The Effects of State-level Child Support Enforcement on Long-term Patterns of Arrears Accumulations among Noncustodial Fathers

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ABSTRACT

Ineffective child support enforcement is responsible for the accumulation of child support arrears. Using the first five waves of data from the Fragile Families and Child Wellbeing Study (FFCWS), the study examines the extent to which child support policies affect noncustodial fathers' long-term patterns of arrears accumulation. To avoid potential biases stemming from the censored observations, a Tobit analysis was designed to address observations clustered at zero. The study finds that the association between the number of years since an order was established and the accumulation of arrears was larger for fathers who live in states with less efficient child support enforcement. The study also finds that more efficient child support enforcement brings a smaller arrears burden to fathers who lived with their child at birth than for those who did not.

Keywords: Child support arrears · Child support enforcement ·Noncustodial fathers

I. INTRODUCTION

The goal of the child support program is to make sure that children receive financial support from both parents, to compel both parents to remain involved in children's lives, and to reduce welfare costs. Another responsibility of the program is to collect accrued child support payments owed either to custodial families or to the government. When the custodial family is receives public assistance, the custodial parent is required to cede their right to child support payments to the state under Federal law. If the noncustodial parent does not comply with the obligation, then the delinquent child support will be treated as a debt owed to the government. As of November 2013, a quarter of all arrears were owed to the government, a number that dropped from 51 percent in November 2002 (Office of Child Support Enforcement, 2014).

Delinquent payments of child support are detrimental in many respects. If the arrears are owed to custodial families, children may receive less support than needed. A substantial research literature shows that children with limited financial resources are at risk of adverse outcomes including poverty (Bradshaw, 2006; Cancian, Meyer, & Han, 2011; Sorensen, 2000), academic failure (Dahl & Lochner, 2005), and behavioral and cognitive problems (Aughinbaugh & Gittleman, 2003; Blau, 1999; Yeung, Linver, & Brooks–Gunn, 2002). If the arrears are owed to the government, delinquency in the payment of child support debt negatively affects the money the state collects, further burdening taxpayers.

In addition, an arrears debt may be problematic in and of itself. Noncustodial fathers with high arrears can lose hope of ever repaying the amount owed (Waller & Plotnick, 2001) and are more likely to avoid working in the formal labor market than those fathers with no arrears burden (Bartfeld & Meyer, 2003; D. P. Miller & Mincy, 2012). The fathers may also be subject to punitive enforcement actions, such as tax refund intercepts, asset seizure, driver's license

restrictions, and even incarceration that may affect their ability to pay child support and, as a result, can aggravate the arrears problems (Holzer, Offner, & Sorensen, 2005; Sorensen, Sousa, & Schaner, 2007; Turetsky, 2007). Moreover, mothers with a large amount of uncollected child support debts owed by noncustodial fathers may not allow their child to visit with those fathers (Turner & Waller, 2017).

In response to these problems, policymakers have enacted a range of child support policies intended to close gaps between the incomes available to children in single and two parent families, however, many policy measures have contributed to the growth in arrears (Bartfeld, 2003; Sorensen et al., 2007; Sorensen & Turner, 1997). In addition, the distribution of arrears is highly skewed toward low-income fathers, suggesting that fathers' ability to pay could be responsible for the growth in arrears (Kim, Cancian, & Meyer, 2015; Sorensen et al., 2007).

Despite a growing body of research on the accumulation of child support arrears, little is known about the extent to which the state and individual-level factors contribute to noncustodial father's long-term patterns of arrears accumulations (Bartfeld, 2003; Heinrich, Burkhardt, & Shager, 2011; Pearson & Davis, 2002; Roberts, 2001; Sorensen, 2004; Sorensen, Koball, Pomper, & Zibman, 2003; Sorensen et al., 2007). Much of the previous research relies on a cross-sectional data set, which is limited to one period, therefore, it may be unable to distinguish between two noncustodial fathers who have accumulated the same amount of arrears but over different amounts of time (Kim et al., 2015). If policymakers can predict which of those two fathers would accumulate arrears more rapidly over the next several years, then they can allocate their resources more effectively to avoid further accumulation of arrears (Bartfeld, 2003; Heinrich et al., 2011; Roberts, 2001; Sorensen et al., 2007).

A study conducted by Kim, Cancian, and Meyer (2015) is the only previous literature that examined the long-term trajectories of child support arrears. Using longitudinal data drawn from the Wisconsin administrative data system, Kim and colleagues (2015) identified six idiosyncratic patterns of arrear accumulations among noncustodial fathers who established their first child support order in 2000. The study found that almost half the fathers in their sample never accumulated a substantial amount of arrears over the 11 years. In addition, once arrears were accumulated, it appears that one-fifth of the cases with increased at a slow pace, while the remainder showed a rapid increase at a certain point in time (Kim et al., 2015).

Although Kim and colleague (2015) offered an informative picture of the patterns of arrears growth, they did not provide any insight into what factors make each trajectory group distinct from the others. Moreover, the data they used was not nationally representative, which inevitably called into question whether the results would be generalizable to people in other states. Lastly, they have not investigated the outcomes for nonresident fathers during childbirth who are less likely than resident parents to comply with child support obligations. To overcome these shortcomings, the proposed study will draw on data from the Fragile Families and Child Wellbeing Study (FFCWS), a nationally representative longitudinal birth cohort study designed to explore a comprehensive understanding of unmarried parents and their children. The objective of this first chapter is to inform state and local OCSE managers and policymakers about the several factors associated with the long-term growth in arrears.

