$O_{ct} = \alpha + \gamma Birthmonth_c + \delta EndofYear_c + \beta_1 Birthweight_c + \beta_2 X_c + \beta_3 P_c + \beta_4 A_{ct} + \mu_t + \epsilon_{ct}$$

Where:

- O_{ct} measures outcome for child c at the time of follow-up (e.g. weight or development score)
- $Birthmonth$ is a forcing variable, re-scaled equal to -5 in July, -4 in August, and so on to 0 in December, and then 1 in January, 2 in March, up to 6 in June
- $EndofYear$ = 1 if the child was born in year Y, and 0 if born in Y+1
- $Birthweight$ is the child's weight at birth (in ounces)
- X_c and P_c are vectors of child and parent characteristics, respectively
- A_{ct} is the child's age (in months) at the time of follow-up, when weight is measured
- μ_t is a cohort fixed effect, relevant for the PSID sample

The re-scaled measure of birth month is a running variable, increasing with child's age (in months) over an artificial year (from July of one year to June of the following year). The coefficient δ provides a test of differences in outcomes at follow-up between children born in second half of year Y, compared to those born in the first half of year Y+1, net of differences in birthweight, demographic characteristics of the child, and demographic and SES characteristics of the parents.

One concern about this specification is that children born in December of year Y are one month older than children born in January of the next year and should be heavier at follow-up as a result. The RD set up provides one reason to dispel this concern: The coefficient on the running variable (γ) measures average increases in weight due to an additional month's age, and the coefficient δ estimates differences in the outcome of interest at the December-January cut-off, net of the typical growth associated with the average month. A second reason is that for both the PSID and NLSY, the timing of follow-up interview varies over the calendar. So, in practice children born in year Y+1 can be older than children born in the prior year when the follow-up interview is conducted and weight is measured. Hence, we include a measure of the child's age at follow-up interview (in months) when weight is measured (A_{ct}). Further, we restrict our sample to children under the age of 5 at the time of follow-up interview. So, our analytic sample includes children of various ages, further de-linking the estimate of the December-January margin from child age.

Another concern is that babies born at the end of the year have an early developmental *dis*advantage; if their parents can successfully time birth to take advantage of tax benefits, these babies may be systematically born at earlier gestational ages with lower birthweights. Controlling for birthweight ameliorates this concern, as we ensure that our analyses of child development net out developmental differences at birth. However, since higher-SES families are better able to manipulate birth timing (Schulkind and Shapiro, 2014) it is also possible that babies born in December are more advantaged than those who are born in January. To address this concern, we control for several measures of parent SES, including mother's marital status at birth, parental education, and whether the mother was a teen at birth, to address potential systematic differences in family advantage between the December and January babies and dispel concerns that developmental differences in these babies are attributable to SES. We do not control for family income at the time of birth because income is affected by child's birth, through the tax savings described above.[6] Finally, because the PSID sample is pooled data from two cohorts born 17 years apart (1997 and 2014), for this sample we include a cohort fixed effect (μ_t) to measure any general changes that might affect child outcomes over time.

We supplement these analyses of the impact of end-of-year births on early childhood development by estimating the same RD model but replacing the outcome of a child's weight at follow-up with measures of cognitive abilities, described above.

Results

In Table 1, we present descriptive statistics for our samples where panel (a) provides summary statistics for our pooled sample from the 1997 and 2014 PSID CDS cohorts, and panel (b) displays comparable information for the children of the NLSY cohort. Recall that we restrict our analyses to children who were under the age of five at the time of follow-up interview. The children in our samples ranged in age from 1 to 59 months and were on average just under three years old (31 months) in the PSID sample and just over 20 months in the NLSY sample.[7] At the time of interview, these

[6] We present results from our main models with birth year income included as a control in Appendix A.
[7] This age difference is an artifact of the sample designs. The first interview for PSID CDS sample children occurred only in 1997 or 2014 for any child under the age of five. The NLSY surveys were conducted bi-annually with any children born between surveys eligible for a first interview.

children weighed between 7 and 71 pounds, with a mean of 30.5 for the PSID sample, and 25.06 for the NLSY sample. At birth, baby weights were comparable across the samples, averaging of 115.9 ounces or about 7.2 pounds for the PSID, and 117.1 ounces (7.3 pounds). The samples are evenly split between girls and boys. In the PSID sample 56.8 percent of children are non-Hispanic white, compared to 54 percent of NLSY children. NLSY children were more likely to be born to married mothers (68.2 percent versus 61.4 percent). This difference is likely due the fact that most of the NLSY children were born in the 1980s, when marriage rates were high (over 10 per 1,000 population) and all PSID children were born in the 1990s or between 2009 and 2014 when marriage rates had fallen to about 6.8 per 1,000, respectively (Curtin and Sutton, 2020). Among PSID children, 14.7 percent were born to teen mothers, compared to 5.7 percent of NLSY children. We measure family income during the year of the child's birth and use the CPI-U to index to 2020 dollars. The mean family income for sample children was $70,192 and $73,480 for the PSID and NLSY samples.[8]

Because we seek to identify the impact of a child's month of birth on weight in early childhood, a first step is assessing how birth month affects a child's weight at birth. In Figure 1, in panel (a) we present the average weight at birth, by month of birth, for all children born into the PSID sample since 1985. Panel b presents the same information for children born to the NLSY sample from 1981 to 2010.[9] Because

[8] For both samples, income is highly skewed, and the median incomes are about two-thirds of the mean.

