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# Maternal Depression and Children's Development: Evidence from Children in Fragile Families

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UNIVERSITY OF MIAMI

MATERNAL DEPRESSION AND CHILDREN'S DEVELOPMENT:  
EVIDENCE FROM CHILDREN IN FRAGILE FAMILIES

By

Yongmin Zang

A DISSERTATION

Submitted to the Faculty  
of the University of Miami  
in partial fulfillment of the requirements for  
the degree of Doctor of Philosophy

Coral Gables, Florida

December 2012

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Human capital development, including both cognitive and non-cognitive skills, at early childhood can have large long-term impacts not only on individual labor market outcomes and socio-economic success but also on economic growth. Studies suggest that parents, especially mothers in single-parent and low-income families, play an important role in developing the skills of their children at different stages of childhood. However, children from disadvantaged environments face many risk factors, such as poverty, parental health problems, and limited parental education. In particular, maternal depression is an “adverse early environment” for child development and is negatively associated with the quality of parenting practices and mother-child relationship. In turn, the lower quality of parenting practices and mother-child relationship might harm children's development.

This thesis examines the effect of maternal depression on pre-school children's development in terms of their cognitive abilities and behavioral problems by using longitudinal data from the Fragile Family and Child Well-being Study (FFCWS). By using a family (child-mother) fixed effects (FE) model, we provide new evidence to the literature that maternal depression imposes a big risk for child development in fragile families, which are mainly those unwed parents and their non-marital childbearing.

Specifically, maternal depression tends to reduce standardized Peabody Picture Vocabulary Test (PPVT) score by about 16.4 percent of a standard deviation. We also find that maternal depression has a similar adverse effect within non-marital families, but the effect gets more adverse (about 18.5 percent of a standard deviation) within non-marital families with higher poverty level. In addition, we find that maternal depression has a much larger adverse effect on girls (about 23.2 percent of a standard deviation), as well as children whose mothers have an education level of high school or above (about 24.4 percent of a standard deviation).

Regarding child's behaviors, maternal depression tends to increase of the child's Anxiety/Depression problems from ages three to five. Specifically, maternal depression tends to increase the Anxiety/Depression Index, on average, by about 20.9 percent of a standard deviation. We also find that maternal depression has a much larger adverse effect (about 31.3% of a standard deviation) on children from households living below the Local Poverty Line (LPL). In addition, we find that maternal depression has a moderately large effect on Black children (about 36.4 percent of a standard deviation), as well as girls (about 30.7 percent of a standard deviation). We find no evidence that maternal depression affects contemporaneous child's Withdrawal behavior, but find weak evidence that maternal depression affects child's Aggression behavior as a whole.

The findings in our study have important implications regarding public policies for dealing with the problem of maternal depression and child development within fragile families.

DEDICATION

*To my parents,  
Junqiang Pang and Jinze Zang*

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## **Chapter 1**

### **Introduction**

Human capital development at early childhood, starting at birth and ending at age five, has been increasingly studied in economics in recent years (Almond and Currie, 2010). It is the agreement of the literature that early childhood development, not only cognitive skills but also non-cognitive (including behavioral) skills, can have large long-term impacts on adult outcomes (Currie and Thomas, 1999a; McLeod and Kaiser, 2004; Cunha and Heckman, 2007a, 2008b; Cunha, Heckman, and Schennach, 2010; Rolnick, et al., 2011).

Children's cognitive development is important because cognitive skills are key determinants of not only individual labor market outcomes and socio-economic success but also economic growth (Heckman, 1995, 2008; Hanusheck and Woessmann, 2006). If the opportunities to develop cognitive skills are missed, children are more likely to underperform and require remediation services, which will be costly (e.g., Knudsen et al., 2006). Therefore, it is very important to pay attention to child development, in particular during the early childhood years. Studies suggest that parents, especially mothers in single-parent and low-income families, play an important role in developing the cognitive skills of their children at different stages of childhood. As for the children from low socio-economic families, they are exposed to a higher risk of disadvantaged parental environment. One potentially important factor affecting children's cognitive development is maternal depression.

Similarly, childhood behavioral problems produce negative and long lasting impact on human capital. For example, the internalizing behaviors, including anxiety,

depression, and social withdrawal, tend to persist (Caspi et al., 1987), and they can lead to an decrease in the likelihood of high school graduation, an increase in the likelihood of being arrested and grade retention (Koning et al., 2010), and lower probabilities of college enrollment, and lower levels of academic achievement (McLeod and Kaiser, 2004). They are also associated with increased long-term mortality risk beyond childhood and adolescence (Jokela et al., 2009), and in adulthood (Mirowsky and Ross 2003).

This thesis provides new evidence on the extent to which maternal depression affects the children's development by using a nationally representative study focusing on non-marital births – the Fragile Family and Child Wellbeing Study (FFCWS).

Heckman (2010) stresses parental investment and family environment's role on child development. However, children from disadvantaged environments face many risk factors, such as poverty, limited parental education and parental health problems (Knudsen, et al., 2006). Maternal depression, in particular, is an early adverse environment for child's development (Beach et al., 2005), and affects the well-being and school readiness of children (Knitzer et al., 2008). Children of depressed mothers are at risk of behavioral and emotional problems (Downey and Coyne, 1990; Anderson and Hammen, 1993; Goodman et al., 1993; Wachs et al., 2009), including symptoms of depression (Radke-Yarrow, 1998; Murray et al.1999; Goodman and Gotlib, 1999).

Several studies find that cognitive skills are important determinants of individual earnings (Heckman, 1995; Bowles and Gintis, 2000) and socio-economic success (Heckman, 2008). It is also found that the cognitive skills of teenagers can predict their future earnings (Murnane et al., 2000). Labor market rewards cognitive skill differences among high school dropouts (Tyler et al., 2000; Tyler, 2004), and among workers (Anger



and Heineck, 2010). Differences in cognitive skills, together with non-cognitive skills, can explain a variety of labor market outcomes (Heckman et al., 2006), moreover, they are an important determinant of the black-white wage gap, and can explain almost the entire male racial wage gap among high wage workers (O'Neill et al., 2006). There is also a growing importance of cognitive skills in wage determination (Murnane et al., 1995). At an aggregate level, the cognitive skills of the population, rather than the mere school attainment, are powerfully related to economic growth (Hanusheck and Woessmann, 2006).

Cognitive development has been widely studied across psychology, sociology and economics because of its importance to educational attainment, employment, and earnings. According to studies on child development, different cognitive skills are formed and shaped at different stages of the life cycle (Shonkoff and Phillips, 2000). At different stages of childhood, the family plays a key part in developing the cognitive skills of its children by providing parental environment and investments, and investments in the early years of life are important for the formation of adult cognitive skills (Cunha, Heckman, and Schennach, 2010). Therefore, it is important to understand the role of family in the cognitive development of children. This is especially the case among fragile families, which are mainly those unwed parents and their non-marital childbearing, since these families are at a greater risk of a disadvantaged parental environment.

Compared to the rest of the families, the mothers and fathers in fragile families, on average, have lower education level and unstable employment, which impose a lot vulnerability to the relationships within those families. They are at greater risk of breaking up and living in poverty than more traditional families. This imposes a lot more

risk on the mothers to develop depressive symptoms, such as dysphoria or anhedonia (Pound et al., 1988; Leadbeater and Linares, 1992). Isaacs (2004) reports that approximately 12 percent of all women experience depression in a given year in the United States, and for low-income women with children, the estimated prevalence is higher. Within the FFCWS, the rate is even higher than 20% in a given year. In turn, exposure to maternal depressive symptoms is found to make the parenting role more difficult, especially single parenthood (Eggebeen and Litcher, 1991), and to increase children's risk for later cognitive and language difficulties (e.g.: Cogill et al., 1986; Murray, 1996; Murray & Cooper, 1997; Huang & Freed, 2006; Tronick & Reck, 2009).

Research suggests that maternal depression imposes risks to children's development. Maternal depression at pregnancy negatively affects birth weight (Conway and Kennedy, 2004), and leads to unfavorable patterns of health care for children (Minkovitz et al., 2005). Postnatal depression has a significant negative impact on breastfeeding duration (Henderson et al., 2003). Children of mothers with major depression are found to be at risk for behavioral problems, and are also at high risk for depression or other mood disorders in later childhood and adolescence (Beardslee et al., 1983; Essex et al., 2001; Murray et al., 2001).

There are several mechanisms by which maternal depression may affect the development of children in the literature. A baby's primary caregiver can be either parent but most often the mother, especially for low-income children. Depression in a woman affects her parenting ability and may influence the quality of mother-child relationship, which in turn influence the child's cognitive competence (Cummings and Davies, 1994; Shaw and Vondra, 1995; Lovejoy et al., 2000; Wacharasin et al., 2003). Depressed

mothers are less responsive to their children and less sensitive to their child's needs (Lyons-Ruth et al., 1986; Cox et al., 1987; Stoneman et al., 1989; Goodman and Brumley, 1990; Field, 1992). Moreover, they have difficulties in forming secure attachment with their children (Martins and Gaffan, 2000) and lack the energy to carry out consistent routines, such as reading to their children, having fun with them, singing, playing, and cuddling (Paulson et al., 2006). In addition, economically disadvantaged children may even experience aversive or inadequate parenting by depressed mothers (Lovejoy et al., 2000).

There have been a number of studies in the literature focusing on the effect of maternal depression on children's cognitive development. The results in the literature are mixed. On the one hand, some studies find that maternal depression is negatively associated with children's cognitive development (Cogill et al., 1986; Sharp et al., 1995; Hay et al., 1995; Brennan, et al., 2000; Hay et al., 2001; Petterson and Albers, 2001); on the other hand, some studies find no adverse effect of maternal depression on children's cognitive development (Murray, 1992; Murray et al., 1996a, b; Kurstjens and Wolke, 2001; Frank and Meara, 2009).

Our goal is to study the potential consequences of maternal depression on children's cognitive development for children from fragile families when they grow up from age 3 to age 5. As compared to the current literature, our study is different in important ways. First, it focuses on socio-economically disadvantaged children from fragile families in the nationally representative study FFCWS. This is important since, as previously discussed, these children may be at greater risk of having a lower cognitive development. To the best of our knowledge, this is the first study to address the effect of maternal depression

on children's cognitive development within a low-income population. Second, our sample size is bigger than those in most of the existing studies. It includes 1,727 children from 20 large cities with populations over 200,000 across the US. Third, the children in our study are preschoolers as they grow up from age 3 to age 5. As a result, their cognitive abilities are independent of schooling, in other words, their families, especially mothers who are the main care-givers, play a more important role in developing children's cognitive skills at this stage than at later stages when children attend school. Finally and more importantly, we employ a family (child-mother) fixed effects (FE) model in our study as opposed to ANOVA, Ordinary Least Squares (OLS), or similar regression methods used in most of the existing studies. The common issue related to these methods is that it is hard to defend that the results reflect the causal relationship between maternal depression and children's cognitive development, mainly because of the possible omitted variable bias caused by unobserved variables such as genetic influences, cultural characteristics of the family, mother's cognitive skills, etc. For instance, research suggests that genetic influences are related to both cognitive skills (e.g., Plomin et al., 1994; Gómez-Sanchiz et al., 2004; Anger and Heineck, 2010) and maternal depression (e.g., Todd et al., 1993; Garber and Flynn, 2001), and it also suggests that genetic influences are related to both child's behavior problems and maternal depression (e.g., Weissman et al., 1984; Thapar and McGuffin, 1996; O'Connor et al., 1998), so they may confound our relation of interest. By using the FE model, we are able to control for all the unobserved variables that remain fixed over time, such as the variables previously mentioned, and move closer toward a causal interpretation of the

effects. This is the advantage of the FE model over OLS or similar methods previously used in the literature.

Our FE model exploits the panel data structure of the FFCWS. The existing datasets for the FFCWS include four waves conducted following the children's births between 1998 and 2000, then when they are one, three and five years old. It is based on interviews with the mothers and fathers at each wave, and two in-home surveys that are carried out when the child is three and five years old, respectively. These two in-home surveys contain the measure of cognitive development used in this thesis: the standardized Peabody Picture Vocabulary Test (PPVT) score.

This thesis contains two main analyses. The first one investigates the effect of maternal depression on child's cognitive development. We find that there is a negative effect of maternal depression on children's cognitive development from age three to age five within fragile families, which is significantly different from zero. Specifically, the results from the FE model show that maternal depression tends to reduce PPVT score by about 16.4 percent of a standard deviation. The results also show that maternal depression has a slightly more adverse effect (about -16.8 percent of a standard deviation) on children's cognitive development within the non-marital families, as well as the non-marital families with higher poverty level (about -18.5 percent of a standard deviation). The effects are statistically significant. Moreover, we find that maternal depression has a larger adverse effect (about -23.2 percent of a standard deviation) on girls, as well as children whose mothers have an education level of high school or above (about -24.4% of a standard deviation). The effects remain statistically significant. Finally, we explore

possible mechanisms through which maternal depression affects children's cognitive development.

The second main analysis is about the effect of maternal depression on child's behavior problems. We find that maternal depression leads to an increase of 20.9 percent of a standard deviation, on average, on children's Anxiety/Depression index from ages three to age five within the fragile families, which is significantly different from zero at 1 percent significance level. We also find that maternal depression has a much larger adverse effect (about 31.3% of a standard deviation) on children from households living below the Local Poverty Line (LPL). In addition, we find that maternal depression has a moderately large effect on Black children (about 36.4 percent of a standard deviation), as well as girls (about 30.7 percent of a standard deviation). We find no evidence that maternal depression affects contemporaneous child's Withdrawal behavior, but find weak evidence that maternal depression affects child's Aggression behavior as a whole.

In addition, we find suggestive evidence that some channels, through which maternal depression affects children's development, are child's health and parenting practices, such as the number of hours a child allowed to watch TV at home on a typical day.

The findings have important implications regarding public policies for dealing with the problem of maternal depression and children's cognitive development within fragile families. For example, treating maternal depression has been linked to other positive outcomes, such as children's better health, in the literature (Perry, 2008).

This thesis is organized as follows. Chapter 2 provides a literature review on maternal depression and children's development. Chapter 3 describes the data, and Chapter 4

presents the econometric methods used. Results are provided in Chapter 5 and Chapter 6, and Chapter 7 concludes.

## **Chapter 2**

### **Literature Review**

#### **2.1 Maternal Depression**

Maternal depression has been an important factor related to child's development. Research suggests that maternal depression imposes risks not only on children's cognitive development (Cogill et al., 1986; Sharp et al., 1995; Hay et al., 1995; Brennan, et al., 2000; Hay et al., 2001; Luoma et al., 2001; Petterson and Albers, 2001), but also on their behavioral health development (Beck, 1999; Civic and Holt, 2000; Verduyn, et al., 2003; Gartstein and Sheeber, 2004; Kim-Cohen, et al., 2005; Josefsson and Sydsjo, 2007; Trapolini, et al., 2007; Dietz et al., 2009; Frank and Meara, 2009; Giles, et al., 2011; Agnafors, 2012).

A lot of research has been done regarding the causes of depression. It suggests that depression is caused by a combination of factors, including genes, biochemical environment, personal experience and psychological factors, though it is still unclear what exactly causes depression. Beck (2001) reveals 13 significant predictors of postpartum depression, and they are prenatal depression, self-esteem, childcare stress, prenatal anxiety, life stress, social support, and marital relationship, history of previous depression, infant temperament, maternity blues, marital status, socioeconomic status, and unplanned or unwanted pregnancy. Some of them might contribute to the occurrence of maternal depression in the FFCWS, such as history of previous depression, marital relationship and socioeconomic status. Similarly, Wachs et al. (2009) summarize the depression-related risk factors for women in low- and middle-income countries, including poverty or high levels of economic stress, low social support, domestic violence, chronic



maternal illness, maternal anemia, families with large numbers of children (four or more, especially when children are below 7 years of age), having a preterm infant or an infant with low birth weight, social stigma associated with a family member being diagnosed with a mental illness, having a child with developmental disabilities, having an unplanned or unwanted infant, female child in a culture where there is a strong preference for male children, lack of participation in family financial decisions and lack of control over resources or reproductive health. Some of them, such as poverty and low social support, might be relevant to the families within the FFCWS. Another relevant factor is having a child with developmental disabilities, which could cause reverse causality in our study. Azar and Badr (2006) find that family strain (an intellectually impaired child), together with parental stress and family income, contributes to maternal depression in their study of a sample of 127 mothers in Lebanon.

## **2.2 Children's Cognitive Development**

In the literature, cognitive skills are measured by different kinds of test scores. For example, Pryor and Schaffer (1999) use the Educational Testing Service (ETS)-designed test of functional literacy, taken from the National Adult Literacy Survey, as the measure of cognitive skills to study employment. Blau (1999) uses the Peabody Individual Achievement Tests of Mathematics (PIAT-M) and Reading Recognition (PIAT-R) to measure academic achievement of children aged five and older, derived from the 1979 National Longitudinal Survey of Youth (NLSY79). Cawley et al. (2001) apply 10 measures of cognitive ability associated with the Armed Services Vocational Aptitude Battery (ASVAB) test score matrix. Heckman et al. (2006) use five measures of cognitive skills, including arithmetic reasoning, word knowledge, paragraph comprehension,

mathematical knowledge, and coding speed, also derived from the NLSY79. In addition, the Armed Forces Qualification Test (AFQT) score has been used extensively as a measure of cognitive skills (Heckman, 1995; Cameron and Heckman, 2001; Osborne-Groves, 2005). Finally, the Peabody Picture Vocabulary Test (PPVT) score has been widely used as a measure of cognitive skills, particularly verbal intelligence, and is highly correlated with scores on other intelligence tests (Center for Human Resource Research, 1989). There has been a lot of research focusing on PPVT from the NLSY (Baydar and Brooks-Gunn, 1991; Blau and Grossberg, 1992; Argys et al., 1998; Waldfogel et al., 2002; Baum II, 2003; James-Burdumy, 2005; Cesur and Rashad, 2008; Johnston et al., 2010). This thesis also uses PPVT score as the measure of cognitive skills.

Cognitive skills are built “from the bottom up”, and developed over time. Cawley, Heckman and Vytlačil (2001) argue that “cognitive ability is a trait that is partly inherited and partly built through education and informal human capital investment”. The likely contributors include years of formal education, quality of formal education, effort put forth by the individual, education environment in the family and native intelligence (Pryor and Schaffer, 1999). Recent theoretical research emphasizes the key role of parents in developing the cognitive skills of their children (McCulloch and Joshi, 2001; Carneiro and Heckman, 2003; Heckman and Masterov, 2004; and Cunha, Heckman, Lochner, and Masterov, 2006). Current research also stresses the importance of parental environment and family investments during the early years of life in the formation of desired adult cognitive skills (Cunha, Heckman, and Schennach, 2010; Cunha and Heckman, 2010).

Children's cognitive development has been widely studied. A large number of empirical studies focus on the effect of maternal employment, which is one important element of parental environment, on the children's cognitive development (e.g. Blau and Grossberg, 1992; Ruhm, 2000; Waldfogel et al., 2002; Baum II, 2003; James-Burdumy, 2005; Bernal, 2008; etc.). However, the results from these studies are mixed, which might be due to the fact that they use different datasets and their analytical approaches are also different. For example, Blau and Grossberg (1992) find that maternal employment has a negative impact on children's cognitive development when it occurs during the first year of the child's life and a potentially offsetting positive effect when it occurs during the second and subsequent years, using a sample of three- and four-year-old children of female respondents from the 1986 National Longitudinal Surveys of Youth (NLSY86). They further suggest that maternal employment throughout a child's first three or four years would have no net effect on the child's cognitive ability. Baum II (2003) studies the effects of maternal work in the initial months of an infant's life on the child's cognitive development. He finds that maternal work in the first year of a child's life has detrimental effects, and the results also indicate negative effects of maternal employment in the child's first quarter of life. However, the negative effects of maternal work are partially offset by positive effects of increased family income. James-Burdumy (2005) examines the effect of maternal employment on child development using fixed effects models, whose results show that PPVT is not negatively affected by maternal hours and weeks worked at Year-one and Year-two of the child's life.

Some studies show that differences in cognitive outcomes can stem from children's own characteristics. Heiland (2009) finds that the verbal ability of firstborns is about one-

tenth of a standard deviation higher than for children in the middle of the birth order. Unlike the sizeable literature on the effects of low birth weight on child development, there has been much less focus on high birth weight. Cesur and Rashad (2008) find high birth weight adversely affects cognitive outcomes, similar to the adverse effect of the low birth weight confirmed in many studies (e.g., Currie and Moretti, 2005; Black et al., 2007). Related to high birth weight, childhood obesity might retard cognitive development (Miller et al. 2009). Moreover, Johnston et al. (2010) find that left-handed children have significantly lower cognitive development test scores than right-handed children in terms of memory, vocabulary, mathematics and comprehension.

The more related literature on children's cognitive development to our research lies on parental intelligence and parental environment. Prior research shows that parental intelligence influences cognitive development (Gómez-Sanchiz et al. 2004). Current research provides more evidence that children's cognitive skills are positively related to their parents' abilities, after controlling for educational attainment and family background. Moreover, cognitive skills that are based on past learning (e.g. parental math skills) are more strongly transmitted between generations than skills that are related to innate abilities (Anger and Heineck, 2010). In our study, we will control for the influences of parent intelligence and genetic transmission on the children's cognitive development by using family (child-mother) fixed effects (FE) model when estimating the effect of maternal depression on children's cognitive development.