II. THEORETICAL FRAMEWORK AND EMPIRICAL EVIDEN

There are no direct theoretical studies available to predict the accumulation patterns of child support arrears among noncustodial fathers. Nevertheless, the study of child support compliance may be consistent with the context in which the fathers are delinquent in paying off

their child support debts (Kim et al., 2015). This study uses Beller and Graham's (1996) economic model of child support as a theoretical framework. They use a simplified version of the theory of the consumer to help identify the factors associated with the child support payments of noncustodial fathers. They find that compliance (or payments) with child support obligations by noncustodial fathers depends on three determinants, including *the child support enforcement, the father's ability to pay, and the father's willingness to pay.*

Child Support Enforcement and Arrears Accumulation

The Federal government has enacted several child support laws ranging from automatic wage garnishment to intercepting federal tax refunds to collect delinquent payments. Although every state has already adopted most of these laws, there is still variation in child support enforcement practices amongst states because the enforcement is a state-run entity (Sorensen et al., 2007). A large body of research indicates that accumulation of arrears is, in part, the result of state-level enforcement policies (Office of Child Support Enforcement, 2014; Sorensen, 2004; Sorensen et al., 2003, 2007). According to a report from the Institute for Research on Poverty (Bartfeld, 2003), nearly 50 percent of total debts were attributable to the following four state-level policies: *interest on arrears, retroactive support orders, lying-in costs*, and, *other fees.* The *interest on arrears* is a penalty charged on past-due child support payments. A certain assessment of interest may contribute to a large arrears balance. In the nine-state study about child support arrears, Sorensen and colleagues (2007) showed that states that assessed interest on a routine basis had a higher arrear growth rate than other states between the 1990s and 2000s. The *retroactive support order* is an obligation that covers the period prior to establishing a child support order. This order usually does not include the direct support given to children before the order was established (Sorensen, 1997b; Sorensen & Turner, 1997; Waller & Plotnick, 2001).

The retroactive order is a crucial factor contributing to arrears growth for some states, including Colorado, where 19 percent of total arrears consisted of the retroactive order (Thoennes, 2001). Therefore, noncustodial parents who are required to pay child support prior to the establishment of current order are less likely to comply with their obligations. Lastly, *lying-in costs* usually refer to the reimbursement for Medicaid costs associated with the birth of the child, and *other fees* refer to any charges associated with paternity establishment, including genetic testing, court, and attorney fees.

The accumulation of arrears depends on the length of time the fathers remain in the child support system, which can be defined *as a case-length effect*. As mentioned by Bartfeld (2003) and the U.S. Department of Health and Service (2000), the four state-level policies mentioned above will directly cause an increase in arrears over time after the establishment of the child support order. This suggests that the longer the father stays in the child support system, the more likely he is to accumulate child support arrears. According to this view, this study posits the following hypothesis:

HYPOTHESIS 1: *Nonresident fathers who have been in the child support system for a long time may have a high level of child support arrears*.

The case-length effect may vary depending upon the efficiency of the enforcement system designed to collect accrued child support payments. A long literature has sought to investigate various aspects of how the ineffectiveness of the child support system is responsible for arrears accumulation. For instance, child support agencies' limited ability to modify support orders would lead to the accumulation of greater arrears when a noncustodial parent's income declines (Ha, Cancian, & Meyer, 2010; Johnson, Levine, & Doolittle, 1999). Furthermore, some states establish child support orders based on noncustodial parents' "imputed income", which

does not necessarily reflect the low-income noncustodial parents' ability to pay (Turetsky, 2000; U. S. Department of Health and Human Services, 2000). [1] The Office of Inspection General (2000) found that a larger percentage of IV-D cases with order amounts established using imputed income exhibited lower compliance than cases with orders using non-imputed income.

To promote the efficiency of child support enforcement, Congress enacted the Child Support Performance and Incentive Act (CSPIA) of 1998[2] (U.S. Government Accountability Office, 2011) and rewarded states that perform well based on the National Child Support Goals measured by a number of achievements, including: arrearage collection, paternity establishment, order establishment, current collection, and cost-effectiveness (Solomon-Fears, 2013). More specifically, thirty-three percent of annual administrative expenditure, or $500 million,[3] are given to the states that have achieved high levels of performances in those goals (U.S. Government Accountability Office, 2011).

To compete for the incentives, state and local governments had to develop a number of strategies to improve the collection of delinquent child support obligations. One strategy is to prevent further accumulation of arrears. Another strategy is to reduce existing arrears (Bartfeld & Meyer, 2003; Heinrich et al., 2011; Sorensen et al., 2007). The preventive strategy includes: establishing realistic child support orders and ease the process for applying for and obtaining modification, reducing lying-in costs and interest rates charged on arrears, and eliminating retroactive orders. Given the substantial amount of arrears that have already accrued, debt reduction policies, such as the debt compromise program, are the favored arrears reduction

[1] The income is imputed based on the noncustodial parents' most recent work history. For low-income men, however, the imputed income usually overestimate the actual income because of their labor market instability (Turetsky, 2000).
[2] Pub. L. No. 105-200, 112 Stat. 645 (1998)
[3] The fund was adjusted to inflation rate, and the amount of which was increased to 504 million in FY2010 (Gerrish, 2017).

strategy being introduced by many states and counties (U. S. Department of Health and Human Services, 2007). The underlying philosophy for debt compromise programs is to use state resources to help noncustodial parents pay off child support debts. At least 40 states were operating such programs in 2011, each program having its own requirements for eligibility (Heinrich et al., 2011). Each of the programs is expected to increase collections on child support debt from noncustodial parents without hurting their financial stability.

In sum, a vast majority of past studies have shown that the accumulation of child support arrears can vary depending on the degree of child support enforcement. Therefore, we can easily assume that compared to nonresident fathers who lived in states with more effective child support enforcement policies, those fathers living in the state with less effective enforcement policies will accumulate more child support debts. However, no study has investigated whether the efficiency effect may operate through the case-length effect. It seems plausible that fathers who respond to the effective child support system may be the one who have accumulated high arrears due to being in the child support system for a long time. On the contrary, fathers who have recently established child support orders may not be responsive to the efficiency of the enforcement system because their arrears amounts are not large enough to be eligible for debt reduction or adjustment programs. This leads to the following hypothesis:

HYPOTHESIS 2: *The efficiency of child support policies will have a strong impact on noncustodial fathers who have been in the child support system for a long time.*

A Role of Fathers' Ability to Pay Child Support in Arrear Growth Model

A long history of empirical research has generally found that a nonresident father's ability to pay is positively associated with child support compliance (Garfinkel, Glei, & McLanahan, 2002; Garfinkel, Meyer, & McLanahan, 1998; Garfinkel & Oellerich, 1989; C.