[9] Less than 1 percent of children of the NLSY cohort (aged 14-22 in 1979) were born after 2000.

of improvements in pre- and neonatal health care, the viability of babies born at low birthweight improved over the period. To net out the secular decline in birthweight, we regressed child's birthweight (in grams) on month-of-birth fixed effects and a linear time trend. Figure 1 presents the expected value of birthweight for each month, along with the corresponding 95 percent confidence interval. In both the PSID and NLSY samples the pattern of birthweight by month of birth in the PSID matches that of Selvin and Janerich (1971), with a late spring early summer peak. We estimate that PSID babies born in May are about 35 grams heavier than average, though the confidence interval overlaps the mean. In the NLSY sample, April and May babies are about 37 grams heavier than average.

As is clear in Figure 1, late year babies are lighter than average. December is the only month in which babies' birthweight is significantly different than the mean in both samples. We estimate babies born in December are about 76 grams lighter than average in the PSID sample, and 44 grams lighter in the NLSY sample. This is about 1.6 to 2.7 ounces. All our models of birth-month effects on child growth control for birthweight, which addresses potential concern that any developmental advantage observed in the December children is merely a "catch-up" effect, as these children reach more similar developmental outcomes to their January peers.

Weight Gain

We next turn to the first outcome of interest: a child's weight at follow-up. To begin understanding how a child's weight at interview varies with age, in Figure 2 we display scatterplots along with linear fits for the relationship between age at interview (x-axis) and measured weight (y-axis) for the PSID sample (panel a) and the NLSY sample (panel b). The slope of the linear fit for the PSID sample is 0.45 and 0.46 for the NLSY sample, implying that for each additional month in age, the average child in the sample is just under one-half a pound heavier. It appears that the age-weight gradient is steeper during the first year, a pattern that is consistent with growth charts.[10] There are also some outliers, with much higher weight than expected. We drop children whose weight is more than 60 pounds before the age of 2.

In Table 2, we present results of the estimation of our models of weight gain during early childhood. The coefficient on the variable measuring an end-of-year birth represents the discontinuity in weight gain for children born in December rather than January, net of a child's age at interview and the forcing variable measuring month of birth, as described above. In columns 1 and 3, we estimate these models with no controls for child and family characteristics for the PSID and NLSY samples, respectively. Columns 2 and 4 present results from models including these measures. Notably, the coefficients of determination are nearly identical between samples, which provides some reassurance of the model's predictive power. Also of note is that the standard errors for coefficients are smaller for models estimated using the NLSY data because of its larger sample size.

Consistent with the gradients in Figure 1, on average children in both samples gain approximately 0.46 pounds per month. The coefficient of interest is on the indicator of end-of-year birth. For the PSID sample, in column 1 we estimate that on

[10] https://www.cdc.gov/growthcharts/clinical_charts.htm

average a child born in December gains 1.18 pounds more than a comparably aged child born in December, a marginal statistically significant difference. In column 2, we add controls for child and family characteristics, and our estimate of weight-gain advantage for children born at the end of the year changes little, to 1.23 pounds. This is a sizeable advantage, about 0.14 standard deviations. Recall that December babies started out with a weight disadvantage at birth of about 0.17 pounds. The subsequent weight-gain advantage more than offset this initial disadvantage. We estimate smaller weight gain advantage for end-of-year babies in the NLSY sample of 0.55 pounds. This is about 0.06 standard deviations of weight at the time of interview.

While we find similar patterns between the PSID and NLSY samples in Table 2, the estimated effects differ in magnitude. One explanation of these differences is that the NLSY cohort was born before many of the tax advantages that benefit families with end-of-year births, and the smaller income boost is consistent with smaller weight gains in infancy. An alternative interpretation of these differences is sampling error. The NLSY sample is a population-representative sample of girls and young women between 14 and 22 in 1979, while the PSID sample inclusion rules are based on links to sample families in the late 1960s. A final interpretation of these differences is that they are not materially important. A t-test of differences in the two coefficients fails to reject the null that they were drawn from the same distribution (t = 0.98).