Finally, there is a literature studying the effects of maternal depression, an element of parental environment, on children's cognitive development. Most of these studies are from the medical literature, and the results are not consistent (Cogill et al., 1986; Sharp et

al., 1995; Hay et al., 1995; Brennan, et al., 2000; Hay et al., 2001; Petterson and Albers, 2001; Murray, 1992; Murray et al., 1996a, b; Kurstjens and Wolke, 2001; Frank and Meara, 2009). For example, Cogill et al. (1986) use a sample of 94 mothers and their children attending the same clinic located in London, and apply means of t tests and two way analyses of variance in their study. They find that maternal depression early in a child's life (first year) has a negative and significant effect on cognitive skills at age 4, measured by McCarthy scales. The National Institute of Child Health and Human Development (NICHD) Early Child Care Research Network (1999) uses a sample of 1,215 mothers and their children from the NICHD Study of Early Child Care. It finds that three year old children whose mothers are depressed in their infancy perform more poorly on cognitive skills, measured by the Bracken Basic Concept Scale and the Reynell Developmental Language Scale. Petterson and Albers (2001) use the data of 7,677 child-mother pairs from the 1988 National Maternal and Infant Health Survey (NMIHS; U.S. Department of Health and Human Services, 1995) and apply OLS and Tobit regression to study the effect of maternal depression on cognitive skills, measured by DDST (Denver Developmental Screening Test). The children are between the ages of 28 and 50 months. They find that maternal depression jeopardizes the children's cognitive development.

On the other hand, Murray (1992) uses a sample of 59 mothers and their first born children and applies t tests, chi-square tests and Fisher's exact tests to do the analysis. She finds that postnatal depression has no effect on general cognitive and language development for infants who are 18 months old, but appeared to have a larger effect on boys from lower social class. Murray et al. (1996a, b) use a sample of 100 mother-infant pairs originally recruited from a maternity hospital in London for a 5-year follow-up

study. They find no evidence of an adverse effect of postnatal depression on cognitive development, even amongst sub-groups of children suggested to be vulnerable (boys and children from low socio-economic status (SES) families). Similarly, Kurstjens and Wolke (2001) use a random sample of 1,329 mothers and their singleton child in the South Bavaria of Germany for a 7-year longitudinal study. They apply OLS and Tobit regression in their study. They conclude that maternal depression per se has negligible effects on children's cognitive development, though adverse effects of maternal depression on cognitive development can be found in lower-SES boys and neonatal risk-born boys if the depression started early and was severe and chronic.

In a recent study, Frank and Meara (2009) analyze data consisting of 1,587 children drawn from the NLSY79 to study the effect of maternal depression on the cognitive development of school aged children, in addition to their behavioral outcomes, when they grow up from ages 7-10 to ages 11-14. The cognitive skills of the children are measured by PIAT-R and PIAT-M scores. They use propensity score models to perform the analysis, as well as a family (sibling) fixed effects model. They find no evidence that maternal depression affects child's contemporaneous cognitive scores, while maternal depression has a moderately large effect on child behavioral problems. Nonetheless, it is worthy to note that schooling, for which they do not control, has a feedback effect on children's cognitive skills, which might mediate the impact of maternal depression when the children attend school during the period of time for their study.

### **2.3 Children's Behavioral Problems**

The literature shows that negative, inconsistent parental behavior and high levels of family adversity are associated with the emergence of problems in early childhood

(Campbell, 1994). It also strongly suggests that mothers play a key role in early childhood development of their children. Maternal alcohol and illicit drug use increase child's Behavior Problems Index (BPI) significantly (Chatterji and Markowitz, 2001), and maternal alcohol abuse/dependence cause more children's behavior problems (Jones, 2007). In addition, children born to adolescent mothers (less than 19 years old at delivery) have more externalizing behavior problems (Black et al., 2002). Previous studies also show that less parental emotional support as early as age 2 is associated with later externalizing problems in children, and that it is important to have very early parental emotional support in promoting positive child development (McCarty et al., 2005).

In the literature, the effect of maternal depression on child's behavior has been widely studied in terms of different age groups, including infants, toddlers/preschoolers, school age children and adolescents. Employing a small sample size (n=175), Bagner et al. (2010) find that the presence of maternal depression during a child's first year of life represents a sensitive period and increases the risk of adverse child internalizing and total behavior problems. Kim-Cohen et al. (2005) show that children exposed to maternal depression between age 5 and age 7 develop subsequent increase in anti-social behavior by age 7. In another study of preschoolers in a socio-economically low-risk sample (n=92), Trapolini et al. (2007) find that maternal depression chronicity is important to determine children's internalizing and externalizing behaviors. Beck (1999) conducts a meta-analysis of 33 studies, published between 1977 and 1995, on the relationship of maternal depression and child's behavioral problems, and concludes that there exists a moderate relationship between maternal depression and child's behavioral problems. Of

the above 33 studies previously mentioned, 11 are on preschoolers, and 14 are on school age children. The result that maternal depression has a significant medium effect on child behavior is similar across the two groups.

An important paper on the effect of maternal depression on child's behavioral problems is Civic and Holt (2000). They use unconditional logistic regression to analyze data from a normal birth weight sample from the 1988 National Maternal and Infant Health Survey (NMIHS) and a 1991 follow-up survey. In their study, maternal depression is measured at both surveys and child behavior problems are assessed by a maternal self-report at follow-up. They find that depressed mothers at either or both surveys are significantly more likely than undepressed mothers to report that their children have frequent temper tantrums or difficulty getting along with other children, and are difficult to manage, unhappy, or fearful. The finding suggests that children exposed to maternal depression are at a significantly increased risk of maternally reported behavior problems.

Many studies also stress the impacts of the timing of maternal depression on child's behavioral health. Philipps and O'Hara (1991) find that postpartum depression may increase the risk for later maternal depression, and in turn, increase the risk for child behavior problems. Josefsson and Sydsjo (2007) point out that mothers with current depressive symptoms are the most likely to have a child with behavioral problems. On the other hand, Bagner et al. (2010) argue that maternal depression before pregnancy and during the prenatal period does not significantly predict later child behavior problems. Giles et al. (2011) find that intermittent maternal depressive symptoms (when the child is between 2 and 3½ years old) do not significantly affect child behavior problems at age 5.



Another recent study is the work by Frank and Meara (2009) mentioned in section 2.2. They find that maternal depression has a moderately large effect on child behavioral problems, specifically, maternal depression leads to a 0.46 standard deviation (SD) increase in behavioral problems index. They also find that maternal alcohol abuse leads to a 0.29 SD increase on child's behavioral problems index.

In contrast to the existing literature, this thesis focuses on the socio-economically disadvantaged children from fragile families in the FFCWS, who are preschoolers as they grow up from age 3 to age 5. We provide new evidence to the literature that maternal depression leads to more Anxiety/Depression problems among preschool children in fragile families, and weak evidence of Aggression problems.

## **Chapter 3**

### **Data**

#### **3.1 The FFCWS**

This thesis uses data from the Fragile Families and Child Wellbeing Study (FFCWS). The FFCWS uses a stratified random sample of non-marital births in all US cities with 200,000 or more people, following a cohort of 4,898 families with children born between 1998 and 2000. Approximately three fourths of the parents are not married at the child's birth. Data on child health and development are collected from parents at the follow-up interviews when the child is 12, 36 and 60 months old, and in-home assessments of child well-being are carried out at 36 and 60 months old (Reichman et al., 2001). The parent interviews collect information on attitudes, relationships, parenting behavior, demographic characteristics, health (mental and physical), economic and employment status, neighborhood characteristics, and program participation. The in-home surveys collect information on children's cognitive and emotional development, health, and home environment. In the rest of this thesis, we refer to the years when the children are one, three and five years old as Year-one, Year-three and Year-five, respectively.

#### **3.2 Variables**

##### **3.2.1 Maternal Depression**

Maternal depression is the control variable of interest. Whether or not a mother is depressed is determined at both Year-three and Year-five in accordance with her answers during the interview to the questions derived from the Composite International Diagnostic Interview - Short Form (CIDI-SF), Section A (Kessler et al. 1998). The CIDI is a standardized instrument for assessment of mental disorders intended for use in

epidemiological, cross cultural, and other research studies. The CIDI questions are consistent with the Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition (American Psychiatric Association, 1994). There are two different stem requirements for maternal depression. One is whether the mother had feelings of dysphoria (depression) in the past year that lasted for two weeks or more, and if so, whether the symptoms lasted most of the day and occur every day of the two week period. The other is whether the mother had feelings of anhedonia (inability to enjoy what is usually pleasurable) in the past year that lasted for two weeks or more, and if so, whether the symptoms lasted most of the day and occur every day of the two week period. If she has one of them, then she will be interviewed for more specific questions about: 1) losing interest, 2) feeling tired, 3) change in weight, 4) trouble sleeping, 5) trouble concentrating, 6) feeling worthless, and 7) thinking about death. In sum, a case of maternal depression has to meet both one of the two stem requirements and some of the branch requirements. For example, to be determined as depressed, a mother has to be losing interest, feeling tired, feeling worthless, etc. or some combinations of these symptoms in the past year that lasted for two weeks or more.

### **3.2.2 PPVT**

The standardized Peabody Picture Vocabulary Test (PPVT) score is one of the measured outcomes in this thesis. The examinations of PPVT are given at Year-three and Year-five respectively. The PPVT scores are standardized for each age group, which allows for comparisons of scores across age groups. The national norm is 100 with a standard deviation of 15 (Dunn and Dunn, 1997). For ease of interpretation, we normalize the standardized PPVT scores to have mean 0 and standard deviation 1 by subtracting

100 and dividing 15 for each outcome. Accordingly, the regression coefficients can be interpreted as the standard deviation change in the outcome predicted by one unit change in the explanatory variable.

### **3.2.3 Behavior Problems Index (BPI)**

Relatively few well-standardized behavioral measures are available for young children. The FFCWS uses Child Behavior Checklists (Achenbach, 1991; 1992), which are the most widely used scales for assessing problematic behavior, with versions available for preschoolers as well as older children, and for teacher- as well as parent-report, to evaluate child's behavior. Child Behavior Checklists (Achenbach, 1991) is a version of the CBCL/4-18, for 2 to 3 year olds (CBCL/2-3), and Child Behavior Checklists (Achenbach, 1992) is for 4 year olds or above. They were used respectively for Year 3 and Year 5 in the FFCWS. Based on the ratings in the FFCWS, three different Behavior Problems Indexes are constructed on child's behavioral problems in this study, namely Anxiety/Depression Index, Withdrawal Index and Aggression Index.

The three tables in Appendix C provide the detailed list of items for each behavioral index. Table 1 is for the Anxiety/Depression Index, Table 2 is for the Withdrawal Index and Table 3 is for the Aggression Index. There are a number of items under each index. It is worth noting that not all the items are the same under each index for Year 3 and Year 5 because they are age-adjusted. Children are more mature at Age 5; accordingly, their scales are rated, to a large extent, based on different behaviors from those at Age 3. Therefore, there are many different items under the same category for age 3 and age 5. For example, for the being anxious category, a 5-year old could have some similar behaviors to a 3-year old, such as "too fearful or anxious", or "self-conscious or easily

embarrassed”, and some different behaviors from a 3-year old, such as “feels too guilty”, or “fears s/he might think/do something wrong”.

For each item, there is a single score out of the 3 possible answers: 0 points for not true, 1 point for somewhat/sometimes true and 2 points for very/often true. After adding all the items up, a raw score is obtained for the category of “anxious”, and then the raw score is adjusted based on the weight to make it comparable between Year 3 and Year 5 and then it is normalized before being used to perform the econometric analysis. The weight is determined as the reciprocal of the number of items. For example, there are 11 items under the Anxiety/Depression Index at Year 3, and then the weight is 1/11. As a result, the range of the raw score for each index is from 0 to 2 for both Year 3 and Year 5, and is comparable across years.<sup>1</sup> For example, the mean of the Anxiety/Depression Index is 0.50, and it means that the children do have some problems of Anxiety/Depression, but only occasionally. In order to facilitate the interpretation of the regression results, all the comparable raw scores are normalized as a pool for each category.<sup>2</sup>

### **3.2.4 Other Variables**

The FFCWS provides a rich set of variables. The following set of variables will be used in the subsequent econometric analysis:

- (1). Child’s demographic characteristics, such as gender, low birth weight, breastfed, disability;

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<sup>1</sup> Fortunately, the missing values seem not to be a big problem here, because the observations in the research sample have much more complete information than the whole sample. Nevertheless, there are still some missing values for some items under every composite index. The missing values are imputed as “0”, which means no behavior problem, to keep the research sample consistent with the study on PPVT, without exaggerating child’s behavior problem. Another way is to impute the mean of each item to check up the robustness of the results. The results stay robust.

<sup>2</sup> The normalization method here is similar to that of PPVT.

- (2). Parental demographic characteristics, such as country of origin, race, education, religion;
- (3). Maternal prenatal and postnatal care information, such as drinking, drugs, smoking, treatment;
- (4). Maternal environment, such as employment, poverty ratio, marriage status, and number of kids in the household;
- (5). Child health, such as obesity, asthma and health status;
- (6). Parenting practices (investments), such as songs, story, outdoor playing, books, TV time and bedtime.

The variable “disability” refers to whether or not the child has any physical disabilities, such as total deafness, or partial deafness, or partial blindness, or problems with limbs. The variable “treatment” refers to whether or not the mother gets professional treatment for a drinking/drug problem during pregnancy. The variable “songs” refers to how often the mother sings songs or nursery rhymes with the child during a typical week. The variable “story” refers to how often the mother reads a story with the child during a typical week. The variable “outdoor playing” refers to how much time the child spends playing outdoors either at home or elsewhere on a typical day. The variable “books” refers to about how many books the mother has for her child. The variable “TV time” refers to how much time the child watches TV either at home/elsewhere on a typical day. The variable “bedtime” refers to the whether or not the child has a regular bedtime.

For the rest of the thesis, the variables included in (1) through (3) are referred as Time-invariant Covariates, the variables included in (4) are referred as Controls, the variables included in (5) are referred as Child Health, and the variables included in (6) are referred

as Parenting Practices. For details regarding the description of the covariates, see Appendix B.

### **3.3 Attrition and Missing Values**

The data employed in this study are drawn from the Baseline, Year-one, Year-three and Year-five Core Telephone Data sets, and the Year-three and Year-five In-home Survey data sets. The In-home Survey data sets contain the standardized PPVT scores, the only measure of cognitive ability available in the FFCWS. There are 4,898 observations at Baseline, but fewer in all the subsequent follow-up interviews, with 4,364, 4,131 and 4,139 observations at Year-one, Year-three and Year-five respectively. The Year-three and Year-five In-home Survey data sets contain 3,288 and 3,001 observations respectively. However, only 2,368 observations at Year-three In-home Survey data set contain standardized PPVT scores, and 2,330 at Year-five. For our analysis, we construct a balanced panel data set in terms of the observations containing standardized PPVT scores at both Year-three and Year-five, and we define this panel data set as our “Research Sample”. The final number of observations in our Research Sample is 1,727 for each year. Table 1.1 provides a summary on how we arrive to our research sample.

The attrition and missing values of the PPVT variable in the FFCWS data set add difficulties to the analysis and interpretation of the results with respect to the original national representative sample. Fortunately, further check on the data sets provides evidence that the analysis based on our research sample is still relevant for policy purposes. In short, our research sample is composed of families that are even more fragile than those in the overall FFCWS sample. Table 1.2 provides the descriptive statistics in

terms of the essential features of the FFCWS, high non-marital rate and high poverty level, in addition to maternal depression and race distribution for the whole sample and the Research Sample.

The FFCWS focuses mostly on unwed parents and their non-marital births. At Baseline, unwed parents account for 75% in terms of the whole sample, and this number stays around 70% at Year-one, Year-three and Year-five. At Year-three, unwed parents account for 72% in our Research Sample, higher than the non-marital rate in the whole sample at Year-three. In other words, the non-marital parents take up a bigger share in our Research Sample at Year-three. At Year-five, the non-marital rate has a similar pattern to that at Year-three. With respect to high poverty level, the average poverty ratio is about 2.22 times the poverty line at Baseline, but drops to below 2 times for all the subsequent years. At Year-three, the average poverty ratio in the whole sample is 1.94, while it is 1.78 in our Research Sample. Similarly, at Year-five, the average poverty ratio is 1.92, while it is 1.77 in our Research Sample. As a result, the families in our research sample are actually poorer than those in the whole sample. Therefore, from the point of view of non-marital rate and poverty level, the families we analyze are even more fragile than those in the overall sample in the FFCWS.

Maternal depression is consistent between the whole sample and the Research Sample. At Year-three, mothers who are depressed account for 21% of the whole sample, which is slightly different from the rate of 22% of the Research Sample, but not statistically different. At Year-5, mothers who are depressed account for 17% of the whole sample, which is the same rate as in our Research Sample. Finally, we compare the race distribution of the whole example to that in our research sample. Whites and Other race



are consistent between the whole sample and the Research Sample. By contrast, Blacks take up 48% in the whole sample, while 57% in the Research Sample at Year-three. Correspondingly, Hispanic children take up 26% in the whole sample, while 20% in the Research Sample. The race distribution has a similar pattern at Year-five. The reason for the change in race distribution is that some of the Hispanics are not native English speakers, so they do not take the PPVT test and take the TVIP test instead. For example, at Year-three, 137 children took the TVIP test instead of the PPVT test, and this fact leads to a relatively less share of Hispanic children in the PPVT-based Research Sample.

### **3.4 Descriptive Evidence**

#### **3.4.1 PPVT**

Tables 2.1 and 2.2 provide descriptive statistics for the observations included in the Research Sample, as well as the observations with maternal depression and those without maternal depression. Table 2.1 is for Year-three and Table 2.2 for Year-five. Both tables display very similar patterns. The mean PPVT score in the sample at Year-three is 86.01. Hence, the children in the FFCWS are almost a full standard deviation below the national average, reflecting the fact that they come from disadvantaged families. The children with non-depressed mothers perform 1.87 points or 12.5% of a standard deviation better than those with depressed mothers at Year-three, which is significantly different at 5% level. At Year-five, somehow surprisingly, the mean PPVT score for the research sample increases to 94.04 by Year-five, so the gap between the sample mean and the national average is cut to less than half of a standard deviation. The children with non-depressed mothers perform 1.33 points or 7.5% of a standard deviation better than those with depressed mothers, which is not significantly different. The non-depressed mothers, on

average, have a higher poverty ratio, a higher marital rate, a better parenting routine with more frequently storytelling and reading to their children, and are more likely to make their children have a regular bedtime. Their children are also more likely to have a better health status and spend less time watching TV and playing outside.

Figures 1 and 2 present some descriptive evidence of the impact of maternal depression on PPVT in terms of the Research Sample. Figure 1 shows kernel density estimates of the distribution of PPVT scores among children whose mothers are either depressed or not depressed at Year-three. Children whose mothers are depressed are more likely to be observed in the left-hand side of the PPVT distribution, and the density is left skewed. Similarly, Figure 2 shows kernel density estimates of the distribution of PPVT scores among children whose mothers are either depressed or not depressed at Year-five, with the tendency similar to that at Year-three. These figures suggest a negative relation between maternal depression and the children's PPVT scores.

The first main goal of our study is to determine whether the PPVT difference between children with depressed mothers and children with non-depressed mothers remains once we control for observable and time-invariant unobservable differences.

### **3.4.2 BPI**

The descriptive characteristics of the BPIs are also provided in Table 2.1 for Year 3 and Table 2.2 for Year 5. At Year 3, all the BPIs, including Anxiety/Depression, Withdrawal and Aggression, are statistically different between the group of children whose mothers are depressed and the other one of children whose mothers are not depressed. Children exposed to maternal depression present more behavioral problems than their counterparts. For example, the mean of BPI for Anxiety/Depression is 0.48 for

the group without maternal depression at Year 3, while it is 0.56 for the group with maternal depression. At Year 5, they display similar patterns to those at Year 3.

Nevertheless, the means of Anxiety/Depression Index for Year 3 and Year 5 are very different. It has a large drop from 0.56 at Year 3 to 0.32 at Year 5 for children whose mothers are depressed. First, it means that the children in the Research Sample, on average, have much less anxious/depressed behaviors from Year 3 to Year 5, which shares the same tendency as the withdrawn behaviors and the aggressive behaviors. It suggests that, on average, the children in the Research Sample have better performance in behaviors. This is similar to their cognitive development, which has an increase from 86 in PPVT at Year 3 to 94 at Year 5. As a whole, both the BPI and PPVT suggest that the wellbeing of the children in the FFCWS is improved. Second, from Year 3 to Year 5, the drop in the Anxiety/Depression Index is much larger relative to those of the Withdrawal Index and the Aggressiveness Index. At the same time, the maternal depression rate also falls from 21 percent to 17 percent over the same period. At Year 3, the correlation between maternal depression and Anxiety/Depression Index is 0.12, and it is 0.18 at Year 5. It might be the case that maternal ratings of child behavior improve when maternal mental health improves (Modell et al., 2001). Finally, children can be affected through observational learning when exposed to maternal depression. This might be another potential mechanism through which maternal depression affects child's behavior, especially being anxious/depressed (Downey and Coyne, 1990). In short, a child possibly gets anxious/depressed when his/her mother is depressed.

Figures 3 through 8 present some descriptive evidence of the impact of maternal depression on BPI in the Research Sample. Figure 3 shows kernel density estimates of

the distribution of BPI of Anxiety/Depression among children whose mothers are either depressed or not depressed at Year 3. Children whose mothers are depressed are more likely to be observed in the right-hand side of the BPI distribution, and the density is left skewed. Similarly, Figure 4 shows kernel density estimates of the distribution of BPI of Anxiety/Depression among children whose mothers are either depressed or not depressed at Year 5, with the tendency similar to that at Year 3. In addition, the kernel distributions on Withdrawal Index and Aggression Index show very similar pattern to that of Anxiety/Depression Index. These figures suggest a positive relation between maternal depression and the children's BPI, which is that maternal depression leads to an increase in the BPI of Anxiety/Depression of the children in fragile families.

The second main goal of our study is to investigate whether the BPI difference between children with depressed mothers and children with non-depressed mothers remains once we control for observable and time-invariant unobservable differences.

## Chapter 4

### Methodology

#### 4.1 The Pooled OLS Model

We follow the basic specification of the production function of the child's outcome widely used in the literature (e.g. James-Burdumy, 2005; Miller et al. 2009; Johnston et al., 2010; Herbst and Tekin, 2010). We also include variables regarding parental environment and investments during the early years of life in the formation of cognitive skills, as stressed in the current studies by Cunha, Heckman, and Schennach (2010) and Cunha and Heckman (2010).