Miller, Garfinkel, & McLanahan, 1997; Sinkewicz & Garfinkel, 2009; Sorensen, 1997a). While the early studies often use fathers' income as a proxy for ability to pay (Bartfeld & Meyer, 1994, 2003; C. Miller et al., 1997; Sonenstein & Calhoun, 1990; Sorensen, 1997a, p. 199), later studies have presented new estimates of the ability to pay, that include incarceration (Geller, Garfinkel, & Western, 2011), multiple fertility (Sinkewicz & Garfinkel, 2009), and the burden of the order (Meyer, Ha, & Hu, 2008).

The evidence of child support compliance appears to be consistent with the context of a father's arrears accumulation (Kim et al., 2015). Recent evidence from a study of nine large states suggests that low-income fathers are likely to owe a large amount of arrears (Sorensen et al., 2007). More specifically, fathers who make less than $10,000 per year owe two-thirds of child support debt. The study also showed that 54 percent of total arrears were owed by 11 percent of the noncustodial parents, and each of these "high debtors" owed $30,000 or more (Sorensen et al., 2007). The most recent data from OCSE Federal Offset Debtor File found similar results, showing that only 17 percent of obligors owed 55 percent of total arrears, and each of these debtors owed $40,000 or more (Putze, 2017).

The high rates of arrears accumulation among low-income fathers may stem from their limited ability to access labor markets (Sorensen & Zibman, 2001). Prior research provided a list of potential barriers to work, which can take the form of poor work history, low educational attainment, dependence on drugs or alcohol, and health limitations (S. Danziger et al., 2000; S. K. Danziger & Seefeldt, 2003; Lipscomb, Loomis, McDonald, Argue, & Wing, 2006; Pugh, 1998). The presence of such barriers to work would likely hamper low-income fathers' ability to find and (if employed) maintain employment. If the father loses his job, there is a time lag between leaving the previous job and entering a new job. During unemployment spells, low-

income fathers may be less likely to comply with their obligations, resulting in an accumulation of arrears more rapidly than other fathers who do comply.

The fathers' ability to pay may also change over time due to men's increasing patterns of income over the life course (Garfinkel, McLanahan, Meadows, Mincy, & others, 2009; Percheski & Wildeman, 2008a; Phillips & Garfinkel, 1993). A study conducted by Nepomnyaschy and Garfinkel (2010) outlined a hypothesis that a father's growing ability to pay child support over time may explain the upswings in total cash support. However, the authors point out that this hypothesis needs to be substantiated by additional research (Nepomnyaschy & Garfinkel, 2010). In the Wisconsin study of arrear trajectories, half of the fathers with arrears paid-off their debts after they owed the maximum amount of arrears (Kim et al., 2015).

Fathers' Relationship Status with the Mother of their Child at the Time of Birth

In the past half-century, there has been a substantial increase in the number of children who were born into a single-parent family (Bumpass & Lu, 2000). According to 2015 data from the National Vital Statistics System, about 40 percent of all children were born out of wedlock, with much higher rates among African Americans (Hamilton, Martin, & Osterman, 2016).

Fathers are less responsive to their nonresident child if they have not lived together at some point after the birth of their child. Previous research found that fathers who were never married to or had never lived with their children's mother were less likely than ever-married or ever-cohabited fathers to pay child support (Carlson & McLanahan, 2002; Nepomnyaschy & Garfinkel, 2010), or other forms of assistance (Paasch & Teachman, 1991). Part of the reason for this discrepancy may be associated with nonresident fathers' willingness to pay child support. That is, as pointed out by Weiss and Willis (1985), fathers who have never cohabited with the mother are less willing to pay optimal amounts in child support because they find it difficult to

monitor the allocation of the child support transfer. In addition, fathers who are not co-residential are likely to form new partnerships and have additional children with more than one partner (Edin & Nelson, 2013). The empirical evidence has indicated that noncustodial fathers will be less devoted to their nonresident children when either or both parents have newborn children (Manning & Smock, 2000; Rangarajan & Gleason, 1998), although Mincy Pouncy and Zilanawala (2016) found that the visitation rates of never resident fathers were as high as its rates of fathers who live with their child at birth.

Despite the substantial evidence supporting the role of fathers' willingness to pay as a determinant of child support compliance, their role in predicting arrears accumulation remains controversial. This is because fathers in the formal system are already obligated to pay child support so they have no incentive to provide additional informal cash support voluntarily. In addition, a father's willingness to pay may not influence the payment behavior of fathers who are employed in the formal labor market, because child support payments are automatically deducted from their paychecks (Bartfeld & Meyer, 2003; Lin, 2000).

A more plausible explanation for the differences in arrears accumulation between the two types of family structures (fathers in the stable relationship vs fathers in the less stable relationship) may come from a "selection effect," which postulates that economically and emotionally disadvantaged fathers are more likely to be selected into a less stable relationship (Conger et al., 1990, 1992). That being said, according to Gary Becker's "gain to trade" model of marriage, men with a lower disposable income are considered less attractive partners in, even if women have a child between such men (Becker, 1973; Bumpass, Sweet, & Cherlin, 1991; Seltzer, Schaeffer, & Charng, 1989). Therefore, when the court establishes a child support order,

fathers in less stable relationships would be at higher risk of accumulating child support debt because they are much more economically vulnerable than fathers in stable relationships.