We also assess whether the impact of end-of-year birth on weight gain changes over the course of early childhood. To do so, we augment the RD model by interacting the treatment variable with a child's age at interview to estimate the impact of an end-of-year birth at 60 different ages (each month from birth to age 5). We present the regression adjusted weight difference for each of these months between a child born in December with an identically aged child born in January in Figure 3. The top (bottom) panel presents estimates from the PSID (NLSY) sample. For the PSID sample, the average weight gain advantage of December babies compared to January babies displays no clear rise/fall with age at follow up. The estimated average weight difference between the groups is around the coefficient estimate from Table 2. There is weak evidence that the end-of-year birth weight gain advantage is largest in early childhood. In the NLSY sample, we estimate larger than average weight gain advantages during the first 12 months, but these differences are statistically significant in only 4 of 12 months. By the age of 40 months and above, end-of year babies are more likely to be lighter than their peers born in January

Cognitive Abilities

We next turn to analyses of month of birth on early childhood outcomes beyond weight gain. As described above, the NLSY administered a composite measure of motor, social and emotional development of key milestones of development from birth to the age of 4, and a memory for locations assessment for children aged 8 to 23 months to measure short-term memory. We use scores on these assessments for age-appropriate children in the NLSY sample. The PSID included assessments of letter-word identification, symbolic learning skills, and applied problem solving and math concepts for children starting at the age of three (Duffy and Sastry, 2014). We use scores on these letter-word recognition and applied problem-solving assessments as measure of cognitive abilities for CDS children between three and five years old. Children's scores on these assessments are standardized by age using the performance of subjects in the same age group to WJ-R norm samples.

In Table 3, we present results from models in which the dependent variables are measures of cognitive skills from these various assessments. Other than the change in outcome and the consequent restriction of the sample to children old enough to be assessed, the models are identical to those used to measure weight gain above. We report results ordered by child age at the time of assessment, with the columns presenting estimates of end-of-year birth on: 1) Motor/social/emotional development; 2) Memory for location; 3) Letter-word recognition scores, and 4) Applied problem-solving. The only outcome for which we find any evidence of a cognitive development advantage for end of year babies is the measure of motor, social and emotional development. We estimate that children born in December score 32 points higher than a comparably aged child born in January. This composite score is measures on a thousand-point scale, with a mean of 510 and a standard deviation of 283, so this is an effect size of 0.11, or about 0.06 of the mean.

We find no evidence that children born at the end of the year perform better on memory for location or WJ-R assessments. The coefficients on the month-of-birth forcing variable are negative but not significant for memory for location and the letter-word recognition and applied problem-solving assessments. The coefficient on the end-of-year birth indicator is negative in all three columns but the standard errors are large. Unlike previous results for weight gain, family income is highly predictive (positively) of child performance on the WJ-R assessments. This may reflect the importance of income as a mechanism for early childhood investments in the development of reading and math skills that overshadows any effects of birth timing advantages three to five years prior to assessment.

In sum, we find evidence that children born at the end of the calendar year are quicker to meet milestones for social, motor, and emotional development. We do not find any impacts on short term memory in early childhood, or on assessments of letter/word recognition or problem solving.

Discussion

In this paper we find that children born at the end of the year have a small physical developmental advantage compared to those born at the beginning of the year. Because of variation in the timing of follow-up interview, we distinguish month-of-birth effects separately from child age at assessment and find that end-of-year babies gain weight faster than beginning-of-year babies. We estimate that end of year babies gain approximately 0.55 to 1.23 pounds more by follow up compared to observationally identical children born early in the calendar year. We find weak evidence that end of year birth results in faster cognitive development. While end of year babies meet milestones for social, motor, and emotional development sooner, we find no impacts on short term memory in early childhood, or letter/word recognition or problem solving.

Here, we assess the robustness of our results, as well as assess the plausibility of income associated with birth timing as a mechanism. As a falsification check, we examine whether attributes of families that could affect child development are themselves related to birth timing. We check whether there are discontinuities at the end-of-year cutoff in family demographics and composition, or characteristics of the mother. In Table 4, we report results for the forcing and end-of-year birth variables from our regression discontinuity models in which we sequentially substitute child/family control variables in place of the dependent variable. For both the PSID and NLSY samples, we find no evidence of discontinuities in a child race/ethnicity, maternal age at birth, birth order, or parental education. For the NLSY sample but not the PSID sample, babies born at the end of the calendar year were less likely to have married mothers. With null effects of birth timing on demographic or social characteristics in 9 of the 10 estimates, it appears that the December weight gain advantage is attributable to end-of-year birth, rather than another variable correlated with birth timing. This falsification exercise further ameliorates concerns that the weight gain advantage we identified is driven by families (particularly those who are high SES) manipulating birth timing to take advantage of tax windfalls. Indeed, the only significant difference we find is that NLSY mothers of December babies are economically disadvantaged, relative to mothers of January babies.

Next, to evaluate whether income windfalls are associated with end-of-year births, we assess how a family's tax liability is affected by the timing of their child's birth. The addition of a new child to a family can change eligibility for tax credits, such as the EITC and the CTC, and the number of dependent exemptions claimed for the tax year of a child's birth. We quantify the value of these benefits for the PSID sample using information on family income, state of residence, and composition to estimate tax liability, measured in 2020 dollars. We focus on the PSID here, because CDS children were born during the period when the federal and state EITC were available or implemented. As this analysis does not require information on birth and early childhood outcomes, we exploit additional years of PSID data by expanding our analysis beyond the CDS. Specifically, we employ the National Bureau of Economic Research (NBER)'s TAXSIM[11] program to estimate family tax liability for all PSID families with children born between 1993 to 2018. We use data on family rental and childcare expenses; income from transfers, unemployment insurance, pensions, dividends, property, wages, alimony, and social security insurance; and family compositional characteristics, including parental marital status, state of residence, number of dependents, and parental age from the PSID to calculate estimated state, federal, and total (combined state and federal) tax liability for the relevant year of filing.