Specifically, we assume that the production of cognitive skills for a given year is as follows:

$$PPVT_{i,t} = \beta_0 + Depression_{i,t}\beta_1 + C_i\beta_2 + M_i\beta_3 + E_{i,t}\beta_4 + u_{i,t} \quad (1)$$

$PPVT_{i,t}$  is the standardized PPVT score of Child  $i$  at year  $t$ .  $Depression_{i,t}$  denotes whether or not child  $i$ 's mother was depressed at year  $t$ . This is the key control variable. The parameter of primary interest is  $\beta_1$ , and it represents the average total effect of maternal depression on child's cognitive ability, measured by standardized PPVT scores.  $C_i$  represents child's characteristics that do not vary over time, such as gender and low birth weight.  $M_i$  represents parent's characteristics that do not vary over time, such as race and education.  $E_{i,t}$  represents a vector of mother's characteristics that vary over time such as marital status and employment. The complete sets of variables are described below.

Equation (1) states that the cognitive skills are determined by child's characteristics ( $C_i$ ), parental environment and investment ( $Depression_{i,t}$ , and  $M_i$ ). We do not include

information on formal schooling since the children in this study are preschoolers from ages three to five.

First, as a starting point, we assume that once we control for a rich set of covariates ( $C_i$ ,  $M_i$  and  $E_{i,t}$ ), maternal depression behaves as if it were randomly assigned. This assumption is commonly referred to as “unconfoundedness” or “selection on observables” (e.g., Imbens, 2004). In order for this assumption to be plausible, it is important to control for variables that affect both maternal depression and PPVT. Hence, based on our review of the literature in Chapter 2, it is important to control for variables such as maternal employment, marital status of the mother, household income, number of kids in the household, etc. In addition, we assume that the effects of  $Depression_{i,t}$ ,  $C_i$ ,  $M_i$  and  $E_{i,t}$  on  $PPVT_{i,t}$  are linear and additive, then we can estimate  $\beta_1$  by running a Pooled Ordinary Least Squares (OLS) regression, and give a causal interpretation to  $\beta_1$ .

The included covariates are listed as follows:

$C_i$  = a vector of child’s characteristics that are fixed over time: gender, whether low birth weight or not, whether or not having disabilities.

$M_i$  = a vector of characteristics of child  $i$ ’s parents that are fixed over time: race, education, whether or not mother born in the U.S., whether or not drinking during pregnancy, whether or not smoking during pregnancy, whether or not taking drugs during pregnancy, whether or not having childcare during pregnancy, whether or not going to church regularly, whether or not breastfeeding during the 1st year of the child.

$E_{i,t}$  = a vector of mother  $i$ ’s characteristics that vary over time: marital status, employment (whether or not mother worked at year  $t$  since the child’s birth), number of kids in her household, her household income (poverty ratio).

$u_{i,t}$  is a random error term, and it is assumed to be unrelated to any of the explanatory variables, normally distributed, and not correlated with each other. Therefore, OLS with robust variance estimation on equation (1) will yield unbiased estimates, and correct standard errors.

#### 4.2 The Fixed Effects (FE) Model

The OLS estimates of the causal effect of maternal depression on PPVT are unbiased only if the assumption of “unconfoundedness” holds. If it fails, that is, if there is indeed some unobservable variable that affects both maternal depression and PPVT (a “confounder”), then the estimates will be biased. In order to control for unobserved confounders that are fixed over time, the family (child-mother) fixed effects (FE) model is used. Unobserved child, mother, or household characteristics that remain fixed over time and that may bias the OLS estimates include genetic influences, cultural influences, childcare habits and mother’s cognitive skills. In order to obtain unbiased estimates of the effect of maternal depression on PPVT, we need to control for these unobserved variables. For instance, several studies suggest that genetic influences are related to both cognitive skills (e.g., Plomin et al., 1994; Gómez-Sanchiz et al., 2004; Anger and Heineck, 2010) and maternal depression (e.g., Todd et al., 1993; Anderson & Hammen, 1993; Treloar et al., 1999; Garber and Flynn, 2001; Zubenko et al., 2002; Hammen et al., 2004), so that they may confound our relation of interest.

In the FE model, the PPVT production function is given as follows:

$$PPVT_{i,t} = \delta_0 + \delta_i + Depression_{i,t}\delta_1 + E_{i,t}\delta_2 + \varepsilon_{i,t} \quad (2)$$

The variable  $\delta_i$  captures all unobserved, time-constant factors that affect  $PPVT_{i,t}$ . All the other variables in equation (2) have the same interpretation as those in equation (1).

Given the data at Year-three and Year-five, we are able to construct a balanced panel data set (the Research Sample) for our analysis, and we estimate equation (2) using a first-difference model. By using the fixed-effects model, we are able to control for all the time-invariant variables, including those that are observed to us, such as low birth weight, disability, parental education, prenatal care, breastfeeding, handedness, and birth order, as well as those time-invariant variables that are unobserved, such as genetic influence, family child care habits, cultural habits and mother's cognitive skills. Therefore, we can account for the endogeneity caused by any of those time-invariant variables. This is a very important distinction with respect to most the current literature analyzing the effect of depression on cognitive skills, which do not control for these relevant factors (an exception is Frank and Meara, 2009).

### **4.3 Discussion**

In addition to the analysis describe above, we explore the potential channels through which maternal depression affects child's cognitive development and behavior problems. The potential channels include child's health status,  $H_{i,t}$  and parenting practices,  $P_{i,t}$ .  $H_{i,t}$  is a vector of child  $i$ 's health characteristics that vary over time: whether the child is obese or not at year  $t$ , whether he/she has asthma or not by year  $t$ , and whether he/she has a good health status or no at year  $t$ .  $P_{i,t}$  is a vector of parenting practices for child  $i$  that vary over time: whether the child has a regular bed time or not, how much time the child spends watching TV on a typical day, how often the mother sings songs for her child, how often the mother tells/reads stories to her child, how many books the mother has for her child and how much time the child playing outdoor on a typical day at year  $t$ .



We perform two exercises to explore the role of  $H_{i,t}$  and  $P_{i,t}$  as channels through which maternal depression affects children's cognitive development. First, we add  $H_{i,t}$  and  $P_{i,t}$  to equation (1) and (2). Previously,  $\beta_1$  in equation (1) and  $\delta_1$  in equation (2) gave the total average effect of maternal depression on PPVT. By adding  $H_{i,t}$  and  $P_{i,t}$ , we look at how  $\beta_1$  and  $\delta_1$  change, and interpret a decrease in their magnitude as evidence that  $H_{i,t}$  and  $P_{i,t}$  mediate the effect of maternal depression on PPVT, and hence, that they are potential channels of the effect. Second, we look at  $H_{i,t}$  and  $P_{i,t}$  as outcomes in equation (1) and (2). In order for  $H_{i,t}$  and  $P_{i,t}$  to be channels through which maternal depression affects PPVT, maternal depression must affect  $H_{i,t}$  and  $P_{i,t}$  in the first place. We estimate equations (1) and (2) by replacing the outcome  $PPVT_{i,t}$  with each of the variables in  $H_{i,t}$  and  $P_{i,t}$ .

One caveat of our FE model is the potential reverse causality between maternal depression and children's cognitive development. If maternal depression were caused by her child's poor cognitive development, then the FE estimates of  $\delta_1$  would be biased. There is no data in the FFCWS regarding maternal depression at Baseline but only at Year-one and beyond. The correlations of maternal depression across years show some evidence on the possible cases of maternal depression that are caused by history of previous depression. The correlation of maternal depression between Year-one and Year-three is 0.33, 0.23 between Year-one and Year-five, and 0.35 between Year-three and Year-five. Unfortunately, there are no specific reasons provided by the depressed mothers in the FFCWS regarding why they become depressed, hence, we are not able to rule out the reverse causality issue. However, based on our discussion regarding the causes of depression in Chapter 2, we believe that in our particular case, the main contributors to

the occurrence of maternal depression in the FFCWS are the history of previous depression, marital relationship and socioeconomic status. Although it is possible that some of the mothers in the FFCWS may become depressed because of their children's poor cognitive skills, we believe the number of such cases is very small to be negligible. Moreover, at ages three and five, it may not be easy to judge whether a child has poor cognitive development without a formal test (like the PPVT), in which case the mother may not know about it.

Despite the potential concern, the present paper provides an improvement over most of the current literature on the topic (which also share the reverse causality concern) by controlling for time-invariant unobservables that may confound our relation of interest.

## Chapter 5

### Maternal Depression and Cognitive Development

#### 5.1 Results

##### 5.1.1 Basic Specification

Table 3.1 provides a summary of the results from the pooled OLS and the family FE models, with the complete set of results provided in Appendix F. Model (1) is unadjusted, and Model (2) controls for the time-variant covariates ( $E_{i,t}$ ) including marital status, maternal employment, maternal household income (poverty ratio) and number of kids in mother's household, and time-invariant covariates ( $C_i$  and  $M_i$ ) including child's characteristics, parent's characteristics and mother's prenatal and postnatal information. Each explanatory variable in the regressions is paired with a dummy variable equaling 1 whenever the explanatory variable has a missing value and 0 otherwise. The explanatory variables with missing values are set equal to 0.

The effect of maternal depression from the pooled OLS (Model 2) is about -0.116, which is statistically significant. It says that the child whose mother is depressed from Year-three to Year-five scores, on average, about 11.6 percent of a standard deviation less than those whose mother is not depressed. This model reveals some results which are consistent to prior studies. For instance, girls develop better than boys in terms of PPVT; low birth weight is negatively associated with PPVT; and maternal education, poverty ratio (income), and breastfeeding are positively related to PPVT. However, as previously discussed, in this cross-section analysis, the effect of maternal depression might be biased by omitted variables.

The effect of maternal depression from the FE model (Model 2) is about -0.164, which is statistically significant. It says that the child whose mother is depressed between Year-three to Year-five scores, on average, about 16.4 percent of a standard deviation less than if the mother were not depressed. Interestingly, the results for the FE models in (1) and (2) are remarkably close to each other, implying that the addition of time-variant controls in the FE model has little effect on the results. The results from the Pooled OLS model and the FE model are not statistically different from each other.

The standard errors are adjusted for individual-level clustering in both the Pooled OLS and the FE models in the following discussions.

## **5.2 Heterogeneity of Effects of Maternal Depression**

In this section, we analyze how the effect of interest varies with respect to non-marital families, non-marital families with high poverty level, race, gender and maternal education.

Table 3.2 provides the heterogeneity results from the Pooled OLS and the FE models corresponding to model (2) in Table 3, employing the normalized PPVT scores as outcome.

### **5.2.1 Heterogeneity of Effect with Respect to Non-marital Status**

The FFCWS focuses on non-marital births. The big non-marital rate in the sample allows us to further check the average total effect of maternal depression within the non-marital families. Separate regressions are run for married and unmarried mothers at both Year-three and Year-five. Row (1) shows the results for unmarried mothers, where the FE model yields a negative average total effect of maternal depression on PPVT of about 16.8 percent of a standard deviation, remaining statistically significant. In contrast to the

results in Table 3.1, the magnitude gets slightly larger, implying that children from non-marital families may face a slightly higher risk of adverse development of cognitive skills when exposed to maternal depression. Row (2) is regarding the marital case. The estimate has negative sign, as expected, but is not statistically different from zero. This might be due to the fact that the sample gets smaller. Accordingly, the results are harder to interpret.

### **5.2.2 Heterogeneity of Effect with Respect to Non-marital Families with a High Poverty Level**

We take as cutoff point for our analysis a 300 percent of Local Poverty Level for a few reasons. Nearly 50 percent of Americans and almost 60 percent of children live in families with a 300 Percent of Local Poverty Level or less.<sup>3</sup> In the FFCWS, it is above 80 percent. It has been found that families with earnings up to 300 Percent of Local Poverty Level do not have the resources to purchase high quality early childhood services for their children.<sup>4</sup> Row (3) is regarding the non-marital case with a poverty ratio of 300 percent of the Local Poverty Line or less. In this case, the average total effect of maternal depression from the FE model is about 18.5 percent of a standard deviation, remaining statistically significant. In contrast to Row (1), the magnitude gets larger, suggesting that children from non-marital families with a higher poverty level face a much higher risk of adverse development of cognitive skills when exposed to maternal depression.

### **5.2.3 Heterogeneity of Effect with Respect to Poverty Level**

Rows (4) through (5) provide the results when breaking the sample by different poverty levels, namely equal to or less than 100 percent of Local Poverty Line, greater than 100

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<sup>3</sup> Source: 2006 Current Population Survey (March Supplement), U.S. Department of Commerce, Bureau of the Census.

<sup>4</sup> <http://nieer.org/resources/policyreports/report3.pdf>.

percent of Local Poverty Line but equal to or less than 200 percent of Local Poverty Line, and greater than 200 percent of Local Poverty Line. No evidence that maternal depression affects child's cognitive development is found for any of these three sub-groups. This is different from the findings by Petterson and Albers (2001). They find poverty negatively affect child's cognitive development.

#### **5.2.4 Heterogeneity of Effect with Respect to Race**

Rows (7) through (9) provide the results when breaking the sample by different races. Maternal depression has an insignificant effect on Blacks and Whites, but significant on both non-Blacks and non-Whites. Row (9) shows the results for other races, composed of mainly of Hispanics and, in a smaller proportion, of Asians. The average total effect of this group is about -32.2 percent of a standard deviation, and it is statistically significant. The t-test of whether the coefficients differ significantly across Other Races and the rest is -0.72.

#### **5.2.5 Heterogeneity of Effect with Respect to Gender**

Rows (10) and (11) show the effects by the children's gender. We find that maternal depression has a much larger adverse effect on girls. The girls from depressed mothers tend to score 23.2 percent of a standard deviation less than those whose mothers are not depressed between Year-three and Year-five, and the effect is statistically significant. Child gender differences in the effects of maternal depression have been previously documented in the literature. As mentioned in Chapter 2, Kurstjens and Wolke (2001) find adverse effects of maternal depression on cognitive development in lower-SES boys and neonatal risk-born boys if the depression started early and was severe and chronic. Petterson and Albers (2001) find that girls whose mothers suffer from moderate

depression score significantly lower on cognitive measures than do girls whose mothers are not depressed among the group of more affluent families. Our finding is complementary because it provides new evidence to the child gender differences in effects of maternal depression from low-income families, and employing a FE model.

### **5.2.6 Heterogeneity of Effect with Respect to Maternal Education**

Many studies show that maternal education is strongly correlated to children's language, cognitive, and academic development. In this section, we explore the effect of maternal depression conditional on maternal education. We find that maternal depression has an adverse effect on children whose mothers have an education level of high school or above. The effect is -24.4 percent of a standard deviation, and statistically significant. As for the children whose mothers have education level less than high school, the results show a statistically insignificant effect of maternal depression on their cognitive development. This may be due to a true smaller effect, but also to a reduced sample size.

On average, children whose mothers are much less educated have lower cognitive development than those whose mothers are more educated within the FFCWS.<sup>5</sup> This is in agreement with the previous literature. Barros et al. (2009) find that child development is strongly related to maternal schooling, and children from less educated mothers are 8.3 times more likely to present low performance than those of high-schooling mothers. Our finding suggests that maternal depression has basically no impact on those children whose mothers are much less educated, probably because their PPVT performance is already relatively poor.

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<sup>5</sup> In the Research Sample, on average, children whose mothers have education level less than high school score 86, while those whose mothers have education level more than high school score 92. A t-test shows that the means are statistically different at the 1 percent significance level.

### **5.3 Analysis of the Channels through which Maternal Depression Affects PPVT**

In this section, we analyze the possible mechanisms through which maternal depression affects PPVT. As discussed in Chapters 2 and 4, two potential important mechanisms are Child's Health and Parenting Practices. Table 3.3 presents the results for both the Pooled OLS and the FE models when controlling for Child Health and Parenting Practices. To facilitate comparisons, Row (1) in Table 3.3 replicates the results presented as "Model (2)" in Table 3.1. In Row (2), we additionally control for Child Health. Row (3) is the case controlling for Parenting Practices, and Row (4) is the case controlling for both Child Health and Parenting Practices. The complete set of results is provided in Appendix F.

Both the Pooled OLS and the FE models display a similar tendency after controlling for Child's Health and /or Parenting Practices. Specifically, based on the FE models, Row (1) presents that, on average, children from depressed mothers tend to score 16.4 percent of a standard deviation less than those whose mothers are not depressed; however, the magnitude goes down to 12.8 percent of a standard deviation after controlling for Child's Health, suggesting that Child's Health, as a possible channel through which maternal depression affects PPVT, wipes out 3.6 percent of a standard deviation. Similarly, Parenting Practices reduce the effect of maternal depression by 2.1 percent of a standard deviation. Moreover, the effect of maternal depression falls to 12 percent of a standard deviation after controlling for both Child's Health and Parenting Practices, a decrease of 4.4 percent of a standard deviation. The changes in the magnitudes of the coefficients in Table 5.3 suggest that both Child's Health and Parenting Practices are in a position to act as channels through which maternal depression affects child's cognitive development.



Nevertheless, note that even after controlling for these two set of variables, there is a relatively large effect of maternal depression on PPVT of about 12 percent. This suggests that there may be other important channels that are not taken into account by these variables.

In this context, as the channels by which maternal depression affects children's cognitive development, Child's Health and Parenting Practices can be captured by data. However, some other channels cannot be captured by data, such as the quality of parenting practices, the quality of mother-child relationship. For example, the variable "books" only provides information on how often the mother reads to her child during a typical week, but the data contain no information on how long the reading is or how well it is. In addition, the possible emotional negligence to her child by a depressed mother is not captured by the data as well.

Some interesting findings from the complete set of results in Appendix F can be summarized as follows. First, regular bedtime is strongly and positively associated with PPVT, with an effect of about 25.3 percent of a standard deviation. This is highly consistent with current research findings. For instance, Gaylor et al. (2010) find that regular bedtime is an important factor in four-year-olds' development in the use of language, literacy and early mathematics ability, and a consistent bedtime results in higher outcomes. This highlights the importance of a consistent bedtime reinforced by intentional parenting practices for children's overall cognitive development. Second, TV time is negatively related to PPVT, with the effect statistically significant, though the magnitude is about 3.4 percent of a standard deviation. This is consistent with previous findings (e.g., Zimmerman and Christakis, 2005), and it suggests that parents should

abide by the guidelines recommended by the American Academy of Pediatrics (AAP) that kids under 2 years old should not watch any TV and that those older than 2 watch no more than 1 to 2 hours a day of quality programming. In sum, those findings confirm the importance of parenting practices, mostly mothering practices, in developing children's cognitive skills, and they are consistent with previous literature (Lugo-Gil and Tamis-LeMonda, 2008; Whiteside-Mansell et al., 2008).

### **5.3.1 Effects of Maternal Depression on Child's Health and Parenting Practices**

If Child's Health and Parental Practices are indeed channels through which maternal depression affect PPVT, then maternal depression must have an effect on those variables in the first place. Table 7 presents the results by using child's health and parenting practices as outcomes to explore the effects of maternal depression. To obtain the results, both the pooled OLS and FE models are implemented on the covariates by using each item under Child's Health or Parenting Practices as the dependent variable, for example, using whether or not the child has asthma at year  $t$ , and whether or not the child has a regular bedtime at year  $t$ , as outcomes. Both the Pooled OLS and the FE models are applied.

Row (2) shows that maternal depression results in lower quality of the children's health. Specifically, when a mother is depressed, her child is 2.8 percent less likely to have a good health status, which is statistically significant. Moreover, Row (3) suggests that a child whose mother is depressed has a 4.8 percent lower probability to develop obesity. Although this could be thought as being positive, it could also suggest that children may not eat well when their mothers are depressed, and the poor nutrition status could affect their cognitive development. As for parenting practices, Row (5) shows that

a child tends to watch more TV when his mother is depressed. The effect is statistically significant. This implies that when a mother is depressed, there is a higher possibility for her to leave her child unattended for a longer time.

It is concluded from the results in Table 7 that maternal depression, to some extent, negatively affects both Child's Health and Parenting Practices, which in turn, can affect the child's cognitive development. In other words, both Child's Health and Parenting Practices could be important channels through which maternal depression affects child's cognitive development.

## Chapter 6

### Maternal Depression and Behavioral Problems

#### 6.1 Results

This Section reports the effects of maternal depression on child's behavior problems. Tables 4.1 through 4.3 present the results of the effects of maternal depression on each BPI outcome. Tables 5.1 through 5.3 display the results of heterogeneity effects of maternal depression on each BPI outcome. Tables 6.1 through 6.3 present the results of the effects of maternal depression plus potential channels on each BPI outcome.

##### 6.1.1 Basic Specification

Table 4.1 presents the results of the effects of maternal depression on each BPI outcome of Anxiety/Depression. It provides a summary of the results from the pooled OLS and the family FE models. Model (1) is unadjusted, and Model (2) controls for the time-variant covariates ( $E_{i,t}$ ) including marital status, maternal employment, maternal household income (poverty ratio) and number of kids in mother's household, and time-invariant covariates ( $C_i$  and  $M_i$ ) including child's characteristics, parent's characteristics and mother's prenatal and postnatal information. As in Chapter 5, each explanatory variable in the regressions is paired with a dummy variable equaling 1 whenever the explanatory variable has a missing value and 0 otherwise. The explanatory variables with missing values are set equal to 0.

The effect of maternal depression from the pooled OLS adjusting for covariates (Model 2) is about 0.362, which is statistically significant. It says that maternal depression, on average, leads to an increase of BPI of Anxiety/Depression by 36.2 percent of a standard deviation. However, as previously discussed, in this cross-section

analysis, the effect of maternal depression might be biased by omitted variables. The effect of maternal depression from the FE model further controlling for time-covariates (Model 2) is about 0.209, which is statistically significant. It says that maternal depression, on average, leads to an increase of BPI of Anxiety/Depression by 20.9 percent of a standard deviation. The associations obtained in the pooled OLS are reduced by almost a half by the inclusion of fixed effects and time-varying covariates. The results from the Pooled OLS model and the FE model are statistically different from each other.