In short, existing literature provides clear evidence that the accumulation of child support arrears can be intertwined with fathers' relationship with the mother of their child. While the vast majority of previous studies have focused on couples who have previously married and divorced, a growing number of recent studies have attempted to focus on child support outcomes for nonresident couples after childbirth (Nepomnyaschy & Garfinkel, 2010). However, no previous studies of which I am aware have addressed whether the trajectories of arrears vary depending upon fathers' residential status with their child at birth.

It is also likely that a heavier arrears burden may be imposed on fathers who are required to pay child support retroactively after the order is established. More specifically, a father who has to pay interest charged on a retrospective order, along with unpaid due child support, can accumulate arrears more rapidly than a father who does not. Of course, the former is more likely to have had an unstable relationship with the mother of his child than the latter. Based on these considerations, I propose related hypothesis.

HYPOTHESIS 3: *Compared to fathers who live with their child at birth, fathers who were nonresident at birth are more likely to accumulate a greater amount of child support arrears over time.*

The government's efforts to reduce the accumulation of arrears may not be as efficient for fathers in an unstable relationship with the mother as it is for those in a stable relationship. Prior empirical work indicates that fathers who have never cohabited with the mother, as compared to those who have cohabited, are less likely to be impacted by efficient child support enforcement (Nepomnyaschy & Garfinkel, 2010). To test whether those results obtained from Nepomnyaschy and Garfinkel's work can also be found in the context of child support arrears, the current study posits the following hypothesis:

HYPOTHESIS 4: *The improvement of government's efforts is more effective in reducing the arrears for those fathers who were nonresident at birth than those who live with their child at birth.*

III. METHODS

Data

The study uses data from the Fragile Families and Child Wellbeing Study (FFCWS, hereafter), a longitudinal birth cohort study of approximately 5,000 children born into 20 large cities with populations over 200,000 in the United States between 1998 and 2000 (Reichman, Teitler, Garfinkel, & McLanahan, 2001). The FFCWS is nationally representative of nonmarital birth in large U.S. cities: the nonmarital births were oversampled and represented 75 percent of the total sample of the study at baseline interview (3,712 nonmarital birth VS. 1,186 marital births). The cities were chosen by a stratified random sampling procedure based on welfare generosity, strength of the child support system, and the strength of the local labor market. Based on being classified as either high, medium, or low level of strictness for each of those three characteristics, cities were chosen at random from the nine clusters formed. This accounts for 16 of the cities.[4] Four additional cities[5] were selected due to funders' interest (Reichman et al., 2001). The parents of each focal child were interviewed in the hospital when the child was born (February 1998 to September 2000 / wave 1), and the follow-up interviews were conducted by phone when the focal child was one (June 1999 to March 2002 / wave 2), three (April 2001 to December 2003 / wave 3), five (July 2003 to February 2006 / wave 4), and nine (February 2007 to 2011 / wave 5). The rate of attrition tends to increase over the long-term: the response rate at

[4] This includes Boston, Pittsburgh, Toledo, Norfolk, Philadelphia, Indianapolis, Richmond, Jacksonville, Baltimore, San Jose, Austin, Chicago, San Antonio, New York, and Corpus Christi.
[5] This include Milwaukee, Detroit, Newark, and Oakland.

baseline and each of the following four waves were 100%, 89%, 86%, 85% and 72% for mothers, and 78%, 69%, 67%, 64%, and 54% for fathers, respectively (FFCWS, 2017).

Analytic Sample

The analysis of the current study uses 7,944 repeated observations (2,781 unique observations) of all fathers who were not living with the mother of the focal child since the 1-year follow-up. A decision to include all noncustodial fathers instead of focusing on those with child support orders was made based on several considerations. First, it is possible that some nonresident fathers with no formal child support obligations would have established child support orders had they lived in a state with different child support policies. Therefore, excluding these fathers from the analytic sample may lower the external validity of the study. In addition, the results for censored data analysis usually demonstrate less bias than for truncated data. A previous simulation study for the developmental processes showed that bias in estimating the treatment effects created by left-truncated data was twice as large as the bias created by left-censored data (Cain et al., 2011).

Consistent with previous studies (Nepomnyaschy & Garfinkel, 2010), I also retain fathers who were married to or cohabitating with the child's mother at baseline, in part to explore whether the results vary depending upon parents' relationship status at childbirth. The analytic sample is further restricted to fathers who were not deceased, not unknown, nor awarded primary custody of the focal child at any wave. These exclusion criteria led to a final sample size of 1,521 for 1-year follow-up, 1,815 for 3-year follow-up, 2,160 for 5-year follow-up, and 2,448 for 9-year follow-up survey. It seems that the number of observations increases as time passes, partly because parents are more likely to divorce or become separated as time passes. Accordingly, it is

presumed that the ratio of fathers with orders to the total number of noncustodial fathers has increased over time.

Missing Data

As a panel study, FFCWS data suffers from attrition, which can result in biased estimation. Panel attrition can reduce the analytic sample size, resulting in wider confidence intervals as the margin of error increases. Moreover, non-random attrition can threaten the external validity of study results by introducing potential selection biases that may distort the causal link between treatment and outcomes. To account for such problems, the current study used multiple imputation using chained equation (MICE), the most advanced imputation technique in social science so far (White, Royston, & Wood, 2011). Unlike other imputation techniques, MI uses multiple complete data sets with multiple times to impute missingness. The main advantage in using the MICE technique is related to its feasibility to handle many complex patterns of missing data, although the process of its implementation can be more difficult. However, software packages, such as STATA, allow researchers to avoid such complexity. Next, the confidence intervals of the study results will have correct coverage properties, as MI addresses more types of uncertainties about the missing values than any other imputation technique. For instance, the regression imputation approach assumes that the coefficients taken from the points on the regression line are true values of the parameter estimates. The MI approach, on the other hand, is skeptical of this assumption due to the uncertainty of the model's parameter values. To address this type of uncertainty, this technique draws the coefficient values from an appropriate distribution, a normal distribution in the case of this study, instead of assuming that the values are true.