The thought experiment we have in mind for measuring changes in tax liability associated with an end-of-year birth is as follows: A baby born in January of year Y has the same effect on their family's tax liability in year Y as a baby born in December of year Y-1. But the baby born in December of Y-1 also affects the family's tax liability in year Y-1, while the January baby does not. To estimate the average

[11] See Feenberg & Coutts (1993). The latest version of TAXSIM can be accessed at taxsim.nber.org.

impact of birth timing on household resource, we replicate our RD model, but change the dependent variable to tax liability in the year a child was born for families of children born at the end of year (year Y) and the year before a child was born for families of children born at the beginning of the year (year Y-1). We regress tax liability in the year of interest on the birth-month forcing variable and end-of-year-birth variable, controlling for family income in the 9-months preceding birth.

We present the results of this test of how PSID families' tax liability changed based on birth timing in Table 6. We estimate that an end-of-year birth decreases state tax liability by $1,975.81 and total tax liability by $5,597.85 for PSID families, although the estimate of total tax liability is marginally statistically significant. This suggests that having a child does reduce tax liability, which indicates greater household resources during a child's first year of life for families with a child born at the end of the year, compared to families with a child born at the beginning of year. These estimates are comparable to those from previous research using tax records. For example, when adjusted for inflation LaLumia (2015) estimates that a married EITC eligible couple would save just about $5,000 in tax liability due to an end-of-year birth. Our estimates for the PSID sample are somewhat larger than those estimated by Barr et al. (2022) and LaLumia (2015), but our sample includes families throughout the income distribution, not just EITC eligible households.

Conclusion

Using data from the PSID and the NLSY and a RD design that exploits variation in birth timing, we show that while children born in December have a slight weight disadvantage at birth, they have a weight-gain advantage by follow up of between 0.55 and 1.23 pounds, compared to those born in January. This advantage is not trivial; it is about 0.06 to 0.14 standard deviations. This is the first study to identify month-of-birth effects on child development during early childhood.

Our findings are relevant to recent work by Barr et al. (2022), who find that children born at the end of the year perform better on tests of achievement in elementary school, are more likely to graduate from high school, and have better labor market outcomes in adulthood than comparable children born at the beginning of the year. We find that the developmental advantages associated with an end-of-year birth are apparent in infancy, suggesting this could play a role in shaping later-life outcomes. Relatedly, using data on birth certificates matched to administrative education and unemployment insurance data in Florida, Figlio et al. (2014) find that early childhood health as measured by birthweight conveys advantages in academic achievement that are effectively constant across grades and invariant to measures of school quality and family attributes. Our findings suggest weight gain in early infancy may convey a similar persistent advantage in later development.

Although we find an end-of-year birth weight gain advantage, we find little evidence of differences in cognitive skills: with end-of-year babies reaching early developmental milestones faster, but exhibiting no advantage in memory or WJ-R subtests on letter/word recognition and applied problem solving. We do not consider these findings to be in conflict with the effects on elementary school test scores identified by Barr et al. (2022), because the assessments used in this analysis measure different concepts at a different developmental stage. Specifically, elementary school test scores may reflect factors other than cognition, such as school attendance, skill acquisition, etc. to a greater degree than WJ-R scores assessed at age three. Moreover, our null findings could be due small sample size (N = 326 for analyses using PSID children).

The weight-gain advantage that we observe during infancy may be driven by increases in household resources in very early childhood. Like previous work (Barr et al., 2022; LaLumia et al., 2015), we find that families whose child is born at the end of the year have reduced tax liability of about $5,600, compared to those whose child is born at the beginning of the year. While we aren't able to directly test whether this positive income shock is driving the weight-gain advantage, there is evidence that similarly sized income shocks are beneficial for other measures of child development (Barr et al., 2022; Hoynes, Miller, and Simon, 2015; Markowitz et al., 2017; Deutscher and Breunig, 2018; Averett and Wang, 2018; Hamad and Rehkopf, 2016; Rostad et al., 2020; Milligan and Stabile, 2011; Rehkopf, Strully, and Dow, 2014; Morrissey, 2022). So, the additional household resources during a child's first year of life from the tax benefits of an end-of-year birth could explain some of the developmental advantage. Our findings contribute to the body of evidence that family income is an important determinant of development in early childhood.