The standard errors are adjusted for individual-level clustering in both the Pooled OLS and the FE models in the following discussions.

Table 4.2 provides the results on BPI of Withdrawal. In short, the model structures are the same as those of BPI of Anxiety/Depression except the different outcome. It presents the results from the basic specifications of the pooled OLS and the FE models. The pooled OLS Model suggests that child's withdrawal behavior is strongly associated with maternal depression; however, the association is basically wiped out and becomes insignificant after inclusions of fixed effects. This might suggest that withdrawal behavior is more related to the fixed effects caused by the unobservables, such as genetic influences, household family characteristics and household childcare habits.

Both Anxiety/Depression and Withdrawal behaviors are composed of Internalizing Problems. If we perform similar regressions on an Internalizing Behaviors Index, we would obtain similar results to what we have obtained on the Anxiety/Depression part.

The gain through breaking it into two individual measures is to enable us see what would be the exact problems that fragile families have regarding child's behaviors.<sup>6</sup>

Table 4.3 shows that there is a strong association between child's aggression behaviors with maternal depression based on the results from the pooled OLS. This is in agreement with the previous research (e.g., Malik et al., 2007). However, most of the association fades away and becomes significant only at the 10% of significance level based on the FE models. Similar to the Withdrawal behaviors outcome, this might suggest that child's aggression behavior is more related to the fixed effects caused by the unobservables, such as genetic influences, household family characteristics and household childcare habits. The current study by Hendricks and Liu (2012) points out that maternal depression increases the likelihood of early childhood aggression by causing negative parenting behaviors. Moreover, they stress that more research is needed to determine the etiology and interplay of mediating factors between maternal depression and childhood aggression.

## **6.2 Heterogeneity of Effects of Maternal Depression on BPI Outcomes**

In this section, we analyze how the effect of maternal depression on Behavioral Problems varies with respect to non-marital families, non-marital families with high poverty level, poverty level, race, gender and maternal education.

Tables 5.1 through 5.3 provide the heterogeneity of the results from the Pooled OLS and the FE models corresponding to model (2) in Table 3.1, employing the three different Behavior Problems Indexes as outcomes individually. Table 5.1 is about the

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<sup>6</sup> Figures 1 and 2 in Appendix D presents the descriptive evidence of the effect of maternal depression on child's Internalizing Behaviors, and Tables in Appendix E provides the results when the Internalizing Behaviors Index employed as the outcome in the regressions.

Anxiety/Depression behavior, Table 5.2 is about the Withdrawal behavior, and Table 5.3 is about the Aggression behavior.

### **6.2.1 Heterogeneity of Effect with Respect to Non-marital Status**

Separate regressions are run for married and unmarried mothers.

About the effect of maternal depression on child's Anxiety/Depression behavior, Row (1) in Table 5.1 shows the results for unmarried mothers, where the average total effect of maternal depression is about 27.6 percent of a standard deviation, remaining statistically significant. In contrast to the results in Table 4.1, the magnitude gets larger, implying that children from non-marital families may have a higher chance to be anxious/depressed when exposed to maternal depression. Row (2) is regarding the marital case. The average total effect of maternal depression is about 29.2 percent of a standard deviation, remaining statistically significant. A t-test shows that the results between married mothers and unmarried mothers are not statistically different.

Similarly, Row (1) in Table 5.2 is for the sub-group of unmarried mothers. The result from the FE model shows that maternal depression has no statistically significant effect on child's withdrawal behavior. Row (2) in Table 5.2 is the sub-group of married mothers. The result from the FE model is 32.4 percent of a standard deviation, statistically significant at 10% significant level.

Similar to Table 5.1 and 5.2, Row (1) in Table 5.3 is the sub-group of unmarried mothers, and Row (2) in Table 5.3 is the sub-group of married mothers. For children from non-marital families, the effect of maternal depression on child's Aggression behavior from the FE model is about 12 percent of a standard deviation, which is significant at 10%

significance level. For children from marital families, the effect from the FE model is not statistically significant.

### **6.2.2 Heterogeneity of Effect with Respect to Non-marital Families with a High Poverty Level**

Rows (3) are regarding the non-marital case with a poverty ratio of 300 percent of the Local Poverty Line or less in Tables 5.1 through 5.3. In this case, the average total effect of maternal depression on child's Anxiety/Depression is about 28.4 percent of a standard deviation, remaining statistically significant. In contrast to Row (1), the magnitude gets slightly larger, suggesting that children from non-marital families with a higher poverty level face a higher risk of adverse development of behavioral health when exposed to maternal depression, although the difference is not statistically different.

Row (3) in Table 5.2 presents the result on child's Withdrawal behavior. The result suggests no effect. In Table 5.3, Row (3) shows the result of maternal depression on child's Aggression behavior. The effect is about 17.1 percent of a standard deviation, which is statistically significant at 5% significance level.

In summary, children from non-marital families with higher poverty level present more behavior problems.

### **6.2.3 Heterogeneity of Effect with Respect to Poverty Level**

Rows (4) through (6) provide the results when breaking the sample by poverty level. Table 5.1 shows that maternal depression has an insignificant effect on child's Anxiety/Depression behavior when poverty ratio falls between 1 and 2 or rises above 2, but significant when poverty ratio is less or equal to 1. The average total effect of this group is 31.3 percent of a standard deviation, and it is statistically significant. This is in



agreement with the findings from the previous research. Both Bolger et al. (1995) and Duncan et al. (1994) find that children from poor neighborhood exhibit more socio-emotional problems. A recent study by Slopen et al. (2010) reports that children from poor households have more internalizing and externalizing symptoms than those from non-poor households.

Both Table 5.2 and Table 5.3 present no evidence that maternal depression affects child's Withdrawal and Aggression Behaviors.

#### **6.2.4 Heterogeneity of Effect with Respect to Race**

Rows (7) through (9) provide the results when breaking the sample by different races. Based on the FE model in Table 5.1, maternal depression has an insignificant effect on Whites and Other Races, but significant on Blacks. The average total effect for Blacks is 36.4 percent of a standard deviation, and it is statistically significant. The t-test of whether the coefficients differ significantly across Other Races and the rest is 2.14.

According to Vosler and Proctor (1990), race is the second highest of five factors explaining the variance in child behavior problems, while Achenbach et al. (1991) presents that race explains very little of the variability in child behavior problems, which is echoed by Dodge et al. (1994). They find that racial differences in child behavior problems fade away after controlling for socioeconomic status. Previous research shows that race is strongly associated with income. In our Research Sample, Blacks' mean of the poverty ratio is 1.33, while non-Blacks' mean of the poverty ratio is 2.38. They are statistically different from each other. Our finding suggests that low income might be the main contributor of the effect of maternal depression in the group of Blacks.

Table 5.2 presents on evidence that maternal depression affects child's Withdrawal behavior; however, in Table 5.3, Row (9) presents the effect of maternal depression on child's Aggression behavior for Other Races, which is about 27.9 percent of a standard deviation.

### **6.2.5 Heterogeneity of Effect with Respect to Gender**

Rows (10) and (11) show the effects by the children's gender. We find that maternal depression has a much larger adverse effect on girls. Girls from depressed mothers tend to have a higher Anxiety/Depression Index of about 30.7 percent of a standard deviation less than those whose mothers are not depressed between Year-three and Year-five, and the effect is statistically significant. However, the results show no evidence that maternal depression affects child's Withdrawal and Aggression behaviors.

Child gender differences in the effects of maternal depression have been previously documented in the literature. Sinclair and Murray (1998) report raised levels of child disturbance at school among boys exposed to maternal depression. Similarly, Costello et al. (2003) find that boys have more externalizing problems. This is also confirmed by Essex et al. (2003), in the meanwhile, they also find that girls of depressed mothers show a greater preponderance to internalizing behaviors. In addition, both Angold et al. (2002) and Hay et al. (2008) find that girls present more internalizing problems that often become more severe in adolescence.

### **6.2.6 Heterogeneity of Effect with Respect to Maternal Education**

Rows (12) and (13) show the effects by maternal education.

About Anxiety/Depression behavior, we find that maternal depression has significantly adverse effect on children no matter what the maternal education is, but the magnitudes

are different. The effect is about 33.3 percent of a standard deviation, and statistically significant for mothers who have education less than high school, in contrast, it is about 19.7 percent of a standard deviation for mothers who have education high school or above.<sup>7</sup> The difference is not statistically significant.

The results in Table 5.2 present no evidence that maternal depression affects child's Withdrawal behavior for the 2 sub-groups. However, it presents in Table 5.3 that maternal depression has a statistically significant effect of about 19.7 percent of a standard deviation for children whose mothers have education of high school or above. This is very similar to the case when we employ PPVT as outcome in Section 5.2.5. There, we found that maternal depression has a statistically insignificant effect on the cognitive development of children whose mothers have education of high school or less; however, a statistically significant effect for children whose mothers have education of more than high school.

### **6.3 Analysis of the Channels through which Maternal Depression Affects BPI**

#### **6.3.1 Effects of Maternal Depression plus Potential Channels**

In this section, we analyze the possible mechanisms through which maternal depression affects the three different Behavior Problems Indexes. As discussed in Chapters 2 and 4, two potential important mechanisms are Child's Health and Parenting Practices. Tables 6.1 through 6.3 present the results for both the Pooled OLS and the FE models when controlling for Child Health and Parenting Practices. To facilitate comparisons, Rows (1) in Tables 6.1 through 6.3 replicate the results presented as

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<sup>7</sup> However, the results do change in terms of maternal education when employing Internalizing Behavior Index as the outcome. The results are provided in Appendix E, where maternal depression has a statistically insignificant effect for the group of maternal education is high school or above.

“Model (2)” in Table 4.1 through 4.3. In Row (2), we additionally control for Child Health. Row (3) is the case controlling for Parenting Practices, and Row (4) is the case controlling for both Child Health and Parenting Practices.

Both the Pooled OLS and the FE models display a similar tendency after controlling for Child’s Health and /or Parenting Practices. Specifically, based on the FE models, Row (1) presents that, on average, children from depressed mothers tend to lead to an increase of 20.9 percent of a standard deviation of the BPI of Anxiety/Depression; however, the magnitude goes down to 6.4 percent of a standard deviation and becomes statistically insignificant after controlling for Child’s Health, suggesting that Child’s Health, as a possible channel through which maternal depression affects BPI, wipes out 14.5 percent of a standard deviation. Similarly, Parenting Practices reduce the effect of maternal depression by 4.4 percent of a standard deviation. Moreover, the effect of maternal depression falls to 6.9 percent of a standard deviation and becomes statistically insignificant after controlling for both Child’s Health and Parenting Practices, a decrease of 14 percent of a standard deviation. The changes in the magnitudes of the coefficients in Table 6.1 suggest that Parenting Practices, and mainly Child’s Health are in a position to act as channels through which maternal depression affects child’s BPI of Anxiety/Depression.

In this context, as the channels by which maternal depression affects children’s behavioral development, Child’s Health and Parenting Practices can be captured by data. However, some other channels cannot be captured by data, such as the quality of parenting practices and the quality of mother-child relationship. For example, the variable “books” only provides information on how often the mother reads to her child during a

typical week, but the data contain no information on how long the reading is or how well it is. In addition, the possible emotional negligence to her child by a depressed mother is not captured by the data, so is the possible observational learning by the child herself as well.

### **6.3.2 Effects of Maternal Depression on Child's Health and Parenting Practices**

If Child's Health and Parental Practices are indeed channels through which maternal depression affect BPI, then maternal depression must have an effect on those variables in the first place. The analysis that we previously did in Section 5.3.1 also applies here because we find that maternal depression negatively affects child's health and parenting practices. Thus, we conclude that Child's Health and Parenting Practices could be important channels through which maternal depression affects child's behavioral health development.

## Chapter 7

### Conclusion and Policy Implications

Maternal depression is an “adverse early environment” and imposes a big risk to not only depressed mothers but also their children. The medical literature suggests that maternal depression is negatively associated with the quality of parenting practices and the mother-child relationship. In turn, the lower quality of parenting practices and mother-child relationship might harm children’s development. This thesis analyzed the question “to what extent does maternal depression affect children’s development within a low socio-economic population?” by using the data from the FFCWS. The results suggest that the children from the FFCWS face a higher risk of having an adverse development when exposed to maternal depression.

We exploit the panel data structure of the FFCWS in order to control for time-invariant unobserved factors that may confound the relation of interest, such as genetic influences, family child care habits and cultural influences. The FE results provide new evidence that maternal depression negatively affects children’s development.

The first main analysis of this thesis investigated the effect of maternal depression on children’s cognitive development. We find that there is a negative effect of maternal depression on children’s cognitive development from age three to age five within fragile families, which is significantly different from zero. Specifically, the results from the FE models show that maternal depression tends to reduce PPVT score by about 16.4 percent of a standard deviation. The results also show that maternal depression has a slightly more adverse effect (-16.8 percent of a standard deviation) on children’s cognitive development within non-marital families, as well as within non-marital families with

higher poverty level (-18.5 percent of a standard deviation). The effects are statistically significant. Moreover, we find that maternal depression has a larger adverse effect on girls (-23.2 percent of a standard deviation), on children whose mothers have an education level of high school or above (-24.4% of a standard deviation), and for races other than Blacks and Whites (e.g. Hispanics and Asian, -32.2 % of a standard deviation).

The second main analysis of this thesis is on the effect of maternal depression on children's behavioral problems. We find that maternal depression leads to an increase of 20.9 percent of a standard deviation, on average, on children's Anxiety/Depression Index from age three to age five within the fragile families, which is significantly different from zero at 1 percent significance level. We also find that maternal depression has a much larger adverse effect (about 31.3% of a standard deviation) on children from households living below the Local Poverty Line. In addition, we find that maternal depression has a moderately large effect on Black children (about 36.4 percent of a standard deviation) , as well as girls (about 30.7 percent of a standard deviation). We find no evidence that maternal depression affects contemporaneous child's Withdrawal behavior, but we find weak evidence that maternal depression affects child's Aggression behavior as a whole.

The findings in our study have important implications regarding public policies for dealing with the problem of maternal depression and child development within fragile families. The implication of this study from a policy standpoint is two-fold. First, it is important to pay more attention to maternal depression within the FFCWS given the fact that it is more prevalent. Actually, there are a number of measures to treat maternal depression, and treating it has been also linked to other positive outcomes in the literature. For instance, it has been shown that treatment of mother's depression improves

management of child's asthma, resulting in a reduction in asthma costs in the 6-month period following diagnosis of \$798 per asthmatic child whose mother is treated for depression (Perry, 2008). Second, it is important to implement measures to remediate those children affected by maternal depression because research has shown that there are high economic returns for remedial investments in young disadvantaged children, as opposed to low returns to interventions targeted toward disadvantaged adolescents (Carneiro and Heckman, 2003; Barnett, 2004; Cunha and Heckman, 2007; Cunha and Heckman, 2010).

There are a few limitations of this study. First, missing values impose some difficulties for the interpretation of the results in terms of the whole random sample of the FFCWS. However, our results are still relevant given that our sample involves, on average, even more disadvantaged families than those in the original FFCWS sample (e.g. they have a higher non-marital rate and a higher poverty level). Second, PPVT is the only measure of cognitive ability in the FFCWS. More measures could allow us to study different aspects of children's cognitive development. Third, there is no clinical or independent but parents' reporting about child's behavioral problems at Year 3 and Year 5 within the FFCWS. As a result, BPI can only be constructed based on parents' reporting on their own children's behaviors. Some previous research shows that maternal depression could cause over-reporting of child behavioral problems (Fergusson et al, 1993), so there might be estimation bias.<sup>8</sup> However, the fixed effects model would alleviate reporting bias if the bias is consistent within individuals over time (although it is difficult to know whether

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<sup>8</sup> Other research shows that there appears to be a substantive association between maternal depression and childhood behavior, although evidence exists for associations between maternal depressed mood and mother rating errors (Boyle et al., 1997). In addition, research also shows that maternal ratings of child behavior improve with treatment of maternal depression (Modell et al., 2001).



this is in fact the case). Fourth, a valid instrument cannot be found within the framework of the FFCWS; hence, the issue of reverse causality cannot be further addressed in this paper.

Finally, this thesis sets the ground for further related research. We will follow up the cognitive and behavioral health development of the children in the FFCWS as they attend school by age 7.

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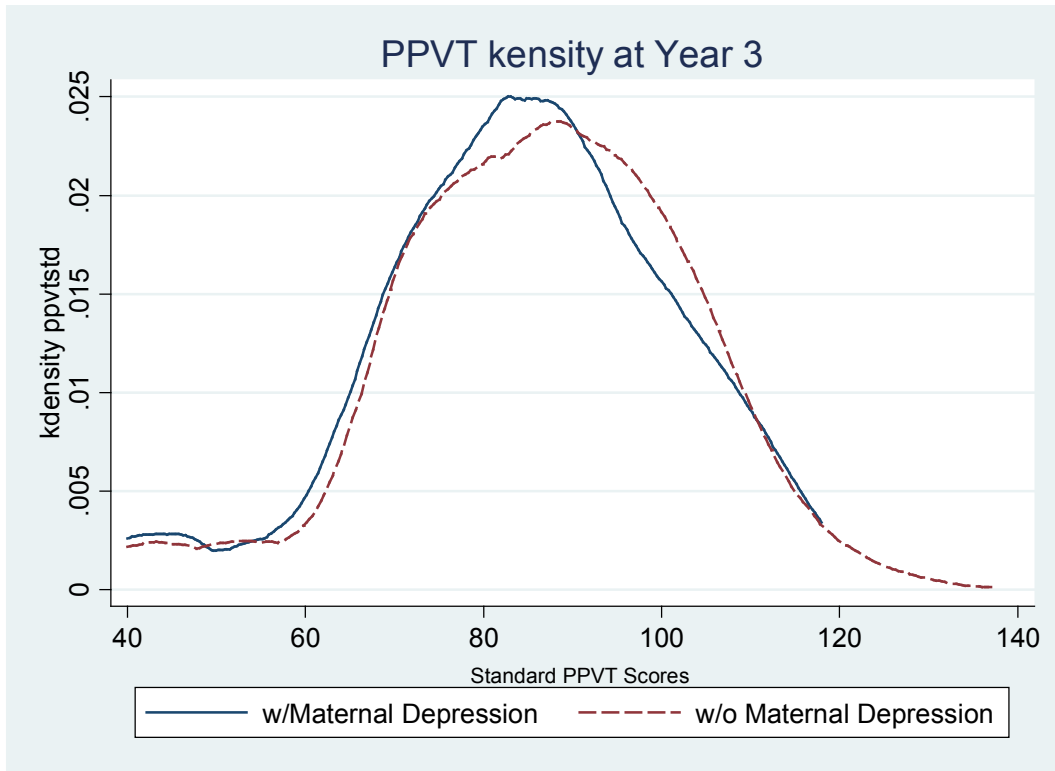
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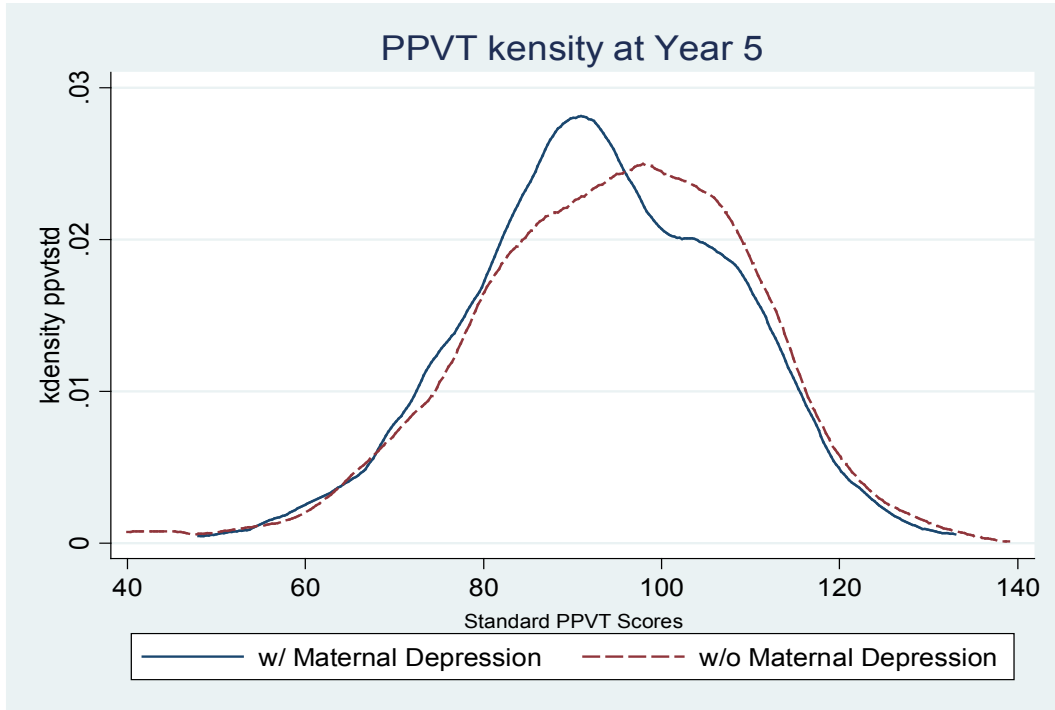
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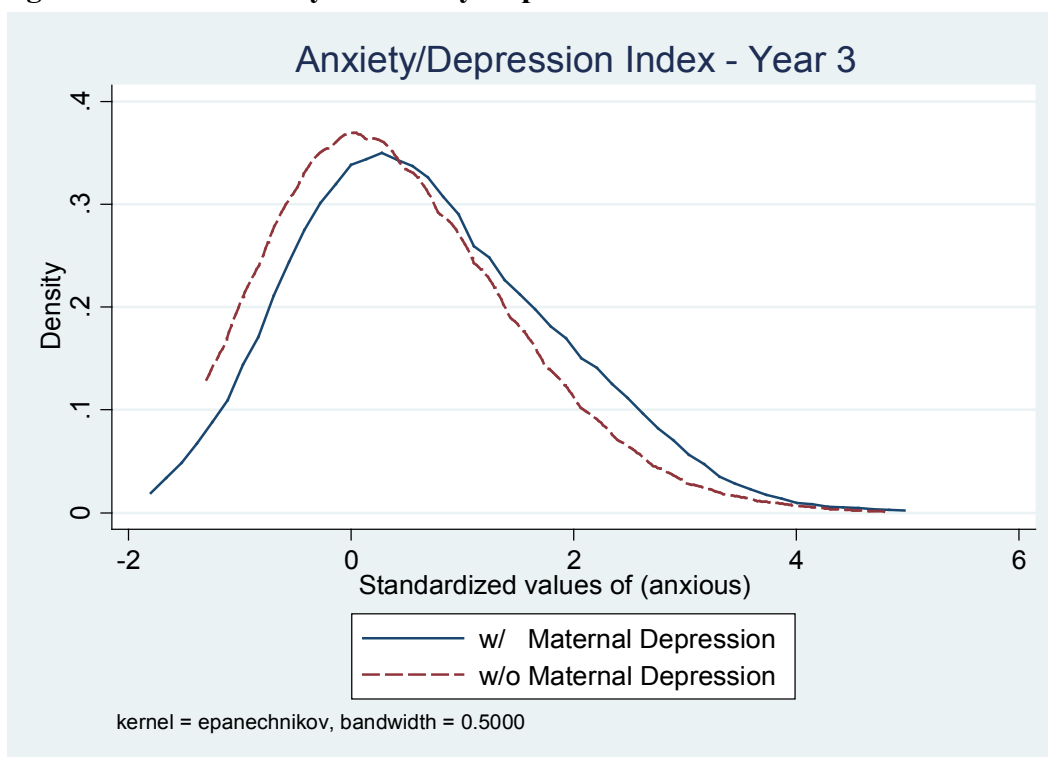
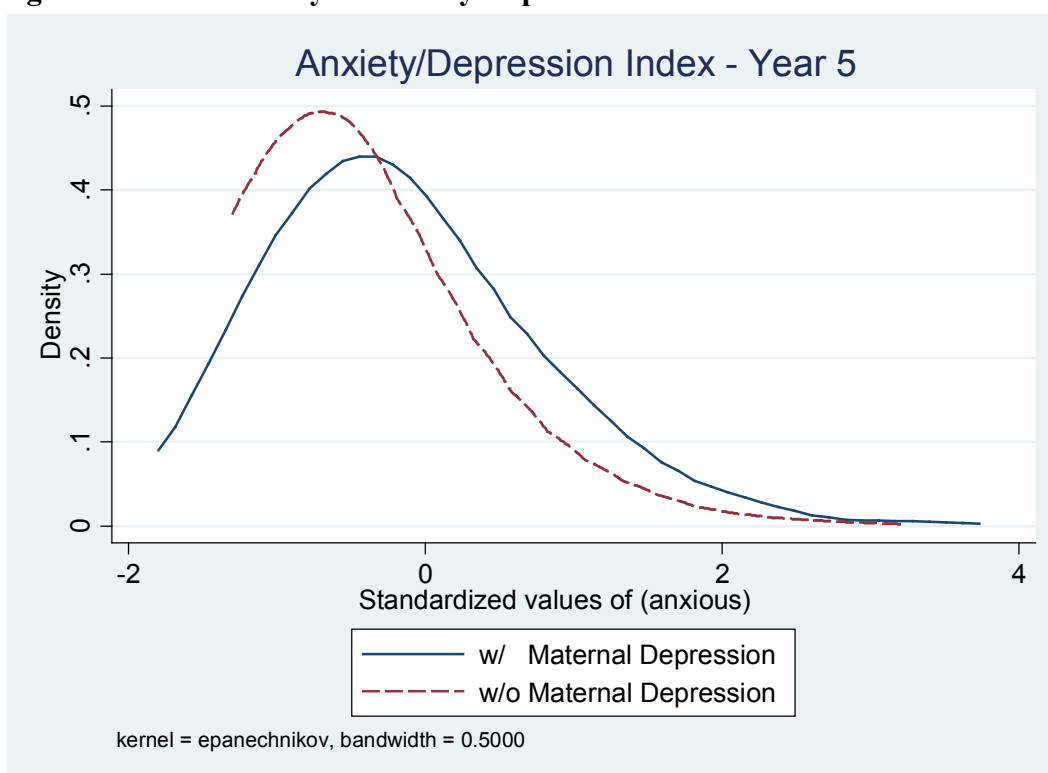
**Figure 1: Kernel Density of PPVT at Age 3\_ the Research Sample**