Measures

The duration of the child support obligation

The duration of the child support obligation is measured at each wave, starting from one-year follow-up interviews, based on the mother's report. Mothers were first asked whether they have a legal agreement or child support order that requires fathers to contribute to children. If mothers answered "yes", they were asked when the legal agreement was first reached. The duration of the child support obligation can be measured by calculating the time interval between the date of legal agreement and the date the mother was interviewed at each wave. By using years as a unit of analysis, the duration of child support obligation is interpreted as *the elapsed number of years since the legal order was established.* The measure is rounded to one if the length of legal obligation is less than one but greater than zero.

Accumulated child support arrears

The amount of accumulated child support arrears is measured across each wave, starting from one-year follow-up interviews, primarily reported by mothers. They were first asked whether the father has any arrears that he is supposed to pay to the mother or the government. If they answered "yes", then they were further asked the amount of the arrears that the father actually accrued. For those who did not report arrears but established child support orders, the study assumed that the amount of arrears is equivalent to the difference between the amount of child support owed and the amount received. It was additionally assumed that the amount of arrears is zero for fathers who complied with child support obligations in full. The annual amount of arrears accrued was adjusted to 2001 dollars using the Consumer Price Index.

It is evident that the mother's report of the father's child support debts can be claimed as an imperfect measurement. For example, as Miller and Mincy (2012) pointed out, mothers may under-report the actual amount of arrears owed by fathers because they have little information

about the unpaid amount of child support owed to children of different mothers. However, unlike Miller and Mincy's work, this study does not address the question of whether the arrears are affecting or being affected by fathers' behaviors. In addition, missing information on arrears can also be considered as measurement errors on the dependent variable, which will end up in the regression error but do not bias the regression results[6] (see Appendix 1). Therefore, complete information on the actual amount of arrears owed by fathers is redundant.

Figure 1 illustrates the distribution of mothers against the amount of arrears owed by the children's fathers. Consistent with prior research (Kim et al., 2015; Sorensen et al., 2007), a significant number of mothers do not have arrears owed by the fathers. However, once the arrears are present, then the amount is high. Panel A of Table 1 shows that average amount of child support arrears increases from one wave to the next, although the evidence does not support the existence of a positive relationship between the arrears and the duration of child support obligations. This is because some mothers have established the orders in earlier waves, while others have done this in later waves.

Performance measures on current and past-due child support collections

Fathers living in different states will be exposed to different degrees of enforcement "treatment," allowing researchers to use a natural experiment methodology to study the effectiveness of child support enforcement (CSE) system. To construct a valid measure that captures the effectiveness of the system, the study uses a performance-based method prescribed by the performance-based incentive and penalty program under the Child Support Performance and Incentive Act of 1998 (CSPIA). Among the five criteria used in the program, this research

[6] However, an additional errors in the regression model may slightly reduce the overall statistical power.

explores two performance measurements, current and arrearage collections, that are expected to have the most salient impacts on fathers' arrears accumulation.

The construction of the performance measures assigned to each observation unfolds in two steps: First, data on performance indicators were collected from the Office of Child Support Enforcement (OCSE) annual reports (1999-2010). Both indicators were measured as percentages, and the method of measuring each indicator is given in Appendix 2. For the next step, the performance indicators were assigned to each observation, based on the state where the mother established the child support order. To avoid the issue of temporal ordering, the performance indicators were measured one-year prior to the mother's interview year for each wave. Figure 1 graphically illustrates trends in both performance measures used in the study. As suggested in the Figure, the results of both performance measures have improved significantly over the period from 1999 to 2010, when the mothers in FFCWS had one to nine-year follow-up interviews (for detailed information on performance measures for each state, see Appendix 3-1 and 3-2).

Covariates

A number of baseline characteristics are associated with fathers' ability to pay child support are added to the model. These include age, education level (high school dropouts, high school graduates, some college, and college graduates), race and ethnicity (White, Black, Hispanic, Other), cognitive functioning (0=low to 15 high; Wechsler Adult Intelligence Scale Revised; WAIS-R, 1981), depressive symptoms (1= not depressed, 1=depressed; measured at wave 2 based on the World Health Organization's Composite International Diagnostic Interview-Short Form ; CIDI, 1998), fathers' number of children, and relationship status with the mother at baseline (1=no cohabitation, 2=cohabitation, 3=married).

A set of time-varying covariates are also added to the model. First, I use an individual-level time-varying covariate that assumed to be correlated with fathers' ability to pay child support: this includes a mother-reported fathers' jail status variable constructed by FFCWS at each given wave (1=Yes, 0=No). Next, I used a set of state-level time-varying covariates that are assumed to be correlated with both performance measures and fathers' arrears outcome. These include an unemployment rate, a poverty rate (percent of person in poverty), a proportion of children in single-parent families, a proportion of people who went to college, and a proportion of people born in the United States.[7] To avoid the reverse causality problem, all state-level variables used in the study were measured one-year prior to the mother's interview year. For ease of interpretation, each state-level covariate is standardized to a mean of 0 and a standard deviation of 1, but unstandardized values are presented in Table 1.

Lastly, to control for both state and annual fixed effects, a series of dummy variables for each state and mothers' interview year are added to the model. In particular, it is important to include the mother's interview year in the model, because the changes in the long-term trend of performance measures can lead to biased estimates of true policy effectiveness. More specifically, it can be misinterpreted as if the positive relationship between arrears and elapsed years are the result of the changes in performance measures that have steadily increased since 2001 (See Figure 2). Including a set of dummy variables indicating mother's interview years in the model can solve this problem by fixing changes in trends over time.

Panel B of Table 1 reports summary statistics for variables used in the analysis. The first six columns represent fathers' baseline demographic characteristics for the main analytic sample (N=2,781), stratified by relationship status with child's mothers at the time of childbirth. When

[7] All state-level data are from Bureau of Labor Statistics website.

compared to the non-resident sub-sample (N=1,421), fathers in the resident sub-sample (N=1,360) were older, less likely to be Black, have post-secondary schooling, and had more children. The next eight columns represent time-varying covariates for repeated observations across an individual over time (N=7,944). On average, fathers in the sample are more likely to be in jail over time. Except for the poverty rate and the proportion of individuals who attended college, most state-level time-varying covariates remained constant from year 1 to year 9 follow-up interviews.