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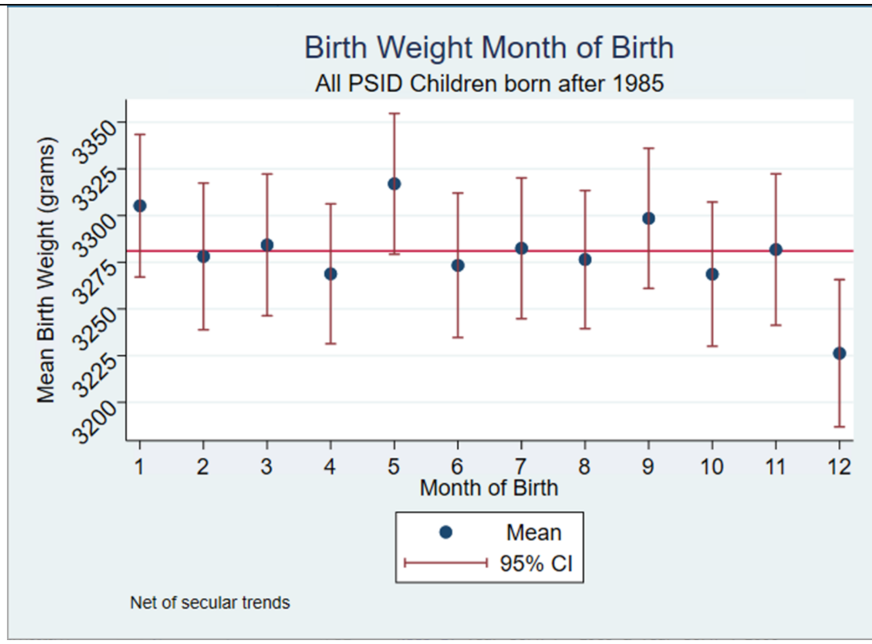
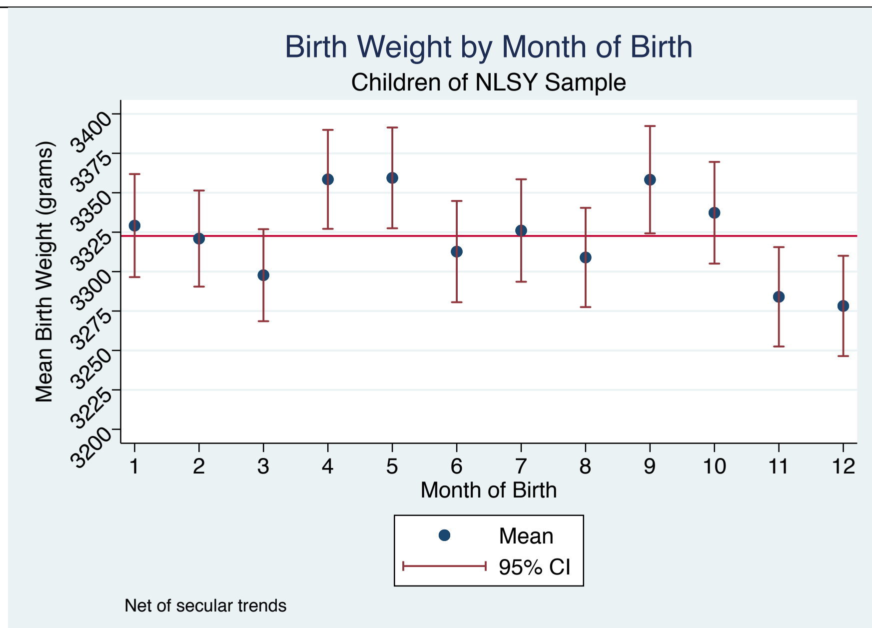
Figure 1



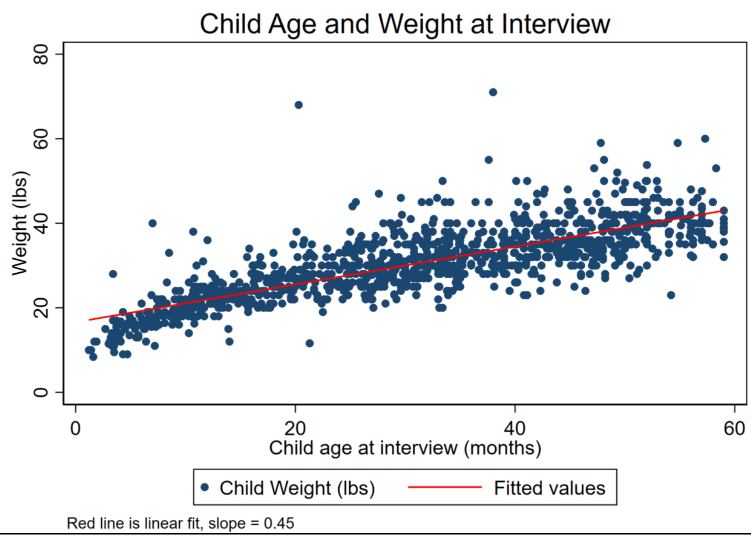


Notes: Authors' analysis using data from the PSID and NLSY showing mean birthweight (in grams) of all children born to sample families, by month of birth. The figure displays coefficients and 95% confidence intervals for the association between month of birth and birthweight. Regressions control for month-of-birth fixed effects and a linear time trend.