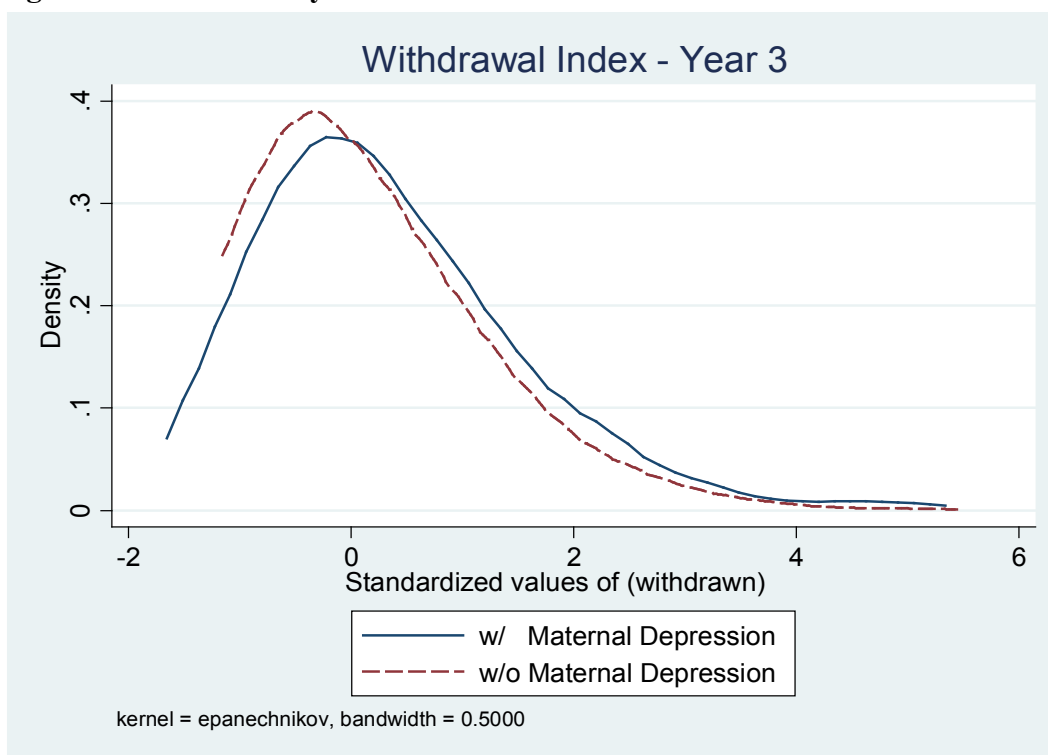
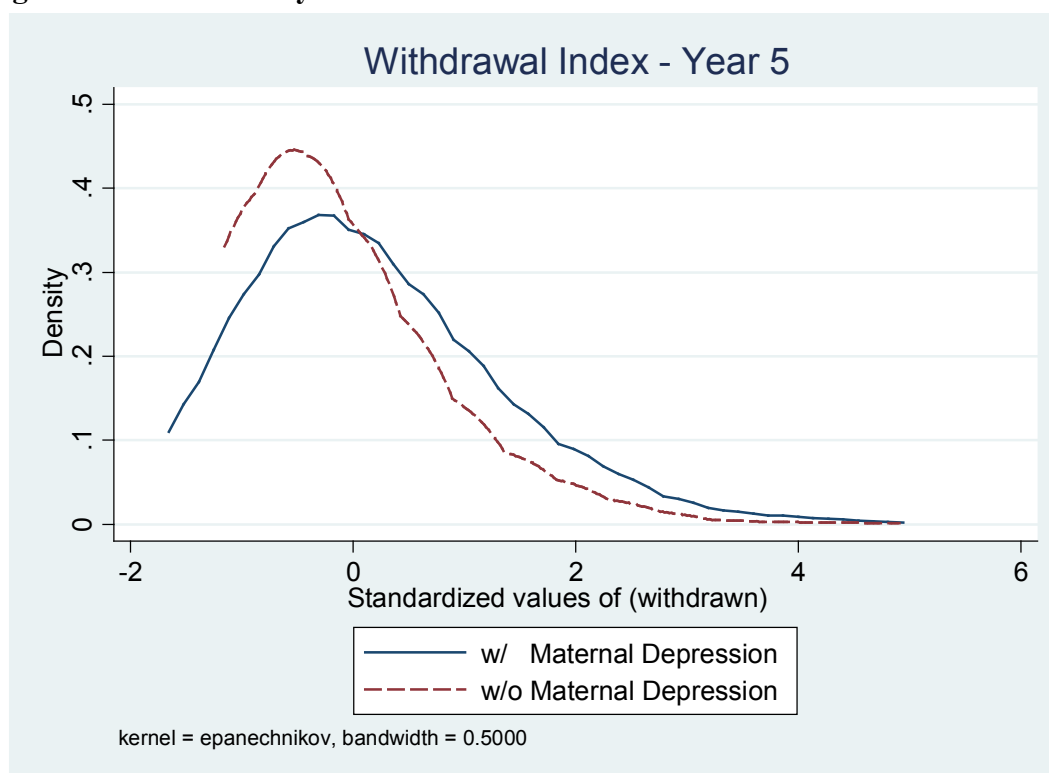


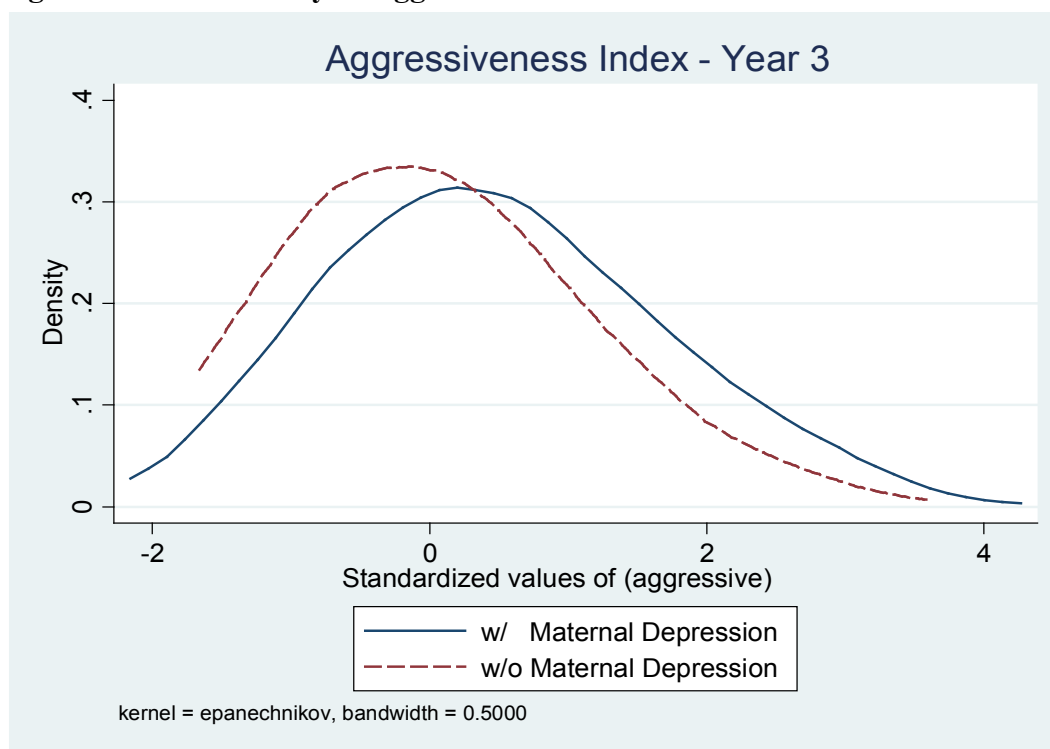
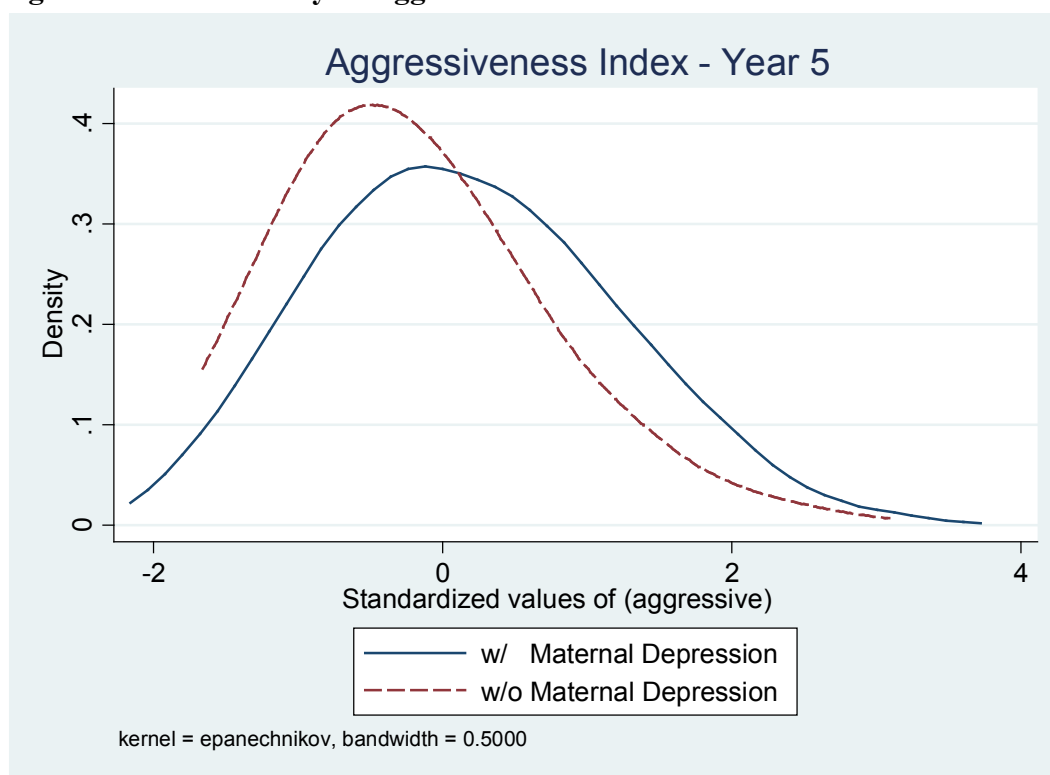
**Figure 2: Kernel Density of PPVT at Age 5\_ the Research Sample**





**Figure 3 Kernel Density of Anxiety/Depression Index – Year 3****Figure 4 Kernel Density of Anxiety/Depression Index – Year 5**

**Figure 5 Kernel Density of Withdrawal Index – Year 3****Figure 5 Kernel Density of Withdrawal Index – Year 5**

**Figure 7 Kernel Density of Aggression Index – Year 3****Figure 8 Kernel Density of Aggression Index – Year 5**

**Table 1.1 Overview of Sample Observations**

	<b>Available</b>	<b>Attrition-rate</b>	<b>With PPVT</b>	<b>Research Sample**</b>
Baseline	4,898*	-	-	-
Year-one	4,364	11%	-	-
Year-three	4,131	16%	2,368	1,727
Year-five	4,139	15%	2,330	1,727

Note:

\* The FFCWS follows a cohort of 4,898 children originally.

\*\* It refers to the children who took part in both Year-three and Year-five PPVT test.

Table 1.2 Key Variables Overview with respect to Missing Values

Key Variable	Year	Variable Name	Whole Sample			Research Sample			t-statistic
			N	Mean	[S. D.]	N	Mean	[S.D.]	
Non-marital	Base line	married	4,882	0.25	0.43				
	Year1	married	4,319	0.30	0.46				
	<b>Year3</b>	<b>married</b>	4,185	<b>0.32</b>	0.47	1,710	<b>0.28</b>	0.45	<b>3.41***</b>
	<b>Year5</b>	<b>married</b>	4,060	<b>0.32</b>	0.47	1,697	<b>0.28</b>	0.45	<b>2.64***</b>
Poverty Level	Base line	poverty ratio	4,897	2.22	2.41				
	Year1	poverty ratio	4,364	1.83	2.18				
	<b>Year3</b>	<b>poverty ratio</b>	4,231	<b>1.94</b>	2.53	1,728	<b>1.78</b>	2.00	<b>2.62***</b>
	<b>Year5</b>	<b>poverty ratio</b>	4,139	<b>1.92</b>	2.25	1,727	<b>1.79</b>	2.10	<b>2.19**</b>
	Base line	<300%*LPL <sup>9</sup>	4,897	0.78	0.42				
Year1	<300%*LPL	4,364	0.83	0.38					
<b>Year3</b>	<b>&lt;300%*LPL</b>	4,231	<b>0.81</b>	0.39	1,728	<b>0.83</b>	0.38	<b>-1.71*</b>	
<b>Year5</b>	<b>&lt;300%*LPL</b>	4,139	0.81	0.39	1,727	0.83	0.38	(1.61)	
Race Distribution	Baseline	blacks	4,886	0.48	0.50				
		whites	4,886	0.21	0.41				
		hispanic	4,886	0.27	0.45				
		other race	4,886	0.04	0.20				
	Year1	blacks	4,355	0.48	0.50				
		whites	4,355	0.22	0.41				
		hispanic	4,355	0.27	0.44				
		other race	4,355	0.04	0.19				
	<b>Year3</b>	<b>blacks</b>	4,220	<b>0.48</b>	0.50	1,724	<b>0.57</b>	0.50	<b>-5.99***</b>
		whites	4,220	0.22	0.41	1,724	0.20	0.40	1.18
		<b>hispanic</b>	4,220	<b>0.26</b>	0.44	1,724	<b>0.20</b>	0.40	<b>5.42***</b>
		other race	4,220	0.04	0.19	1,724	0.03	0.17	1.53
<b>Year5</b>	<b>blacks</b>	4,130	<b>0.49</b>	0.50	1,724	<b>0.57</b>	0.50	<b>-5.45***</b>	
	whites	4,130	0.21	0.41	1,724	0.20	0.40	0.57	
	<b>hispanic</b>	4,130	<b>0.26</b>	0.44	1,724	<b>0.20</b>	0.40	<b>5.61***</b>	
	other race	4,130	0.04	0.18	1,724	0.03	0.17	0.99	
<b>Maternal Depression</b>	<b>Year3</b>	maternal depression	4,221	0.21	0.40	1,727	0.22	0.42	(1.51)
	<b>Year5</b>	maternal depression	4,129	0.17	0.38	1,727	0.17	0.38	(0.18)

Note: \* p< 0.10 \*\* p<0.0 \*\*\* p<0.01

<sup>9</sup> LPL refers to local poverty line.