Analytic Strategy

Tobit Analysis

The estimation of arrears trajectories using the standard regression model will lead to inconsistent and biased estimates of the parameters of interest. This is, as explained above, because many observations are clustered at zero when the child support order has not been established. To obtain consistent and unbiased parameter estimates, the study uses Tobit analysis. The idea of this model is a combination of Probit and Truncated regression models, allowing researchers to predict whether or not the dependent variable is at zero and, if not zero, to estimate the expected value of the uncensored distribution (Breen, 1996; Greene, 1981, 2000). The structural equation of the standard Tobit model is given below:

$$y_{it} = \begin{cases} y_{it}^{*} = X_{it}\beta + \epsilon_{it} & if \quad y_{it}^{*} > 0 \\ 0 & if \quad y_{it}^{*} \leq 0 \end{cases} \qquad (1)$$

where $\epsilon_i \sim i.i.d \;\; N(0, \sigma^2)$, and y_{it}^{*} is a latent variable (accumulation of arrears) for father i (reported by mother) at wave t (2 to 5). The $X_{it}\beta$ matrix represents the specification for two multivariate models. The first model is a baseline model estimating changes in debt accumulation over time. The regression equation is expressed in the following form:

$$X_{it}\beta \equiv \beta_0 + \beta_1(years)_{it} + \beta_2{}^T W_{it} + \beta_3{}^T Z_i + \beta_4{}^T State_i + \beta_5{}^T i\_yr_{it} \quad (2)$$

Where $years_t$ is the number of years that has passed since the child support order was established; W_{it} is a vector of time-varying covariates (state-level covariates were measured 1 year prior to the mother's interview year); Z_i is a vector of time-invariant covariates; *State* is a set of dummy variables indicating the state where child support was established; and i_yr_{it} is the survey year for each i at which the arrears were measured. As for the coefficients of interest, the intercept β_0 represents an initial status of child support arrears that remain constant over time (at $years_t$=0) and the slope β_1 refers to the growth rate on the trajectories of child support arrears over time. The β_1 is also defined as a *case-length effect*, which refers to the changes in the accumulation of child support arrears depending on the time between the date the order was established and the date the arrears were measured.

The second model analysis is a moderation model, examining the extent to which changes in performance measures affect debts accumulation over time. Results should show whether the outcome of the first regression model varies depending on the performance measures. The estimation equation is as follows:

$$X_{it}\beta \equiv \beta_0 + \beta_1(years)_{it} + \beta_2(PM)_{it} + \tau(PM \times years)_{it} + \beta_3{}^T W_{it} + \beta_4{}^T Z_i + \beta_5{}^T State_i + \beta_6{}^T i\_yr_{it} \quad (3)$$

Where $(PM)_{it}$ denotes each performance measure; and the interaction term, $(PM \times years)_{it}$, indicates if the growth rate on the trajectories of child support arrears differs depending on each performance measure.

Results are presented as marginal effects on the expected value for arrearage outcomes for both censored and uncensored observations (so, the intercept β_0 is not stated in the result). Unlike its classical linear model counterpart, the expression of marginal effects for the Tobit

model depends not just on the coefficient itself, but also on the values of all other variables in the equation. [8] Since the interaction term presented in Eq3 is composed of two continuous variables, it is advisable to set these two variables to discrete values so that results can be readily interpreted. Therefore, when estimating marginal effects, the performance measure values are set at a one standard deviation interval around the mean[9] and the elapsed year indicator is set at a one-year interval.[10]

To estimate the parameters of interest, statistical software packages, such as Stata use the following (log)-likelihood function for the censored normal distribution (see Appendix III for derivation):

$$\ln L = \sum_{y_{it}>0}^{N} \ln f(y_{it}) + \sum_{y_{it}=0}^{N} \ln F(0)$$

$$= \sum_{y_{it}>0}^{N} \left\{-\ln \sigma + \ln \phi \left(\frac{y_{it} - X_{it}\beta}{\sigma}\right)\right\} + \sum_{y_{it}=0}^{N} \ln\left(1 - \Phi\left(\frac{X_{it}\beta}{\sigma}\right)\right) \quad (4)$$

[8] In the Tobit model, the marginal effects on the expected value of the outcome (censored and uncensored) can be expressed as:

$$\frac{\partial E[y|x_1, X]}{\partial x_1} = \beta_1 \Phi\left(\frac{X_{it}\beta}{\sigma}\right)$$

for changes in variable x_1 if the variable is not a part of the interaction term, and

$$\frac{\partial E[y|x_1, X]}{\partial x_2} = (\beta_2 + \beta_3 x_3)\Phi\left(\frac{X_{it}\beta}{\sigma}\right)$$

for changes in variable x_2 if the variable is a part of the interaction term $(x_2 * x_3)$ (Ai & Norton, 2003; Greene, 1999). Note that Φ is a cumulative density function of the standard normal distribution of outcome.

The $\Phi\left(\frac{X_{it}\beta}{\sigma}\right)$ is an adjustment factor, indicating the estimated probability of observing an uncensored observation given the value of X_{it}. Therefore, the marginal effect of X would be equal to an expected value of β if the $\Phi\left(\frac{X_{it}\beta}{\sigma}\right)$ is equal to 1 (meaning that there are no censored observations).

[9] As presented in Figure 2, both arrearage collection and current collection measures have a mean value of .60, but as for a standard deviation, the arrearage collection is .06 and the current collection is .09.