Figure 2

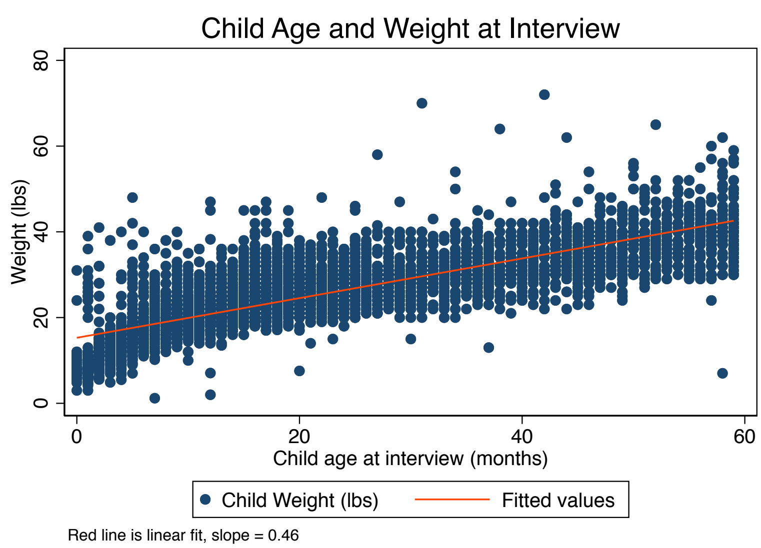
(a)

PSID Sample



(b)

NLSY Sample

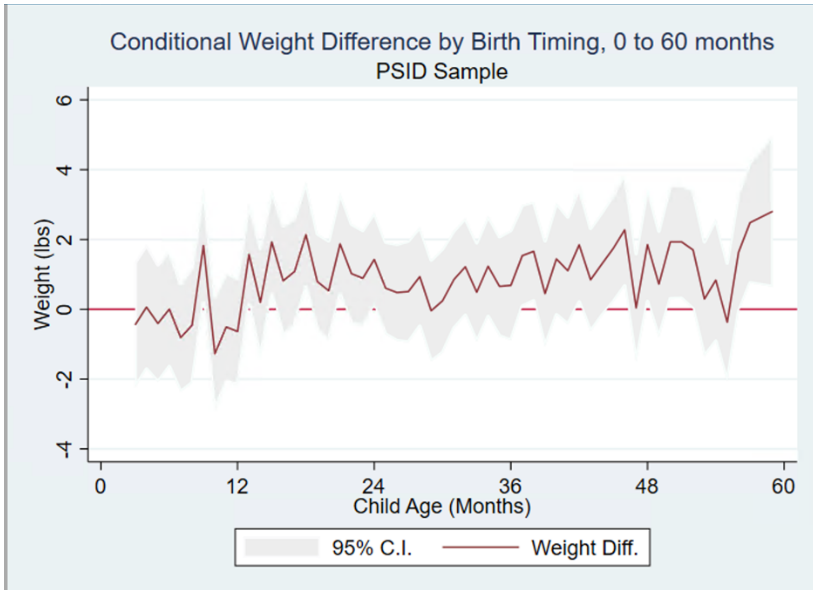


Notes: Authors' analysis using data from the 1997 and 2014 cohorts of the PSID (N=1,170) and NLSY (N=6,953) showing scatterplots of child weight (in pounds) at interview by child age (in months), and linear fits.

Figure 3

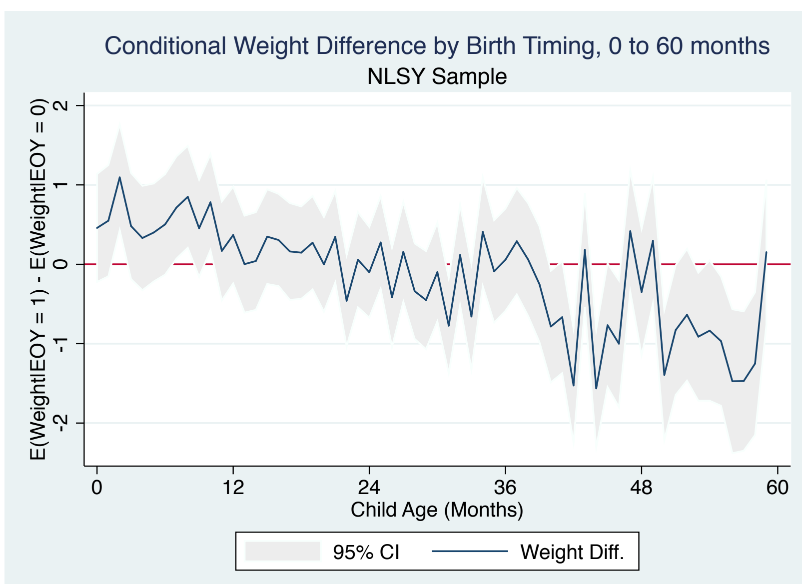
(a)

PSID Sample



(b)

NLSY Sample



Notes: Authors' analysis using data from the 1997 and 2014 cohorts of the PSID (N=1,170) and NLSY (N=6,953) showing fully-specified regression adjusted differences between weight of baby born at end vs. beginning of calendar year by age, from birth to 60 months.