**Table 2.1 Research Sample Descriptive Characteristics - Year 3**

Variable	Research Sample		Sample w/ maternal depression		Sample w/o maternal depression		t- statistic
	N=1727		N=386		N=1341		
	Mean	[S. D.]	Mean	[S. D.]	Mean	[S. D.]	
standardized PPVT score	<b>86.01</b>	<b>16.47</b>	<b>84.58</b>	<b>16.41</b>	<b>86.45</b>	<b>16.44</b>	<b>-1.98**</b>
Anxiety/Depression Index	<b>0.50</b>	<b>0.01</b>	<b>0.56</b>	<b>0.02</b>	<b>0.48</b>	<b>0.01</b>	<b>-5.05***</b>
Withdrawal Index	<b>0.31</b>	<b>0.01</b>	<b>0.35</b>	<b>0.01</b>	<b>0.30</b>	<b>0.01</b>	<b>-3.78***</b>
Aggressiveness Index	<b>0.67</b>	<b>0.01</b>	<b>0.78</b>	<b>0.02</b>	<b>0.63</b>	<b>0.01</b>	<b>-6.66***</b>
maternal depression	0.22	0.42	1.00	-	-	-	
<b>Time-invariant Covariates-Child's Characteristics</b>							
gender	0.52	0.50	0.52	0.50	0.52	0.50	(0.11)
low birth weight	0.10	0.30	0.10	0.30	0.10	0.30	0.02
<b>breast feeding</b>	<b>0.53</b>	<b>0.50</b>	<b>0.57</b>	<b>0.50</b>	<b>0.52</b>	<b>0.50</b>	<b>1.91*</b>
disabilities	0.02	0.15	0.03	0.16	0.02	0.14	0.66
<b>Time-invariant Covariates-Parental Characteristics</b>							
less than high school	0.38	0.48	0.39	0.49	0.37	0.48	0.71
high school	0.28	0.45	0.27	0.44	0.28	0.45	(0.36)
<b>some college</b>	<b>0.25</b>	<b>0.43</b>	<b>0.30</b>	<b>0.46</b>	<b>0.24</b>	<b>0.43</b>	<b>2.27**</b>
<b>college</b>	<b>0.10</b>	<b>0.29</b>	<b>0.04</b>	<b>0.20</b>	<b>0.11</b>	<b>0.32</b>	<b>-5.26***</b>
whites	0.20	0.40	0.19	0.39	0.21	0.41	(0.71)
<b>blacks</b>	<b>0.57</b>	<b>0.50</b>	<b>0.62</b>	<b>0.49</b>	<b>0.55</b>	<b>0.50</b>	<b>2.57**</b>
<b>hispanic</b>	<b>0.20</b>	<b>0.40</b>	<b>0.15</b>	<b>0.36</b>	<b>0.21</b>	<b>0.41</b>	<b>-2.84***</b>
other race	0.03	0.17	0.03	0.18	0.03	0.17	0.45
<b>less than high school (father)</b>	<b>0.31</b>	<b>0.46</b>	<b>0.34</b>	<b>0.48</b>	<b>0.30</b>	<b>0.46</b>	<b>1.65*</b>
high school (father)	0.38	0.49	0.39	0.49	0.38	0.49	0.32
some college (father)	0.22	0.42	0.22	0.42	0.22	0.42	0.01
<b>college (father)</b>	<b>0.09</b>	<b>0.28</b>	<b>0.04</b>	<b>0.20</b>	<b>0.10</b>	<b>0.30</b>	<b>-4.11***</b>
<b>country</b>	<b>0.93</b>	<b>0.26</b>	<b>0.95</b>	<b>0.23</b>	<b>0.92</b>	<b>0.27</b>	<b>1.76*</b>
<b>Time-invariant Covariates-Mother's Characteristics during Pregnancy</b>							
<b>drinking</b>	<b>0.10</b>	<b>0.29</b>	<b>0.15</b>	<b>0.36</b>	<b>0.08</b>	<b>0.27</b>	<b>3.47***</b>
<b>drugs</b>	<b>0.05</b>	<b>0.22</b>	<b>0.08</b>	<b>0.27</b>	<b>0.04</b>	<b>0.20</b>	<b>2.44**</b>
<b>smoking</b>	<b>0.20</b>	<b>0.40</b>	<b>0.28</b>	<b>0.45</b>	<b>0.18</b>	<b>0.38</b>	<b>4.13***</b>
<b>treatment</b>	<b>0.04</b>	<b>0.20</b>	<b>0.06</b>	<b>0.25</b>	<b>0.04</b>	<b>0.19</b>	<b>2.09**</b>
<b>religion</b>	<b>0.58</b>	<b>0.49</b>	<b>0.53</b>	<b>0.50</b>	<b>0.59</b>	<b>0.49</b>	<b>-2.06**</b>
child care	0.27	0.45	0.26	0.44	0.27	0.45	(0.48)
<b>Controls</b>							
number of kids in the household	2.48	1.40	2.47	1.42	2.49	1.40	-0.14
<b>marital status</b>	<b>0.28</b>	<b>0.45</b>	<b>0.21</b>	<b>0.41</b>	<b>0.30</b>	<b>0.46</b>	<b>-3.60***</b>
maternal employment	0.90	0.30	0.90	0.30	0.90	0.30	(0.18)
<b>poverty ratio</b>	<b>1.78</b>	<b>2.00</b>	<b>1.42</b>	<b>1.56</b>	<b>1.88</b>	<b>2.10</b>	<b>-4.70***</b>
<b>Child Health</b>							
obesity	0.11	0.31	0.11	0.31	0.11	0.32	(0.37)
<b>health</b>	<b>0.98</b>	<b>0.14</b>	<b>0.95</b>	<b>0.21</b>	<b>0.99</b>	<b>0.12</b>	<b>-2.97***</b>
asthma	0.20	0.40	0.21	0.41	0.20	0.40	0.55
<b>Parenting Practices</b>							
songs	5.24	2.14	5.20	2.22	5.25	2.12	(0.38)
story	5.24	2.14	5.20	2.22	5.25	2.12	(0.38)
outdoor playing	2.66	2.20	2.82	2.21	2.62	2.20	1.56
books	3.87	0.46	3.85	0.47	3.87	0.45	(0.65)
<b>TV time</b>	<b>3.37</b>	<b>2.60</b>	<b>3.91</b>	<b>3.26</b>	<b>3.21</b>	<b>2.35</b>	<b>3.89***</b>
bed time	0.81	0.39	0.79	0.41	0.82	0.39	(1.13)

Note: \* p<0.10    \*\* p<0.05    \*\*\* p<0.01

Table 2.2 Research Sample Descriptive Characteristics - Year 5

Variable	Research Sample		Sample w/ maternal depression		Sample w/o maternal depression		t-statistic
	N=1727		N=297		N=1430		
	Mean	[S. D.]	Mean	[S. D.]	Mean	[S. D.]	
standardized PPVT score	94.04	15.34	93.11	14.36	94.24	15.53	(1.21)
<b>Anxiety/Depression Index</b>	<b>0.24</b>	<b>0.01</b>	<b>0.32</b>	<b>0.01</b>	<b>0.22</b>	<b>0.01</b>	<b>-7.45***</b>
<b>Withdrawal Index</b>	<b>0.24</b>	<b>0.01</b>	<b>0.31</b>	<b>0.01</b>	<b>0.22</b>	<b>0.01</b>	<b>-6.43***</b>
<b>Aggressiveness Index</b>	<b>0.56</b>	<b>0.01</b>	<b>0.68</b>	<b>0.02</b>	<b>0.54</b>	<b>0.01</b>	<b>-7.09***</b>
maternal depression	0.17	0.38	1.00	-	-	-	
<b>Time-invariant Covariates - Child's Characteristics</b>							
gender	0.52	0.50	0.52	0.50	0.52	0.50	1.46
low birth weight	0.10	0.30	0.10	0.30	0.10	0.30	(0.41)
<b>breast feeding</b>	0.53	0.50	0.57	0.50	0.52	0.50	1.62
disabilities	0.02	0.15	0.03	0.16	0.02	0.14	1.33
<b>Time-invariant Covariates - Parental Characteristics</b>							
less than high school	0.38	0.48	0.39	0.49	0.37	0.48	0.11
high school	0.28	0.45	0.27	0.44	0.28	0.45	(0.92)
<b>some college</b>	<b>0.25</b>	<b>0.43</b>	<b>0.30</b>	<b>0.46</b>	<b>0.24</b>	<b>0.43</b>	<b>2.77***</b>
<b>college</b>	<b>0.10</b>	<b>0.29</b>	<b>0.04</b>	<b>0.20</b>	<b>0.11</b>	<b>0.32</b>	<b>-3.99***</b>
whites	0.20	0.40	0.19	0.39	0.21	0.41	1.27
<b>blacks</b>	<b>0.57</b>	<b>0.50</b>	<b>0.62</b>	<b>0.49</b>	<b>0.55</b>	<b>0.50</b>	0.93
<b>hispanic</b>	<b>0.20</b>	<b>0.40</b>	<b>0.15</b>	<b>0.36</b>	<b>0.21</b>	<b>0.41</b>	<b>-3.14***</b>
other race	0.03	0.17	0.03	0.18	0.03	0.17	0.71
<b>less than high school (father)</b>	0.31	0.46	0.34	0.48	0.30	0.46	0.63
high school (father)	0.38	0.49	0.39	0.49	0.38	0.49	0.49
some college (father)	0.22	0.42	0.22	0.42	0.22	0.42	(0.24)
<b>college (father)</b>	<b>0.09</b>	<b>0.28</b>	<b>0.04</b>	<b>0.20</b>	<b>0.10</b>	<b>0.30</b>	<b>-1.74*</b>
<b>country</b>	0.93	0.26	0.95	0.23	0.92	0.27	1.54
<b>Time-invariant Covariates - Mother's Characteristics during Pregnancy</b>							
<b>drinking</b>	0.10	0.29	0.15	0.36	0.08	0.27	1.36
<b>drugs</b>	<b>0.05</b>	<b>0.22</b>	<b>0.08</b>	<b>0.27</b>	<b>0.04</b>	<b>0.20</b>	<b>2.03**</b>
<b>smoking</b>	<b>0.20</b>	<b>0.40</b>	<b>0.28</b>	<b>0.45</b>	<b>0.18</b>	<b>0.38</b>	<b>2.76***</b>
<b>treatment</b>	0.04	0.20	0.06	0.25	0.04	0.19	1.45
<b>religion</b>	<b>0.58</b>	<b>0.49</b>	<b>0.53</b>	<b>0.50</b>	<b>0.59</b>	<b>0.49</b>	<b>-1.69*</b>
child care	0.27	0.44	0.26	0.44	0.27	0.45	(0.67)
<b>Controls</b>							
number of kids in the household	2.59	1.43	2.57	1.52	2.60	1.41	(0.21)
<b>marital status</b>	<b>0.28</b>	<b>0.45</b>	<b>0.22</b>	<b>0.41</b>	<b>0.30</b>	<b>0.46</b>	<b>-3.02***</b>
maternal employment	0.92	0.28	0.90	0.30	0.92	0.27	(0.84)
<b>poverty ratio</b>	<b>1.79</b>	<b>2.10</b>	<b>1.46</b>	<b>1.78</b>	<b>1.86</b>	<b>2.15</b>	<b>-3.38***</b>
<b>Child Health</b>							
obesity	0.23	0.42	0.24	0.43	0.22	0.42	0.61
<b>health</b>	<b>0.99</b>	<b>0.12</b>	<b>0.96</b>	<b>0.20</b>	<b>0.99</b>	<b>0.10</b>	<b>-2.70***</b>
asthma	0.20	0.40	0.22	0.41	0.20	0.40	0.77
<b>Parenting Practices</b>							
songs	4.61	2.27	4.63	2.31	4.60	2.26	0.16
story	4.72	2.08	4.54	2.20	4.75	2.05	(1.51)
outdoor playing	2.06	1.87	2.05	1.91	2.06	1.87	(0.07)
books	3.92	0.34	3.93	0.33	3.91	0.35	0.64
TV time	2.67	2.10	2.58	1.80	2.69	2.15	(0.87)
bed time	0.92	0.27	0.90	0.30	0.92	0.27	(1.02)

Note: \* p<0.10    \*\* p<0.05    \*\*\* p<0.01

**Table 3.1 The Effects of Maternal Depression on Standardized PPVT**

Model No.	Pooled OLS		FE	
	(1)	(2)	(1)	(2)
Outcome: Standardized PPVT				
Controls	Unadjusted	All Covariates	Unadjusted	Time-variant Covariates
maternal depression	<b>-0.146***</b> (0.049)	<b>-0.116***</b> (0.044)	<b>-0.165***</b> (0.062)	<b>-0.164***</b> (0.062)
maternal employment		<b>0.199***</b> (0.069)		0.117 (0.117)
poverty ratio		<b>0.047***</b> (0.011)		0.016 (0.018)
marital status		<b>0.151***</b> (0.049)		0.140 (0.100)
number of kids in the household		<b>-0.061***</b> (0.014)		<b>0.067**</b> (0.031)
a dummy variable equal to 1 if maternal employment has a missing value and 0 otherwise		0.239 (0.132)		0.334 (0.208)
a dummy variable equal to 1 if marital status has a missing value and 0 otherwise		0.030 (0.166)		0.113 (0.275)
a dummy variable equal to 1 if number of kids in the household has a missing value and 0 otherwise		<b>0.334**</b> (0.151)		<b>0.551**</b> (0.275)
constant	<b>-0.635***</b> (0.024)	<b>-0.912***</b> (0.133)	<b>-0.631***</b> (0.019)	<b>-0.980***</b> (0.128)
N	3454	3454	3454	3454
R-sq	0.003	0.212	0.004	0.012

Note:

See Appendix F for detailed regression information.

Standard errors in parentheses.

\* p< 0.10      \*\* p<0.05      \*\*\* p<0.01



Table 3.2 Heterogeneity of Effects on Standardized PPVT

		Effect of Maternal Depression			Sample Size
		Pooled OLS +All Covariates	FE+Time-variant Covariates	t-test of whether the coefficients differ significantly across sub- samples	
<b>Marriage</b>					
(1)	<b>Non-marital</b>	<b>-0.117**</b> <b>(0.050)</b>	<b>-0.168**</b> <b>(0.074)</b>		<b>2495</b>
(2)	Married	-0.093 (0.098)	-0.274 (0.182)	-0.44	959
<b>Non-marital Family with High Poverty Level</b>					
(3)	<b>Non-marital + Poverty ratio&lt;=3</b>	<b>-0.117**</b> <b>(0.053)</b>	<b>-0.185**</b> <b>(0.080)</b>	-	<b>2279</b>
<b>Poverty Level</b>					
(4)	Poverty Ratio <=1	-0.018 (0.060)	-0.129 (0.116)		1590
(5)	1 < Poverty Ratio<=2	<b>-0.233**</b> <b>(0.094)</b>	-0.153 (0.257)	1.47	818
(6)	Poverty Ration>2	-0.142 (0.091)	-0.204 (0.217)		1046
<b>Race</b>					
(7)	Blacks	-0.068 (0.056)	-0.130 (0.083)		1954
(8)	Whites	-0.102 (0.094)	-0.132 (0.125)	-0.72	706
(9)	<b>Other Races</b>	<b>-0.313***</b> <b>(0.103)</b>	<b>-0.322**</b> <b>(0.143)</b>		<b>786</b>
<b>Gender</b>					
(10)	Boys	-0.049 (0.064)	-0.095 (0.087)		1798
(11)	<b>Girls</b>	<b>-0.180***</b> <b>(0.060)</b>	<b>-0.232**</b> <b>(0.090)</b>	1.07	<b>1656</b>
<b>Maternal Education</b>					
(12)	Less than high school	0.000 (0.071)	-0.132 (0.125)		1294
(13)	<b>High school or more</b>	<b>-0.177***</b> <b>(0.056)</b>	<b>-0.244***</b> <b>(0.078)</b>	<b>1.76</b>	<b>2160</b>

Note:

Standard errors in parentheses.

\* p&lt; 0.10    \*\* p&lt;0.05    \*\*\* p&lt;0.01

**Table 3.3 The Effects of Maternal Depression Plus Potential Channels**

		<b>Pooled OLS + All Covariates</b>	<b>FE+ Time-variant Covariates</b>
(1)	Maternal Depression	<b>-0.116***</b> (0.044)	<b>-0.164***</b> (0.062)
(2)	+ Child's Health	<b>-0.107**</b> (0.044)	<b>-0.128**</b> (0.062)
(3)	+ Parenting Practices	<b>-0.099**</b> (0.043)	<b>-0.143**</b> (0.061)
(4)	+ Child's Health & Parenting Practices	<b>-0.092**</b> (0.043)	<b>-0.120**</b> (0.061)

Note:

See Appendix F for detailed regression information.

Standard errors in parentheses.

\* p< 0.10      \*\* p<0.05      \*\*\* p<0.01

**Table 4.1 The Effects of Maternal Depression on BPI - Anxiety/Depression**

	Pooled OLS		FE	
	(1)	(2)	(1)	(2)
<b>Outcome: BPI – Anxiety/Depression</b>				
<b>Controls</b>	<b>Unadjusted</b>	<b>All Covariates</b>	<b>Unadjusted</b>	<b>Time-variant Covariates</b>
maternal depression	<b>0.391***</b> (0.044)	<b>0.362***</b> (0.045)	<b>0.243***</b> (0.073)	<b>0.209***</b> (0.069)
maternal employment		<b>0.440***</b> (0.039)		<b>0.551***</b> (0.043)
poverty ratio		<b>-0.030***</b> (0.009)		<b>-0.043*</b> (0.023)
marital status		-0.073 (0.046)		<b>-0.227*</b> (0.120)
number of kids in the household		0.009 (0.014)		-0.002 (0.032)
a dummy variable equal to 1 if maternal employment has a missing value and 0 otherwise		<b>0.919***</b> (0.144)		<b>1.201***</b> (0.146)
a dummy variable equal to 1 if poverty ratio has a missing value and 0 otherwise		-0.217 (0.449)		<b>-1.089**</b> (0.446)
a dummy variable equal to 1 if marital status has a missing value and 0 otherwise		<b>0.597**</b> (0.260)		<b>0.895***</b> (0.204)
a dummy variable equal to 1 if number of kids in the household has a missing value and 0 otherwise		0.156 (0.330)		0.445 (0.344)
constant	<b>-0.077***</b> (0.018)	<b>-0.250**</b> (0.123)	<b>-0.048***</b> (0.014)	<b>-0.502***</b> (0.107)
N	3454	3454	3454	3454
R-sq	0.024	0.115	0.007	0.126

Note:

See Appendix G for detailed regression information.

Standard errors in parentheses.

\* p< 0.10      \*\* p<0.05      \*\*\* p<0.01

Table 4.2 The Effects of Maternal Depression on BPI - Withdrawal

Model No.	Pooled OLS		FE	
	(1)	(2)	(1)	(2)
Outcome: BPI - Withdrawal				
Controls	Unadjusted	All Covariates	Unadjusted	Time-variant Covariates
maternal depression	<b>0.317***</b> (0.046)	<b>0.299***</b> (0.047)	0.061 (0.062)	0.047 (0.061)
maternal employment		<b>0.176***</b> (0.044)		<b>0.214***</b> (0.044)
poverty ratio		<b>-0.044***</b> (0.011)		-0.038 (0.020)
marital status		-0.034 (0.049)		<b>-0.282***</b> (0.096)
number of kids in the household		0.011 (0.015)		<b>-0.075***</b> (0.029)
a dummy variable equal to 1 if maternal employment has a missing value and 0 otherwise		<b>0.300**</b> (0.148)		<b>0.349**</b> (0.152)
a dummy variable equal to 1 if poverty ratio has a missing value and 0 otherwise		-0.264 (0.698)		-1.189 (0.772)
a dummy variable equal to 1 if marital status has a missing value and 0 otherwise		0.433 (0.383)		<b>0.735**</b> (0.300)
a dummy variable equal to 1 if number of kids in the household has a missing value and 0 otherwise		0.215 (0.583)		0.475 (0.682)
constant	<b>-0.063***</b> (0.018)	<b>0.026*</b> (0.135)	-0.012 (0.012)	0.077 (0.093)
N	3454	3454	3454	3454
R-sq	0.016	0.085	0.001	0.039

Note:

Standard errors in parentheses.

\* p&lt; 0.10      \*\* p&lt;0.05      \*\*\* p&lt;0.01

**Table 4.3 The Effects of Maternal Depression on BPI - Aggression**

Outcome: BPI - Aggression	Pooled OLS		FE	
	(1)	(2)	(1)	(2)
	Unadjusted	All Covariates	Unadjusted	Time-variant Covariates
maternal depression	<b>0.425***</b> (0.045)	<b>0.386***</b> (0.049)	<b>0.123**</b> (0.059)	<b>0.111*</b> (0.057)
maternal employment		<b>0.130***</b> (0.039)		<b>0.177***</b> (0.037)
poverty ratio		<b>-0.028**</b> (0.012)		-0.030 (0.017)
marital status		<b>-0.099*</b> (0.051)		<b>-0.258***</b> (0.086)
number of kids in the household		-0.000 (0.016)		-0.043 (0.025)
a dummy variable equal to 1 if maternal employment has a missing value and 0 otherwise		0.106 (0.143)		0.253 (0.143)
a dummy variable equal to 1 if poverty ratio has a missing value and 0 otherwise		0.095 (0.458)		-0.302 (0.494)
a dummy variable equal to 1 if marital status has a missing value and 0 otherwise		0.412 (0.302)		<b>0.706***</b> (0.272)
a dummy variable equal to 1 if number of kids in the household has a missing value and 0 otherwise		-0.060 (0.293)		-0.178 (0.357)
constant	<b>-0.084***</b> (0.018)	-0.047 (0.138)	<b>-0.024**</b> (0.012)	0.008 (0.082)
N	3454	3454	3454	3454
R-sq	0.029	0.082	0.003	0.039

Note:

Standard errors in parentheses.

\* p&lt;0.10    \*\* p&lt;0.05    \*\*\* p&lt;0.01

**Table 5.1 Heterogeneity of Effects of Maternal Depression on BPI - Anxiety/Depression**

		<b>Effect of Maternal Depression</b>			
		<b>Pooled OLS +All Covariates</b>	<b>FE + Time-variant Covariates</b>	<b>t-statistic of whether the coefficients differ significantly across sub- samples</b>	<b>Sample Size</b>
<b>Marriage</b>					
(1)	<b>Non-marital</b>	<b>0.351*** (0.050)</b>	<b>0.276*** (0.086)</b>	0.07	<b>2495</b>
(2)	Married	<b>0.350*** (0.094)</b>	<b>0.292* (0.156)</b>		959
<b>Non-marital Family with High Poverty Level</b>					
(3)	<b>Non-marital + Poverty ratio&lt;=3</b>	<b>0.347*** (0.053)</b>	<b>0.284*** (0.092)</b>	-0.39	<b>2279</b>
<b>Poverty Level</b>					
(4)	<b>Poverty Ratio &lt;=1</b>	<b>0.401*** (0.065)</b>	<b>0.313** (0.127)</b>		1590
(5)	1 < Poverty Ratio<=2	<b>0.224** (0.088)</b>	0.162 (0.189)	<b>2.41</b>	818
(6)	Poverty Ratio>2	<b>0.364*** (0.078)</b>	-0.008 (0.151)		1046
<b>Race</b>					
(7)	<b>Blacks</b>	<b>0.418*** (0.058)</b>	<b>0.364*** (0.100)</b>		1954
(8)	Whites	<b>0.207** (0.084)</b>	-0.080 (0.132)	<b>2.14</b>	706
(9)	Other Races	<b>0.323*** (0.116)</b>	0.240 (0.154)		<b>786</b>
<b>Gender</b>					
(10)	Boys	<b>0.349*** (0.060)</b>	<b>0.184* (0.099)</b>	-0.97	1798
(11)	<b>Girls</b>	<b>0.350*** (0.066)</b>	<b>0.307*** (0.106)</b>		<b>1656</b>
<b>Maternal Education</b>					
(12)	<b>Less than high school</b>	<b>0.284*** (0.080)</b>	<b>0.333** (0.135)</b>	0.92	1294
(13)	<b>High school or more</b>	<b>0.410*** (0.053)</b>	<b>0.197** (0.082)</b>		<b>2160</b>

Note:

Standard errors in parentheses.