[10] This type of marginal effects is usually termed as "marginal effects at a representative value (MER)" in microeconometrics (Cameron & Trivedi, 2010). ~~Cameron and Trivedi~~

where f(.) and F(.) denote the probability density function (PDF) and the cumulative density function (CDF) of the latent variable y_{it}^{*}, respectively, and ϕ and Φ represent the PDF and the CDF of the standard normal distribution. The log-likelihood function consists of two parts: The first part is the likelihood function for the classical OLS under $y_{it} > 0$ (uncensored), whereas the second part is the probability function that the outcome is censored.

Instrumental Variable Estimation for the Measurement Errors

OCSE's annual reports were believed to be the most accurate source to measure the state performance measurements. The OCSE Office of Audit is now responsible for assessing the completeness, accuracy, and reliability of states' reporting system. The Data Reliability Audits (DRA) proclaimed that the reliability of state reporting system has improved since 1999 (Huang & Edwards, 2009). Despite OCSE's efforts towards minimizing reporting errors, states still have incentives to over-report their performance measures, resulting in a potential upward bias in our estimates (See Appendix I for the reasons the estimates will be biased upward). In order to adjust for the potential measurement errors that can occur, this paper used state expenditures on enforcement as an instrument to predict performance in the subsequent analysis. In doing so, the changes in the level of the performance measure are explained only through state expenditures on arrears.

Following the notation used by Angrist and Pischke (2008), the instrumental variable model is estimated using a two-stage least squares (2SLS) estimation. The first stage can be written as Equation (2):

$$PM_{it} = \alpha_1 + {\beta_1}^T X_i + \beta_2 EXP_{it} + \varepsilon_{it} \quad (5)$$

where PM_{it} denotes the performance measured for state i at year t; a_i is the state-effect constant over time; χ is a vector of confounders that are included in the Tobit model (Time-varying and

Time-invariant covariates with state and year dummies); EXP is the expenditure variable (IV); and δt is the time-trend effect (constant across states). In accordance with the method used by Huang and Edwards(2009), the expenditure variable will be measured by an inverse ratio of each state's total number of OCSE caseloads to the number of full-time staff members.

It is assumed that states with high expenditures on child support systems are expected to spend more on hiring full-time workers, and as a result, the child support caseload per capita is expected to decrease. Note that Time-variant confounders and EXP_{it} variable that were measured one-year prior to the mother's interview year for each wave were used. In the second stage, the actual performance measures used in the original equation (3) are substituted into the predicted performance measures estimated from the first-stage regression. For ease of interpretation, the EXP_{it} variable is standardized to a mean of 0 and a standard deviation of 1.

To be valid, the instrument used in the analysis must satisfy two requirements: it must be predictive of the performance measures, and orthogonal to any other determinants on an accumulation of arrears except the performance measure. The first condition is assumed to be satisfied based on the evidence provided by Huang and Edwards (2009) suggesting that the indicator of state expenditures on the enforcement is one of three dimensions that causes the child support performance index. The second condition also appears to be fulfilled since the government's expenditure on enforcement affects the accumulation of arrears only through its effects on the state's efforts in managing arrears. The first condition is tested and reported in the current study. If the expenditures could serve as a good instrument by passing these two conditions, then theoretically the variances in the performance measure can be purged of the measurement errors. However, as explained in Appendix 4, the variance of the 2SLS estimator is

usually higher than that of OLS estimator and is assumed to be the same in Tobit models used in this study.

IV. RESULTS

Accumulation of Child Support Arrears over Time (Case-Length Effect)

With reference to equation (2), I begin the multivariate Tobit analysis by estimating the effects of elapsed time since the establishment of child support orders (hereafter *elapsed time*) on an accumulation of child support arrears. In this study, I define this effect as a *case-length effect*, which refers to the changes in the accumulation of child support arrears depending on the time between the date the order was established and the date the arrears were measured. Results are presented as marginal effects in Table 2. In the first column, only the elapsed time indicator as a key independent variable is included. The result is consistent with my first Hypothesis that the longer the father stays in the child support system, the greater the debt to be accumulated. More specifically, fathers in the overall analytic sample accumulate a new arrear of $433.43 on average per every year after establishing the child support order.

In the next two columns, a set of covariates is included, along with state and year fixed effects. The case-length effects have slightly decreased ($415.92 and $407.16 per year), but are statistically significant even after adjusting for an array of covariates and state-and year fixed effects. Consistent with a host of prior studies, fathers are accumulating less arrears as they get older, indicating that the fathers' ability to pay child support increases over time (Garfinkel et al., 2009; Percheski & Wildeman, 2008b; Phillips & Garfinkel, 1993). In addition, fathers who have more children, and have higher scores on the Weschler Adult Intelligence Scale, accumulate a greater amount of arrears than fathers who have fewer children and lower intelligence scores. The accumulation of arrears is estimated to be smaller for Black fathers (as compared to White

fathers), demonstrating the differences across racial and ethnic lines. Though at first glance these racial differences might seem counterintuitive, White fathers are more likely than Black fathers to have a greater amount of child support obligations because they have a relatively higher income than their Black counterparts. Therefore, more White fathers will accumulate more arrears than Black fathers if they do not fulfill their obligations. Lastly, fathers who were in jail are estimated to have about $200 more in child support arrears per year than fathers who were not in jail.

The final two columns disaggregate the sample by parents' relationship status at the time of the focal child's birth. The fathers who lived with the child's mother at the time of childbirth (hereafter resident group) have a lower amount of arrears accumulation over time after establishing a child support order than those fathers who did not live with the mother at the time of childbirth (hereafter nonresident group). More specifically, the fathers in the resident group accumulate new arrears of $350.72 on average per year after establishing the order, while the fathers in the nonresident group accumulate new arrears of $421.80 annually. The effects of covariates on the accumulation of arrears also vary by this relationship sub-group. Fathers' intelligence seems to play an important role in accumulating arrears in the resident group, but not in the nonresident group. On the other hand, race/ethnicity is a significant factor contributing to the accumulation of arrears only in the nonresident group. Finally, the fathers in the resident group accumulate arrears nearly three times more than their nonresident group counterparts if they were in prison during the survey period.