Table 1: Descriptive Statistics

(a)

PSID Sample

Variable	Mean	Std. Dev.
Child weight at interview (pounds)	30.460	8.586
Child age at interview (months)	31.000	15.105
Child is female? (0/1)	0.489	0.500
Child race is white? (0/1)	0.568	0.499
Mom was married at childbirth? (0/1)	0.614	0.487
Mom was <20 at childbirth? (0/1)	0.147	0.354
Breast fed as infant? (0/1)	0.537	0.499
Birth order	1.867	1.077
Family birth-year income (1000s)	70.192	75.472
Birthweight (ounces)	115.873	22.481
Parental education at birth (1-17 years)	13.394	2.410

Notes: Authors' analysis using data from the 1997 and 2014 cohorts of the Panel Study of Income Dynamics (PSID) Child Development Supplement (CDS) showing descriptive demographic characteristics of the analytic sample (N=1,170). Family income in 2020 dollars.

(b)

NLSY Sample

	Mean	Std. Dev.
Child weight at interview (pounds)	25.06	8.88
Child's age at interview (months)	20.945	15.278
Child female? (0/1)	0.492	0.5
Child non-Hispanic white? (0/1)	0.54	0.498
Mom married? (0/1)	0.682	0.466
Mom < 20 at childbirth? (0/1)	0.057	0.231
Breast fed as infant? (0/1)	0.495	0.5
Birth order	1.967	1.148
Family income	73.48	157.84
Birthweight (ounces)	117.195	21.552
Parental education at birth (0-20 years)	12.577	2.391

Notes: Authors' analysis using data from the NLSY Child Supplement Surveys conducted between 1986 and 2014 showing descriptive demographic characteristics of the analytic sample (N=6,953). Family income in 2020 dollars.

Table 2: End of Year Birth and Child Weight Gain

	PSID Sample		NLSY Sample	
	(1)	(2)	(3)	(4)
Child's age at interview (months)	0.456***	0.456***	0.464***	0.473***
	(0.011)	(0.011)	(0.004)	(0.005)
Birth-month forcing variable	0.045	0.0538	0.075**	0.0756**
	(0.088)	(0.088)	(0.037)	(0.036)
End-of-year birth (0/1)	1.23*	1.238**	0.556**	0.55**
	(0.613)	(0.613)	(0.258)	(0.2579)
Birthweight (ounces)	0.060***	0.063***	0.046***	0.047***
	(0.007)	(0.007)	(0.003)	(.003)
Child female? (0/1)	-0.747**	-0.722**	-1.1538***	-1.1494***
	(0.300)	(0.300)	(0.127)	(0.1263)
Child non-Hispanic white? (0/1)	-0.848***	-0.633*	-0.691***	-0.667***
	(0.310)	(0.351)	(0.127)	(0.1376)
Mom married? (0/1)		0.150		-0.294*
		(0.390)		(0.151)
Mom < 20 at childbirth? (0/1)		-0.358		-1.704***
		(0.47)		(0.301)
Breast fed as infant? (0/1)		-0.476		-0.103
		(0.032)		(0.136)
Birth order		-0.087		-0.059
		(0.145)		(0.059)
Parental education at birth*		-0.156**		0.046
		(0.073)		(0.03)
Constant	9.31***	11.58***	10.5847***	10.1889***
	(0.965)	(1.39)	(0.404)	(0.577)
Observations	1170	1170	6953	6953
R-squared	0.6508	0.6534	.6512	.6531

Notes: Authors' analysis using data from the 1997 and 2014 cohorts of PSID Child Development Supplement (CDS) and NLSY Child Supplement showing the effect of end-of-year birth on child weight gain based on child weight (in pounds) at follow-up interview. Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1.