\* p&lt; 0.10      \*\* p&lt;0.05      \*\*\* p&lt;0.01

**Table 5.2 Heterogeneity of Effects of Maternal Depression on BPI - Withdrawal**

		Effect of Maternal Depression			
		Pooled OLS +All Covariates	FE+Time- variant Covariates	t- statistic of whether the coefficients differ significantly across sub- samples	Sample Size
<b>Marriage</b>					
(1)	Non-marital	<b>0.266***</b> (0.053)	0.031 (0.072)	1.33	2495
(2)	<b>Married</b>	<b>0.312***</b> (0.097)	<b>0.324*</b> (0.169)		959
<b>Non-marital Family with High Poverty Level</b>					
(3)	Non-marital + Poverty ratio<=3	<b>0.285***</b> (0.055)	0.079 (0.074)	-	2279
<b>Poverty Level</b>					
(4)	Poverty Ratio <=1	<b>0.323***</b> (0.068)	0.079 (0.105)	0.28	1590
(5)	1 < Poverty Ratio<=2	<b>0.178</b> (0.091)	0.028 (0.154)		818
(6)	Poverty Ration>2	<b>0.234***</b> (0.081)	0.023 (0.142)		1046
<b>Race</b>					
(7)	Blacks	<b>0.309***</b> (0.060)	0.051 (0.082)	0.67	1954
(8)	Whites	<b>0.156</b> (0.086)	-0.097 (0.127)		706
(9)	Other Races	<b>0.321***</b> (0.123)	0.263 (0.146)		786
<b>Gender</b>					
(10)	Boys	<b>0.303***</b> (0.064)	0.020 (0.091)	-0.83	1798
(11)	<b>Girls</b>	<b>0.244***</b> (0.069)	0.102 (0.085)		1656
<b>Maternal Education</b>					
(12)	<b>Less than high school</b>	<b>0.380***</b> (0.082)	<b>0.189*</b> (0.110)	1.65	1294
(13)	High school or more	<b>0.227***</b> (0.055)	-0.009 (0.074)		2160

Note:

Standard errors in parentheses.

\* p&lt; 0.10    \*\* p&lt;0.05    \*\*\* p&lt;0.01

Table 5.3 Heterogeneity of Effects of Maternal Depression on BPI - Aggression

		Effect of Maternal Depression			Sample Size
		Pooled OLS +All Covariates	FE+Time-variant Covariates	t- statistic of whether the coefficients differ significantly across sub-samples	
<b>Marriage</b>					
(1)	<b>Non-marital</b>	<b>0.397***</b> (0.056)	<b>0.120*</b> (0.071)	0.28	2495
(2)	Married	<b>0.396***</b> (0.093)	0.182 (0.120)		959
<b>Non-marital Family with High Poverty Level</b>					
(3)	<b>Non-marital + Poverty ratio&lt;=3</b>	<b>0.407***</b> (0.058)	<b>0.171**</b> (0.075)	-	2279
<b>Poverty Level</b>					
(4)	Poverty Ratio <=1	<b>0.446***</b> (0.070)	0.150 (0.101)	-0.14	1590
(5)	1 < Poverty Ratio<=2	<b>0.250***</b> (0.092)	0.139 (0.174)		818
(6)	Poverty Ration>2	<b>0.406***</b> (0.089)	-0.108 (0.119)		1046
<b>Race</b>					
(7)	Blacks	<b>0.417***</b> (0.064)	0.110 (0.077)	0.36	1954
(8)	Whites	<b>0.332***</b> (0.097)	0.028 (0.117)		706
(9)	<b>Other Races</b>	<b>0.371***</b> (0.108)	<b>0.279**</b> (0.135)		786
<b>Gender</b>					
(10)	Boys	<b>0.436***</b> (0.066)	0.135 (0.086)	-0.06	1798
(11)	Girls	<b>0.332***</b> (0.069)	0.126 (0.080)		1656
<b>Maternal Education</b>					
(12)	Less than high school	<b>0.274***</b> (0.085)	0.107 (0.103)	-0.34	1294
(13)	<b>High school or more</b>	<b>0.478***</b> (0.057)	<b>0.148**</b> (0.070)		2160

Note:

Standard errors in parentheses.

\* p&lt; 0.10    \*\* p&lt;0.05    \*\*\* p&lt;0.01



**Table 6.1 The Effects of Maternal Depression Plus Potential Channels on BPI - Anxiety/Depression**

		<b>Pooled OLS + All Covariates</b>	<b>FE+ Time-variant Covariates</b>
(1)	Maternal Depression	<b>0.391***</b> (0.044)	<b>0.209***</b> (0.069)
(2)	+ Child's Health	<b>0.300***</b> (0.041)	0.064 (0.058)
(3)	+ Parenting Practices	<b>0.313***</b> (0.042)	<b>0.165**</b> (0.064)
(4)	+ Child's Health & Parenting Practices	<b>0.288***</b> (0.041)	0.069 (0.057)

Note:

See Appendix G for detailed regression information.

Standard errors in parentheses.

\* p< 0.10      \*\* p<0.05      \*\*\* p<0.01

**Table 6.2 The Effects of Maternal Depression Plus Potential Channels on BPI - Withdrawal**

		<b>Pooled OLS + All Covariates</b>	<b>FE+ Time-variant Covariates</b>
(1)	Maternal Depression	<b>0.299***</b> (0.047)	0.047 (0.061)
(2)	+ Child's Health	<b>0.258***</b> (0.045)	-0.001 (0.061)
(3)	+ Parenting Practices	<b>0.272***</b> (0.045)	0.046 (0.060)
(4)	+ Child's Health & Parenting Practices	<b>0.246***</b> (0.045)	0.015 (0.061)

Note:

Standard errors in parentheses.

\* p< 0.10      \*\* p<0.05      \*\*\* p<0.01

**Table 6.3 The Effects of Maternal Depression Plus Potential Channels on BPI - Aggression**

		<b>Pooled OLS + All Covariates</b>	<b>FE+ Time-variant Covariates</b>
(1)	Maternal Depression	<b>0.386***</b> (0.049)	<b>0.111*</b> (0.057)
(2)	+ Child's Health	<b>0.373**</b> (0.044)	0.048 (0.055)
(3)	+ Parenting Practices	<b>0.387**</b> (0.044)	<b>0.098*</b> (0.055)
(4)	+ Child's Health & Parenting Practices	<b>0.360**</b> (0.044)	0.057 (0.053)

Note:

Standard errors in parentheses.

\* p< 0.10      \*\* p<0.05      \*\*\* p<0.01

**Table 7 Channels as Outcomes**

	<b>Pooled OLS + Covariates</b>	<b>FE + Covariates</b>	<b>n Sample Size</b>
<b>Child's Health</b>			
whether or not the child has asthma at year t	0.007 (0.020)	0.009 (0.016)	3454
<b>whether or not the child has good health status at year t</b>	<b>-0.040*** (0.010)</b>	<b>-0.025** (0.011)</b>	3454
<b>whether or not the child is obese at year t</b>	-0.010 (0.017)	<b>-0.051** (0.023)</b>	3454
<b>Parenting Practices</b>			
whether or not the child has a regular bedtime at year t	-0.029 (0.016)	-0.010 (0.025)	3454
<b>how many hours the child watch TV on a typical day at home at year t</b>	<b>0.277** (0.116)</b>	<b>0.295* (0.170)</b>	3454
how many hours the child plays outdoor or anywhere else on a typical day at year t	0.110 (0.088)	0.128 (0.159)	3454
how many books the mother has for her child at home at year t	0.041 (0.028)	0.016 (0.047)	3454
how often the mother tells story to her child during a typical week at year t	-0.072 (0.102)	0.087 (0.144)	3454
how often the mother sings songs for her child during a typical week at year t	0.032 (0.108)	0.117 (0.143)	3454

Note:

Standard errors in parentheses

\* p&lt; 0.10      \*\* p&lt;0.05      \*\*\* p&lt;0.01

**Appendix A**

**Maternal Depression Transition Table between Year-three and Year-five**

Year 3		Year 5		
		0	1	
		1430	297	
0	1341	1204	137	1727
1	386	226	160	

Year 3		Year 5		
		0	1	
		82.80%	17.20%	
0	77.65%	69.72%	7.93%	100%
1	22.35%	13.09%	9.26%	

## Appendix: B Variable Description

The variable description is in accordance with the Data Codebook of FFCWS.

<b>ppvtstd</b>	Child's Standardized PPVT score
<b>momdep</b>	Binary, whether or not mother meets depression criteria at Year-one, Year-three and Year-five (CIDI)
<b>gender</b>	Binary, Focal baby's gender
<b>cmllbw</b>	Binary, whether or not the baby has Low Birth Weight
<b>obesity</b>	Binary, whether or not wap (weight for age percentile) greater or equal 95%
<b>health</b>	Binary, whether or not the child's health is in good condition
<b>asthma</b>	Binary, whether or not the child has had asthma by Year-three or Year-five
<b>lesshs</b>	Binary, whether or not the mother's education is below high school
<b>hs</b>	Binary, whether or not the mother's education is high school
<b>somocol</b>	Binary, whether or not the mother's education is some college
<b>college</b>	Binary, whether or not the mother's education is college or above
<b>whites</b>	Binary, whether or not the mother's race is White
<b>blacks</b>	Binary, whether or not the mother's race is Black
<b>hispanic</b>	Binary, whether or not the mother's race is Hispanic
<b>otherace</b>	Binary, whether or not the mother's race is other race, such as Asian, etc.
<b>country</b>	Binary, whether or not the mother was born in the US
<b>drinking</b>	Binary, whether or not the mother drink during pregnancy
<b>drugs</b>	Binary, whether or not the mother takes drugs during pregnancy
<b>smoking</b>	Binary, whether or not the mother smokes during pregnancy
<b>treatment</b>	Binary, whether or not the mother uses treatment during pregnancy
<b>religion</b>	Binary, whether or not the mother regularly goes to church
<b>childcare</b>	Binary, whether or not the mother uses childcare during pregnancy
<b>childnumber</b>	The number of children the mother have had at the child's birth
<b>breastfed</b>	Binary, whether or not the mother breastfeeds her child
<b>disabilities</b>	Binary, whether or not the child has any kind of disability
<b>onlychild</b>	Binary, whether or not the child is the only child to the mother at his birth
<b>dadlesshs</b>	Binary, whether or not the father's education is below high school
<b>dadhs</b>	Binary, whether or not the father's education is high school
<b>dadsomocol</b>	Binary, whether or not the father's education is some college
<b>dadcollege</b>	Binary, whether or not the father's education is college or above
<b>married</b>	Binary, whether or not the mother is married at Year-three or Year-five
<b>momworks</b>	Binary, whether or not the mother has worked since the child's birth
<b>povertyratio</b>	The ratio of the mother's household income over the local poverty line
<b>songs</b>	How often the mother sing songs for her child during a typical week
<b>story</b>	How often the mother tell stories to her child during a typical week
<b>outdoorplaying</b>	How many hours the child spends playing outdoor wither at home or somewhere else on a typical day
<b>books</b>	How many books the mother has for her child at home
<b>tvtime</b>	How many hours the child watch TV on a typical day
<b>bedtime</b>	Binary, whether or not the child has a regular bedtime

**Appendix C BPI Construction**  
**Table 1 Anxiety/Depression Index**

	<b>Year 3</b>	<b>Year 5</b>
	<b>Full Scale: 11 Items</b>	<b>Full Scale: 14 Items</b>
1	He/She is self-conscious or easily embarrassed	Child is self-conscious or easily embarrassed
2	(He/She) is too fearful or anxious	Child is too fearful or anxious
3	He/She is unhappy, sad, depressed	Child is unhappy, sad, or depressed
4	He/She clings to adults or is too dependent	Child complains of loneliness
5	He/She) feelings are easily hurt	Child cries a lot
6	He/She gets too upset when separated from parents	Child fears s/he might think/do something wrong
7	He/She looks unhappy without good reason	Child is nervous, hing strung, or tense
8	He/She is nervous, high strung, or tense	Child feels worthless/inferior
9	He/She is overtired	Child is suspicious
10	He/She wants a lot of attention	Child worries
11	He/She is too shy or timid	Child feels others out to get him/her
12		Child feels or complains no one loves him/her
13		Child feels s/he has to be perfect
14		Child feels too guilty
<b>Raw Score</b>	<b>[0,22]</b>	<b>[0,28]</b>
<b>weight</b>	<b>1/11</b>	<b>1/14</b>
<b>Comparable Raw Score</b>	<b>[0, 2]</b>	<b>[0, 2]</b>
	<b>Normalization as a pool</b>	

**Appendix C BPI Construction (Continued)**  
**Table 2 Withdrawal Index**

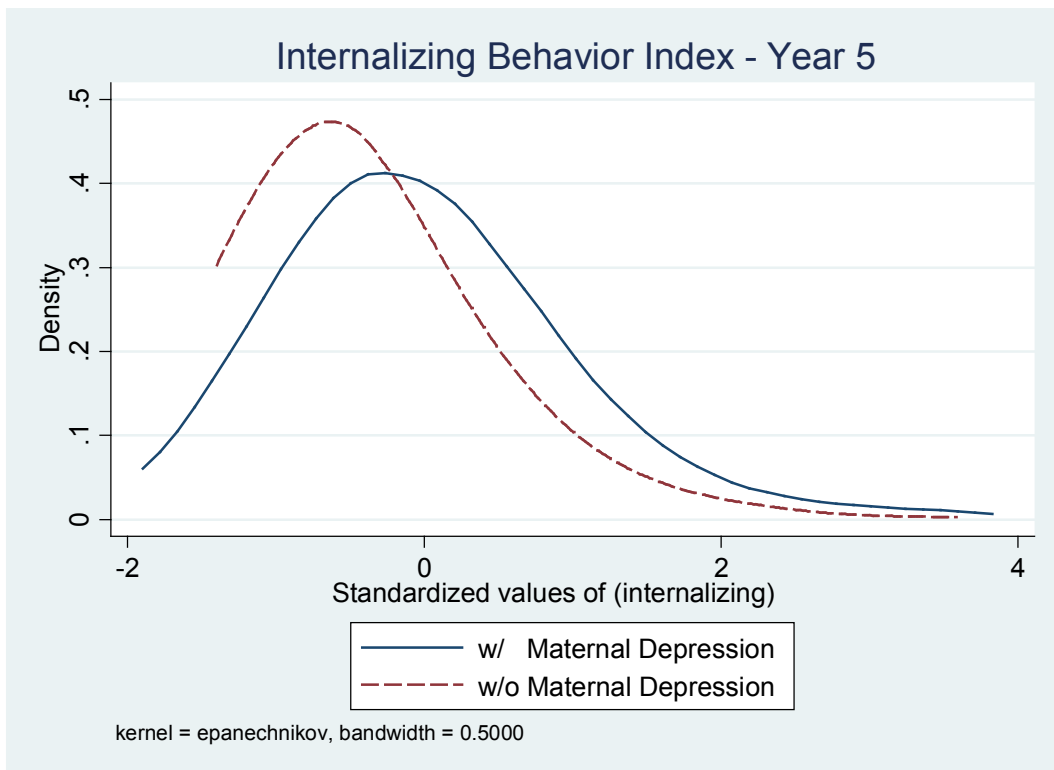
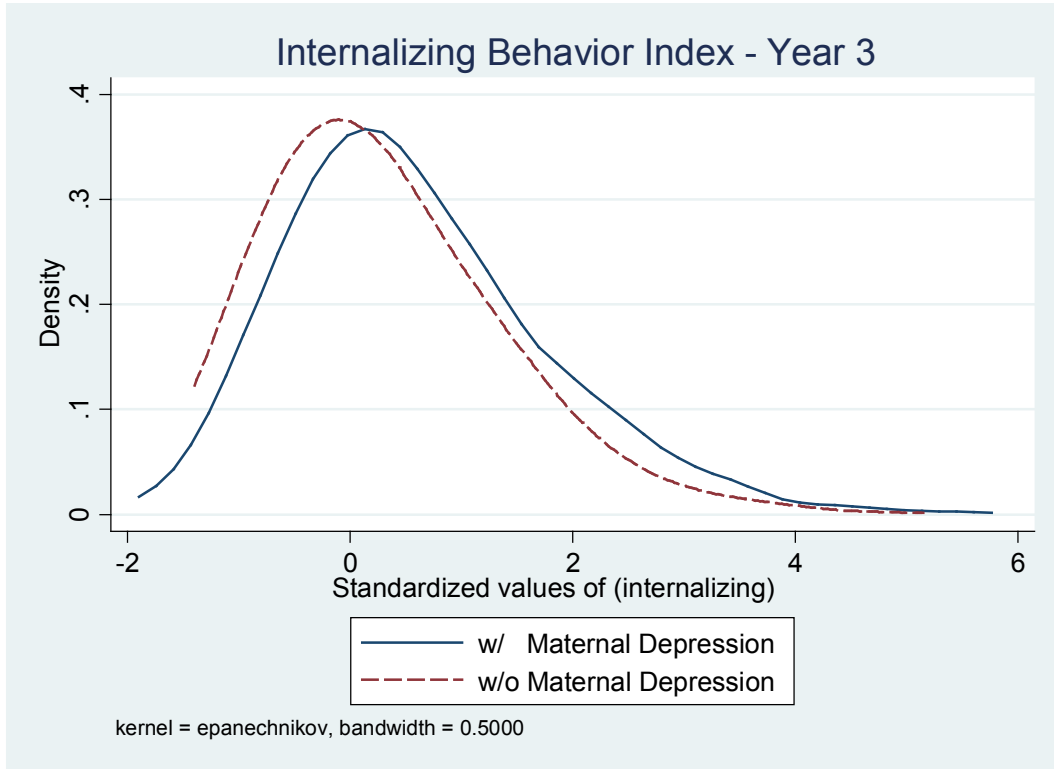
	<b>Year 3</b>	<b>Year 5</b>
	<b>Full Scale: 14 Items</b>	<b>Full Scale: 9 Items</b>
1	He/She acts too young for age	Child would rather be alone than with others
2	He/She avoids looking others in the eye	Child refuses to talk
3	He/She doesn't answer when people talk to (him/her)	Child is secretive, keeps things to self
4	He/She doesn't get along with other children	Child stares blankly
5	He/She doesn't know how to have fun, or he/she acts like little adult	Child sulks a lot
6	He/She doesn't seem to feel guilty after misbehaving	Child is underactive, slow moving, lacks energy
7	He/She refuses to play games	Child is unhappy, sad, or depressed
8	He/She seems unresponsive to affection	Child is shy or timid
9	He/She shows little affection toward people	Child is withdrawn, doesn't get involve w others
10	He/She shows little interest in things around (him/her)	
11	He/She is stubborn, sullen, or irritable	
12	He/She is uncooperative	
13	He/She is under active, slow moving, or lacks energy	
14	He/She is withdrawn, doesn't get involved with others	
<b>Raw Score</b>	<b>[0,28]</b>	<b>[0,18]</b>
<b>weight</b>	<b>1/14</b>	<b>1/9</b>
<b>Comparable Raw Score</b>	<b>[0, 2]</b>	<b>[0, 2]</b>
	<b>Normalization</b>	



**Appendix C BPI Construction (Continued)**  
**Table 3 Aggression Index**

	<b>Year 3</b>	<b>Year 5</b>
	<b>Full Scale: 15 Items</b>	<b>Full Scale: 20 Items</b>
<b>weight</b>	<b>Each item 1/15</b>	<b>Each item 1/20</b>
1	He/She screams a lot	Child screams a lot
2	(He/She) has sudden changes in mood or feelings	Child has sudden changes in mood of feelings
3	(He/She) has temper tantrums or hot temper	Child has temper tantrums or hot temper
4	He/She is unusually loud	Child is unusually loud
5	He/She is disobedient	He/She is disobedient at home
6	He/She is easily jealous	Child is easily jealous
7	He/She hits others	Child physically attacks people
8	He/She gets in many fights	He/She gets in many fights
9	He/She is whiny	He/She is disobedient in school
10	He/She is easily frustrated	Child argues a lot
11	(His/Her) demands must be met immediately	Child threatens people
12	He/She has angry moods	Child talks too much
13	Punishment doesn't change (hiHe/Sher) behavior	Child is stubborn, sullen, or irritable
14	He/She is defiant	Child teases a lot
15	He/She is selfish or won't share	Child is showing off or clowning
16		Child destroys things belong to his/her family or others
17		Child destroys his/her own things
18		Child demands a lot of attention
19		Child is cruel, bullying, or mean to others
20		Child brags or boasts
Raw Score	[0,30]	[0,40]
weight	1/15	1/20
<b>Comparable Raw Score</b>	<b>[0,2]</b>	<b>[0,2]</b>
	Normalization	

## Appendix D Kernel Density of Internalizing Behavior Index



## Appendix E

**Table 1 The Effects of Maternal Depression on Child's Internalizing Behavior**

	Pooled OLS		FE	
	(1)	(2)	(1)	(2)
<b>Outcome: Internalizing Behavior Index</b>				
Controls	Unadjusted	All Covariates	Unadjusted	Time-variant Covariates
maternal depression	<b>0.405***</b> (0.045)	<b>0.378***</b> (0.046)	<b>0.181***</b> (0.066)	<b>0.153**</b> (0.062)
maternal employment		<b>0.363***</b> (0.041)		<b>0.450***</b> (0.041)
poverty ratio		<b>-0.041***</b> (0.010)		<b>-0.046**</b> (0.021)
marital status		-0.063 (0.047)		<b>-0.286***</b> (0.104)
number of kids in the household		0.011 (0.014)		-0.040 (0.030)
a dummy variable equal to 1 if maternal employment has a missing value and 0 otherwise		<b>0.722***</b> (0.148)		<b>0.921***</b> (0.143)
a dummy variable equal to 1 if poverty ratio has a missing value and 0 otherwise		-0.271 (0.579)		<b>-1.287**</b> (0.607)
a dummy variable equal to 1 if marital status has a missing value and 0 otherwise		<b>0.592*</b> (0.326)		<b>0.933***</b> (0.235)
a dummy variable equal to 1 if number of kids in the household has a missing value and 0 otherwise		0.208 (0.461)		0.520 (0.522)
constant	<b>-0.080***</b> (0.018)	<b>-0.141</b> (0.130)	<b>-0.036***</b> (0.013)	<b>-0.270***</b> (0.096)
N	3454	3454	3454	3454
R-sq	0.026	0.121	0.005	0.111

Note:

Standard errors in parentheses.

\* p< 0.10    \*\* p<0.05    \*\*\* p<0.01

**Appendix E**  
**Table 2 Heterogeneity of Effects of Maternal Depression on Child's Internalizing Behavior**

		Effect of Maternal Depression		
		Pooled OLS +All Covariates	FE+Time-variant Covariates	Sample Size
<b>Marriage</b>				
(1)	<b>Non-marital</b>	<b>0.354***</b> (0.051)	<b>0.187**</b> (0.077)	2495
(2)	<b>Married</b>	<b>0.377***</b> (0.096)	<b>0.348**</b> (0.150)	959
<b>Non-marital Family with High Poverty Level</b>				
(3)	<b>Non-marital + Poverty ratio&lt;=3</b>	<b>0.361***</b> (0.054)	<b>0.216***</b> (0.081)	2279
<b>Poverty Level</b>				
(4)	<b>Poverty Ratio &lt;=1</b>	<b>0.414***</b> (0.067)	<b>0.234***</b> (0.114)	1590
(5)	1 < Poverty Ratio<=2	<b>0.230***</b> (0.087)	0.115 (0.170)	818
(6)	Poverty Ration>2	<b>0.345***</b> (0.077)	0.007 (0.134)	1046
<b>Race</b>				
(7)	<b>Blacks</b>	<b>0.418***</b> (0.058)	<b>0.251***</b> (0.087)	1954
(8)	Non-Blacks	<b>0.272***</b> (0.073)	0.091 (0.098)	1500
(9)	Whites	<b>0.208**</b> (0.082)	-0.100 (0.124)	706
(10)	<b>Non-Whites</b>	<b>0.400***</b> (0.053)	<b>0.262**</b> (0.076)	2748
(11)	<b>Other Races</b>	<b>0.365***</b> (0.123)	<b>0.284*</b> (0.155)	786
<b>Gender</b>				
(12)	Boys	<b>0.372***</b> (0.061)	0.124 (0.091)	1798
(13)	<b>Girls</b>	<b>0.342***</b> (0.067)	<b>0.242***</b> (0.094)	1656
<b>Maternal Education</b>				
(14)	<b>Less than high school</b>	<b>0.372***</b> (0.082)	<b>0.303**</b> (0.121)	1294
(15)	High school or more	<b>0.370***</b> (0.053)	0.117 (0.075)	2160

Note

Standard errors in parentheses.

\* p< 0.10      \*\* p<0.05      \*\*\* p<0.01

**Appendix E**  
**Table 3 The Effects of Maternal Depression Plus Potential Channels on**  
**Child's Internalizing Behavior**

		<b>Pooled OLS + All Covariates</b>	<b>FE+ Time-variant Covariates</b>
(1)	Maternal Depression	<b>0.378***</b> (0.046)	<b>0.153**</b> (0.062)
(2)	+ Child's Health	<b>0.318***</b> (0.042)	0.039 (0.055)
(3)	+ Parenting Practices	<b>0.349***</b> (0.043)	<b>0.126**</b> (0.059)
(4)	+ Child's Health & Parenting Practices	<b>0.305***</b> (0.042)	0.051 (0.054)

Note:

Standard errors in parentheses.

\* p< 0.10      \*\* p<0.05      \*\*\* p<0.01

## Appendix F

**Table 1 The Effects of Maternal Depression on PPVT in the Pooled OLS Models**

Model No.	Pooled OLS				
	(1) zppvt Unadjusted OLS	(2) zppvt OLS + All Covariates	(3) zppvt OLS + All Covariates + Child's Health	(4) zppvt OLS + All Covariates + Parenting Practices	(5) zppvt OLS + All Covariates + Child's Health + Parenting Practices
momdep	-0.146** (0.049)	-0.116** (0.044)	-0.107* (0.044)	-0.099* (0.043)	-0.092* (0.043)
momworks		0.199** (0.069)	0.190** (0.070)	0.205** (0.069)	0.196** (0.070)
momworksm		0.239 (0.132)	0.219 (0.133)	0.299* (0.134)	0.281* (0.134)
povertyratio		0.047** (0.011)	0.048** (0.011)	0.043** (0.010)	0.043** (0.010)
married		0.151** (0.049)	0.156** (0.049)	0.126** (0.048)	0.132** (0.048)
marriedm		0.030 (0.166)	0.014 (0.172)	-0.052 (0.157)	-0.060 (0.163)
kids		-0.061** (0.014)	-0.060** (0.014)	-0.056** (0.014)	-0.055** (0.014)
kidsm		0.334* (0.151)	0.224 (0.173)	0.361* (0.158)	0.286 (0.161)
country		0.339** (0.087)	0.319** (0.086)	0.351** (0.084)	0.333** (0.084)
gender		-0.166** (0.037)	-0.170** (0.037)	-0.152** (0.037)	-0.157** (0.037)
cmllbw		-0.174* (0.069)	-0.158* (0.069)	-0.185** (0.069)	-0.172* (0.068)
hs		-0.038 (0.051)	-0.034 (0.051)	-0.066 (0.050)	-0.059 (0.050)
somecol		0.282** (0.057)	0.278** (0.056)	0.240** (0.056)	0.239** (0.056)
college		0.517** (0.099)	0.496** (0.099)	0.483** (0.097)	0.466** (0.097)

blacks	-0.497** (0.056)	-0.505** (0.057)	-0.477** (0.056)	-0.488** (0.057)
hispanic	-0.509** (0.067)	-0.524** (0.068)	-0.485** (0.066)	-0.502** (0.067)
otherace	-0.193 (0.129)	-0.173 (0.128)	-0.200 (0.128)	-0.185 (0.127)
dadhs	0.058 (0.049)	0.045 (0.049)	0.053 (0.049)	0.041 (0.049)
dadsomecol	0.147* (0.059)	0.140* (0.059)	0.128* (0.058)	0.123* (0.058)
dadcollege	0.132 (0.092)	0.131 (0.093)	0.101 (0.092)	0.101 (0.092)
drinking	0.066 (0.068)	0.064 (0.069)	0.074 (0.068)	0.074 (0.068)
drugs	0.055 (0.101)	0.056 (0.100)	0.083 (0.102)	0.085 (0.101)
smoking	0.003 (0.053)	0.011 (0.053)	0.005 (0.053)	0.011 (0.053)
treatment	-0.008 (0.096)	-0.015 (0.097)	-0.029 (0.099)	-0.033 (0.099)
religion	0.013 (0.040)	0.011 (0.039)	-0.005 (0.040)	-0.006 (0.039)
childcare	0.097* (0.043)	0.086* (0.043)	0.096* (0.043)	0.085* (0.043)
breastfed	0.129** (0.043)	0.131** (0.043)	0.114** (0.042)	0.116** (0.042)
disabilities	-0.269* (0.134)	-0.258 (0.132)	-0.259* (0.128)	-0.253* (0.127)
countrym	0.788* (0.317)	0.820** (0.277)	0.738* (0.322)	0.758** (0.294)
cm1lbwm	-0.030 (0.129)	0.011 (0.127)	-0.025 (0.125)	0.010 (0.122)
hsm	0.097 (0.069)	0.083 (0.067)	0.214* (0.103)	0.197 (0.111)
blacksm	0.263 (0.360)	0.316 (0.437)	0.293 (0.379)	0.347 (0.438)

dadhsm	0.100 (0.099)	0.109 (0.099)	0.119 (0.098)	0.125 (0.099)
drinkingm	-0.502 (0.498)	-0.529 (0.478)	-0.428 (0.496)	-0.450 (0.484)
drugsm	0.593 (0.532)	0.577 (0.522)	0.560 (0.492)	0.547 (0.487)
smokingm	0.308 (0.282)	0.304 (0.276)	0.349 (0.285)	0.337 (0.281)
treatmentm	-0.024 (0.074)	-0.027 (0.075)	-0.105 (0.075)	-0.099 (0.076)
religionm	0.101 (0.116)	0.055 (0.117)	0.182 (0.130)	0.151 (0.131)
childcarem	0.328 (0.274)	0.330 (0.261)	0.335 (0.233)	0.338 (0.221)
breastfedm	-0.649** (0.160)	-0.659** (0.163)	-0.780** (0.163)	-0.778** (0.164)
disabilitiesm	0.707** (0.101)	0.697** (0.102)	0.801** (0.104)	0.789** (0.104)
health		0.258 (0.132)		0.229 (0.127)
healthm		0.327 (0.217)		-0.981** (0.280)
asthma		0.049 (0.046)		0.058 (0.046)
asthmam		0.582 (0.489)		0.455 (0.513)
obesity		0.111* (0.048)		0.095* (0.048)
obesitym		-0.678** (0.120)		-0.605** (0.121)
bedtime			0.157** (0.049)	0.144** (0.049)
bedtimem			-0.659 (0.400)	-0.569 (0.357)



tvtime				-0.035** (0.008)	-0.033** (0.008)
tvtimem				-0.219 (0.269)	-0.166 (0.258)
outdoorplaying				-0.032** (0.008)	-0.031** (0.009)
outdoorplayingm				0.064 (0.210)	0.118 (0.204)
books				0.273** (0.046)	0.259** (0.045)
booksm				1.043** (0.213)	0.974** (0.209)
story				0.019 (0.010)	0.019* (0.010)
storym				-1.201** (0.239)	0.000 (.)
songs				-0.014 (0.010)	-0.013 (0.010)
songsm				1.237** (0.172)	1.255** (0.178)
_cons	-0.635** (0.024)	-0.912** (0.133)	-1.132** (0.188)	-1.948** (0.225)	-2.093** (0.246)
N	3454	3454	3454	3454	3454
R-sq	0.003	0.212	0.228	0.240	0.252

Standard errors in parentheses

= " \* p < 0.05

\*\* p < 0.01 "

## Appendix F

### Table 2 The Effects of Maternal Depression on PPVT in the FE Models

Model No.	FE				
	(6) zppvt Unadjusted FE	(7) zppvt FE + Time-variant Covariates	(8) zppvt FE + Time-variant Covariates + Child's Health	(9) zppvt FE + Time-variant Covariates + Parenting Practices	(10) zppvt FE + Time-variant Covariates + Child's Health + Parenting Practices
momdep	-0.165** (0.062)	-0.164** (0.062)	-0.128* (0.062)	-0.143* (0.060)	-0.120* (0.060)
momworks		0.117 (0.117)	0.122 (0.117)	0.097 (0.114)	0.106 (0.113)
momworksm		0.334 (0.207)	0.317 (0.204)	0.307 (0.192)	0.302 (0.191)
povertyratio		0.016 (0.018)	0.019 (0.018)	0.012 (0.017)	0.015 (0.017)
married		0.140 (0.100)	0.151 (0.099)	0.156 (0.098)	0.159 (0.097)
marriedm		0.113 (0.275)	0.027 (0.271)	-0.030 (0.248)	-0.078 (0.241)
kids		0.067* (0.031)	0.052 (0.031)	0.053 (0.030)	0.041 (0.030)
kidsm		0.551* (0.274)	0.291 (0.363)	0.271 (0.341)	0.181 (0.364)
health			0.084 (0.145)		0.070 (0.137)
healthm			0.398 (0.383)		-0.955* (0.456)
asthma			0.013 (0.089)		0.040 (0.088)
asthmam			0.051 (0.646)		-0.101 (0.640)
obesity			0.132 (0.074)		0.068 (0.073)
obesitym			-0.799** (0.138)		-0.710** (0.139)

bedtime				0.275** (0.067)	0.253** (0.066)
bedtimem				-0.286 (0.535)	-0.151 (0.486)
tvtime				-0.039** (0.010)	-0.034** (0.010)
tvtimem				-0.227 (0.296)	-0.150 (0.277)
outdoorplaying				-0.050** (0.010)	-0.047** (0.010)
outdoorplayingm				0.200 (0.219)	0.277 (0.205)
books				0.142** (0.054)	0.129* (0.054)
booksm				0.603* (0.252)	0.517* (0.252)
story				0.021 (0.012)	0.023 (0.012)
storym				-0.969* (0.423)	0.000 (.)
songs				-0.046** (0.013)	-0.043** (0.013)
songsm				1.153** (0.253)	1.206** (0.247)
_cons	-0.631** (0.012)	-0.980** (0.127)	-1.042** (0.199)	-1.363** (0.266)	-1.396** (0.303)
N	3454	3454	3454	3454	3454
R-sq	0.004	0.012	0.049	0.069	0.095

Standard errors in parentheses

=\* p<0.05

\*\* p<0.01"

## Appendix G

**Table 1 The Effects of Maternal Depression on BPI of Anxiety/Depression in the OLS Models**

Model No.	Pooled OLS				
	(1) zppvt Unadjusted OLS	(2) zppvt OLS + All Covariates	(3) zppvt OLS + All Covariates + Child's Health	(4) zppvt OLS + All Covariates + Parenting Practices	(5) zppvt OLS + All Covariates + Child's Health + Parenting Practices
momdep	0.391** (0.044)	0.362** (0.045)	0.300** (0.041)	0.338** (0.043)	0.288** (0.041)
momworks		0.440** (0.039)	0.102* (0.045)	0.397** (0.041)	0.098* (0.044)
momworksm		-0.030** (0.009)	-0.053** (0.008)	-0.046** (0.008)	-0.047** (0.008)
povertyratio		-0.073 (0.046)	-0.095* (0.038)	-0.106** (0.040)	-0.091* (0.038)
povertyrationom		0.009 (0.014)	0.004 (0.012)	-0.001 (0.013)	-0.001 (0.012)
married		0.919** (0.144)	0.276 (0.150)	0.946** (0.139)	0.278 (0.144)
marriedm		-0.217 (0.449)	-0.532 (0.479)	-0.537 (0.449)	-0.428 (0.471)
kids		0.597* (0.260)	0.252 (0.244)	0.527* (0.263)	0.246 (0.240)
kidsm		0.156 (0.330)	-0.135 (0.360)	-0.082 (0.315)	-0.243 (0.349)
country		-0.067 (0.076)	-0.072 (0.075)	-0.105 (0.077)	-0.090 (0.075)
gender		-0.030 (0.034)	-0.035 (0.034)	-0.030 (0.034)	-0.036 (0.034)
cm1lbw		0.064 (0.057)	0.063 (0.056)	0.061 (0.057)	0.060 (0.056)
hs		-0.048 (0.047)	-0.052 (0.047)	-0.031 (0.047)	-0.040 (0.047)
somecol		-0.199** (0.049)	-0.200** (0.049)	-0.182** (0.050)	-0.185** (0.049)

college	-0.289** (0.071)	-0.321** (0.071)	-0.264** (0.072)	-0.298** (0.071)
blacks	-0.044 (0.049)	-0.055 (0.049)	-0.051 (0.050)	-0.066 (0.049)
hispanic	0.084 (0.062)	0.069 (0.061)	0.061 (0.062)	0.051 (0.061)
otherace	0.169 (0.111)	0.166 (0.109)	0.168 (0.114)	0.166 (0.111)
dadhs	-0.074 (0.044)	-0.071 (0.044)	-0.063 (0.044)	-0.061 (0.044)
dadsomecol	-0.108* (0.053)	-0.118* (0.052)	-0.082 (0.053)	-0.101 (0.052)
dadcollege	-0.075 (0.071)	-0.097 (0.070)	-0.047 (0.072)	-0.071 (0.070)
drinking	-0.047 (0.057)	-0.041 (0.057)	-0.050 (0.057)	-0.056 (0.057)
drugs	-0.112 (0.091)	-0.102 (0.093)	-0.103 (0.091)	-0.110 (0.092)
smoking	0.028 (0.048)	0.039 (0.048)	0.032 (0.048)	0.043 (0.048)
treatment	0.072 (0.101)	0.099 (0.099)	0.088 (0.100)	0.096 (0.098)
religion	-0.061 (0.037)	-0.059 (0.036)	-0.048 (0.037)	-0.048 (0.036)
childcare	-0.040 (0.040)	-0.050 (0.040)	-0.028 (0.040)	-0.041 (0.040)
breastfed	0.020 (0.039)	0.008 (0.039)	0.020 (0.039)	0.007 (0.038)
disabilities	0.193 (0.131)	0.180 (0.125)	0.185 (0.127)	0.174 (0.122)
countrym	0.122 (0.534)	-0.062 (0.473)	0.102 (0.602)	-0.049 (0.524)
cm1lbwm	-0.046 (0.067)	-0.038 (0.068)	-0.075 (0.064)	-0.052 (0.066)
hsm	0.347 (0.200)	0.368** (0.088)	0.283 (0.258)	0.322* (0.135)

blacksm	-0.090 (0.380)	-0.072 (0.371)	-0.036 (0.344)	-0.091 (0.345)
dadhsm	0.171 (0.115)	0.160 (0.115)	0.158 (0.114)	0.164 (0.114)
drinkingm	0.555 (0.550)	0.611 (0.583)	0.604 (0.523)	0.605 (0.581)
drugsm	-0.124 (0.314)	-0.113 (0.325)	-0.161 (0.314)	-0.126 (0.321)
smokingm	-0.111 (0.143)	-0.247 (0.154)	-0.212 (0.144)	-0.293 (0.152)
treatmentm	0.431** (0.063)	0.412** (0.063)	0.490** (0.066)	0.425** (0.066)
religionm	0.469** (0.107)	0.331** (0.126)	0.543** (0.118)	0.345** (0.133)
childcarem	0.010 (0.199)	0.093 (0.215)	-0.010 (0.188)	0.081 (0.202)
breastfedm	0.124 (0.136)	0.341* (0.140)	0.362* (0.141)	0.422** (0.141)
disabilitiesm	-0.590** (0.096)	-0.589** (0.095)	-0.691** (0.100)	-0.643** (0.099)
health		-0.346* (0.139)		-0.334* (0.141)
healthm		-0.717** (0.197)		-0.993** (0.219)
asthma		0.390** (0.016)		0.380** (0.016)
asthmam		1.149** (0.102)		1.114** (0.103)
obesity		-0.093* (0.043)		-0.086* (0.043)
obesitym		-0.131* (0.058)		-0.114* (0.056)
bedtime			-0.255** (0.052)	-0.145** (0.050)
bedtimem			-0.959** (0.331)	-0.995** (0.351)

tvtime				0.027** (0.009)	0.015 (0.008)
tvtimem				-0.083 (0.269)	-0.026 (0.282)
outdoorplaying				0.013 (0.008)	-0.002 (0.008)
outdoorplayingm				0.013 (0.216)	-0.104 (0.198)
books				-0.104* (0.046)	-0.089* (0.043)
booksm				-0.710** (0.201)	-0.474* (0.189)
story				-0.003 (0.009)	-0.013 (0.008)
storym				-0.392* (0.182)	
_cons	-0.077** (0.019)	-0.228 (0.117)	0.123 (0.179)	0.288 (0.226)	0.606* (0.253)
N	3454	3454	3454	3454	3454
R-sq	0.024	0.114	0.234	0.140	0.245

Standard errors in parentheses

="\* p<0.05

\*\* p<0.01"

## Appendix G

**Table 2 The Effects of Maternal Depression on BPI of Anxiety/Depression in the FE Models**

Model No.	FE				
	(6) zppvt Unadjusted FE	(7) zppvt FE + Time-variant Covariates	(8) zppvt FE + Time-variant Covariates + Child's Health	(9) zppvt FE + Time-variant Covariates + Parenting Practices	(10) zppvt FE + Time-variant Covariates + Child's Health + Parenting Practices
momdep	0.243** (0.073)	0.209** (0.069)	0.064 (0.058)	0.165* (0.064)	0.069 (0.057)
momworks		0.551** (0.043)	0.100* (0.048)	0.428** (0.043)	0.099* (0.046)
momworksm		-0.043 (0.023)	-0.014 (0.020)	-0.044* (0.022)	-0.021 (0.020)
povertyratio		-0.227 (0.120)	-0.093 (0.098)	-0.157 (0.111)	-0.088 (0.096)
povertyrationom		-0.002 (0.032)	0.012 (0.026)	-0.000 (0.030)	0.008 (0.026)
married		1.201** (0.146)	0.259 (0.141)	1.009** (0.141)	0.297* (0.139)
marriedm		-1.089* (0.446)	-0.909 (0.483)	-0.810 (0.468)	-0.851 (0.481)
kids		0.895** (0.204)	0.271 (0.193)	0.590* (0.261)	0.199 (0.201)
kidsm		0.445 (0.344)	0.225 (0.389)	0.291 (0.342)	0.176 (0.388)
health			-0.059 (0.202)		-0.083 (0.200)
healthm			-0.613 (0.335)		-0.939** (0.347)
asthma			0.385** (0.017)		0.366** (0.018)
asthmam			1.330** (0.112)		1.254** (0.112)
obesity			-0.281** (0.064)		-0.277** (0.064)



obesitym			-0.036 (0.104)		0.017 (0.104)
bedtime				-0.366** (0.070)	-0.126* (0.060)
bedtimem				-0.492 (0.383)	-0.341 (0.328)
tvtime				0.031** (0.011)	-0.003 (0.010)
tvtimem				-0.043 (0.311)	-0.117 (0.288)
outdoorplaying				0.033** (0.011)	0.004 (0.010)
outdoorplayingm				-0.297 (0.286)	-0.445 (0.252)
books				-0.152* (0.068)	-0.097 (0.056)
booksm				-1.399** (0.300)	-0.874** (0.258)
story				0.007 (0.014)	-0.007 (0.012)
storym				-0.401 (0.280)	
songs				0.049** (0.014)	0.013 (0.012)
songsm				-0.229* (0.100)	0.323** (0.089)
_cons	-0.048** (0.014)	-0.502** (0.107)	-0.396 (0.211)	0.054 (0.302)	0.127 (0.316)
N	3454	3454	3454	3454	3454
R-sq	0.007	0.126	0.373	0.197	0.389

Standard errors in parentheses

="\* p<0.05

\*\* p<0.01"