Table 3: End of Year Birth and Measures of Early Development

Sample	NLSY	NLSY	PSID	
Child Age:	**Birth – 3 Yrs.**	**8 – 23 Months**	**3-5 Yrs.**	
Measure:	**NCHS Motor and Social Dev. Scale**	**Memory for Locations Scale**	**WJ Letter/Word Recognition**	**WJ Applied Problem Solving**
Child's age at interview (months)	-0.466	0.153***	-0.377**	-0.218
	(0.331)	(0.044)	(0.118)	(0.149)
Birth-month forcing variable	3.40	-0.445	-0.555	-0.285
	(2.16)	(0.303)	(0.402)	(0.498)
End-of-year birth (0/1)	32.19**	-2.405	-2.984	-3.769
	(15.33)	(2.177)	(2.873)	(3.538)
Birthweight (ounces)	1.355***	0.032	-0.004	-0.010
	(0.178)	(0.024)	(0.032)	(0.039)
Child female? (0/1)	63.885***	3.22***	0.023	0.969
	(7.48)	(1.053)	(1.389)	(1.638)
Child non-Hispanic white? (0/1)	-0.584	3.314***	-1.737	5.309***
	(8.257)	(1.158)	(1.583))	(1.919)
Mom married at childbirth? (0/1)	-6.874	0.991	4.022**	2.606
	(8.96)	(1.258)	(1.721)	(2.084)
Mom < 20 at childbirth? (0/1)	-68.635***	-0.554	-0.704	-2.796
	(20.45)	(2.131)	(1.978)	(2.331)
Family income ($1,000s)	0.0001	0.0001	0.015	0.019*
	(0.0001)	(0.0001)	(0.009)	(0.011)
Breast fed as infant? (0/1)	0.156	0.896	2.552*	3.330*
	(7.908)	(1.109)	(1.490)	(1.823)
Birth order	-28.11***	-1.059*	-0.483	-0.195
	(3.472)	(0.566)	(0.682)	(0.878)
Parent education at childbirth (years)			1.007***	0.708
			(0.357)	(0.441)
Cohort FE	NA	NA	3.043*	5.688**
			(1.790)	(2.263)
Constant	374.47***	43.0837***	102.231***	91.599***
	(25.61)	(3.6951)	(8.419)	(10.461)
Observations	5616	2682	326	326
R-squared	0.0341	0.019	0.174	0.209

Notes: Authors' analysis using data from the 1997 and 2014 cohorts of the Panel Study of Income Dynamics (PSID) Child Development Supplement (CDS) showing the effect of end-of-year birth on child cognitive development based on age-standardized Woodcock-Johnson, revised (WJ-R) assessments of letter/word recognition and WJ-R assessments of applied problem solving and math concepts at follow-up interview, net of birth-month forcing variable, child age at interview (in months), birthweight (in ounces), child gender, child race/ethnicity, maternal marital status at birth, maternal age at childbirth, whether the child was breast fed as an infant, birth order, family income at birth (in $1000s), parental education at birth (in years), and cohort fixed effect. WJ-R assessments are only given to children aged 3 and older, so the sample is only 326 children. Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: End of Year Birth and Other Family Characteristics

PSID Sample

	Child non-Hispanic white	Mom married	Mom <20 at childbirth	Birth order	Parent education at childbirth (years)
Birth-month forcing variable	0.001	0.002	0.004	-0.007	0.040
	(0.007)	(0.007)	(0.038)	(0.018)	(0.035)
End-of-year birth (0/1)	0.040	0.001	0.006	-0.096	0.111
	(0.051)	(0.046)	(0.038)	(0.124)	(0.246)
Constant	-0.348***	-0.416***	0.826***	3.177***	12.619***
	(0.116)	(0.036)	(0.083)	(0.266)	(0.417)
Observations	1,170	1,170	1,170	1,170	1,170
R-squared	0.281	0.388	0.205	0.094	0.290

NLSY Sample

	Child non-Hispanic white	Mom married	Mom <20 at childbirth	Birth order	Parent education at childbirth (years)
Birth-month forcing variable	-0.001	-0.007**	0.001	0.0005	-0.005
	(0.003)	(0.002)	(0.001)	(0.007)	(0.015)
End-of-year birth (0/1)	-0.002	-0.057***	-0.001	0.028	-0.020
	(0.023)	(0.021)	(0.010)	(0.053)	(0.104)
Constant	0.172***	-0.072	0.189***	3.715***	13.12***
	(0.05)	(0.046)	(0.001)	(0.109)	(0.173)
Observations	6,982	6,982	6,982	6,982	6,982
R-squared	0.161	0.191	0.184	0.133	0.211

Notes: Authors' analysis using data from the 1997 and 2014 cohorts of the PSID and 1986 to 2014 NLSY Child surveys, showing the effect of end-of-year birth on family characteristics, net of birth-month forcing variable. Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1.

Table 5: End of Year Birth and Tax Liability

	Federal	State	Combined
Birth-month forcing variable	-636.97*	-278.76*	-915.73**
	(366.96)	(149.80)	(437.28)
End-of-year birth (0/1)	-3622.04	-1975.81**	-5597.85*
	(2343.39)	(975.16)	(2943.81)
Pre-birth income ($1,000s)	520.52***	61.18***	581.70***
	(18.57)	(14.26)	(24.57)
Constant	-20108.04***	-214.35	-20322.39***
	(1045.53)	(1024.62)	(1438.61)
Observations	4,814	4,814	4,814
R-squared	0.962	0.552	0.955

Notes: Authors' analysis using data from the Panel Study of Income Dynamics (PSID) showing the effect of end-of-year birth on family tax liability using a sample of PSID children born from 1993 to 2018, net of birth-month forcing variable and family income (in $1,000s) 9 months before the child's birth. Tax liability was calculated using the National Bureau of Economic Research (NBER)'s TAXSIM.