Moderation Effects of CSPIA's Performance measures on Accumulation of Child Support Arrears over Time

The case-length effects presented in Table 2 may vary depending on the different CSE agencies and its strategies. The interactive models in Figure 3 and Table 3 show variations in

trajectories of child support arrears by CSPIA's *two performance measures* – current collection (Panel 1) and arrearage collection (Panel 2) – which are used as proxy measures for the effectiveness of CSE system. Each regression model controls for a host of time-invariant and time-varying characteristics along with state and year fixed effects. The performance measure values are set at a one standard deviation interval around the mean and the elapsed year indicator is set at a one-year interval.

Performance measures assumed to be constant over time

The current study estimates the moderating effects in two ways. First, I stratify the case-length effect by each performance measure that is assumed to be constant over time.[11] Results are visually displayed in Figure 3 using the *marginsplot* command implemented in Stata15. The solid line represents the growth trajectory of arrears for fathers who live in the states where the focal performance measure is at the mean, and the dotted line represents the same growth trajectory but only for fathers in the states where the performance measure is one standard deviation above the mean. Note that the gray-shaded area indicates 90% confidence interval for expected p-values. The results reported in Panel 1 provide support for Hypothesis 2 that the efficiency of child support policies have a strong impact on noncustodial fathers who have been in the child support system for a long time. That is to say, the case-length effect is higher for fathers who live in the states with less efficient child support enforcement when compared with fathers who live in the states with more efficient enforcement.

[11] With reference to Equation (3). the conditional marginal effect of this interactive model in the Tobit framework can be expressed as

$$\frac{\partial E[Y|years, PM, X]}{\partial years_{it}} = (\beta_1 + \tau \times PM_i)\Phi\left(\frac{X_{it}\beta}{\sigma}\right)$$

More specifically, suppose that fathers have been accumulating arrears for four years since the order was established. If these fathers lived in states where the current collection performance is 60 percent[12], they would accumulate additional arrears of $1,479.11 for next year. By contrast, fathers who lived in states where the current performance is 69 percent[13] would accumulate additional arrears of only $847.87 under the same condition.

Furthermore, the gaps in the case-length effect between the fathers from states with high- and low-performance in CSE were becoming more pronounced over time. For instance, if the elapsed time is at 3 years, the difference in case-length effect between the two groups of states is $208.14 [$801.36 - $593.22], whereas if the elapsed time increases to 7 years, then the difference becomes $ 602.87 [$1952.08 - $1349.21]. Therefore, promoting the effectiveness of CSE system would alleviate the burden of arrears for fathers and provides more benefits to these fathers over time. Results are consistent with those in Panel 2, except that the gaps are not statistically significant across the elapsed years.

Allow performance measures to change over time

While the first approach is intuitive in visualizing the moderating effects, it does not provide policymakers with enough information about how much the arrears accumulate if the performance measures change over time. To overcome this limitation, the second approach estimates the conditional marginal effects of the performance measure on an accumulation of child support arrears at each elapsed year.[14] For the sake of brevity, the results of the second

[12] Note that mean value of the current collection measure is 60 percent
[13] Note that one standard deviation above the mean of current collection measure is 69 percent
[14] The same as above, the conditional marginal effect of this interactive model can be expressed as:

$$\frac{\partial E[Y|years, PM.X]}{\partial PM_{it}} = (\beta_2 + \tau \times years_{it})\, \Phi\left(\frac{X_{it}\beta}{\sigma}\right)$$

approach presented in Table 3 show only the most relevant information (full results are available upon request).

There are several notable findings from the second approach. First, an increase in performance measures after a long elapsed time can reduce arrears more substantially than it does in a short elapsed time. For instance, suppose that fathers have been accumulating arrears for five years since the order was established. Assuming that performance measures have changed at this time, the results in the first column of Panel 1 show that the increase in the current collection by one standard deviation from the mean is expected to decrease the arrears by $918.23. However, if the performance measures change when the elapsed time is ten years, then the amount of arrears is expected to be decreased by $2,034.07 under the same condition.

On the contrary, the improvement of the CSE system cannot moderate the case-length effects when the elapsed period is short. That is, the difference in the level of performance measure does not contribute to the changes in arrears for the first two years after the order is established (results not shown in Table 3).

The amount of arrears that is reduced due to an increase in performance measure is not constant but rather increases over time. If the arrears were to decrease linearly, then the reduced amount of arrears when the elapsed time is 7 years would be $242.90*7/3=$566.77 or 918.23*7/5=$1,285.52, which are much smaller than what was estimated in current study ($2,034.07). These results are quite similar to those in Panel 2 using the arrearage collection as a performance measure.

Lastly, suppose that states may require the same, or at least similar, efforts to increase one standard deviation from the mean for both performance measures. Since the overall values of arrears in Panel 1 are lower than the corresponding values in Panel 2, the current collection

performance may be a more efficient tool for predicting the reduction in child support arrears than the arrearage collection performance is. However, states may need the same efforts to raise 1 percentage point on both performance measures. If so, then the states can reduce arrears much more efficiently by spending money on improving the arrearage collection rather than by funding on promoting the collection on current child support performance. The results from Table 4 support that fathers in the resident group who live in a state where the arrearage collections have improved from 60 to 65 percent would accumulate less in arrears than fathers living a state where collections on current child support have improved the same percentage.

Results stratified by the fathers' residential status during childbirth

The second and third columns in both Panels of Table 3 indicate that the increase in performance of CSE system decreases the case-length effects more rapidly for fathers who were resident at birth than for fathers who were nonresident at birth. If the arrears have been accumulating for 7 years since the order was established, fathers who were resident at birth and who live in states with the current collection of 69 percent are estimated to accumulate $3,251.40 less in arrears than fathers who live in states with the current collection of approximately 60 percent. On the other hand, as presented the third column of Panel 1, the reduction in arrears for fathers in the nonresident group is much smaller than reduction in arrears for fathers in the resident group under the same condition ($-3,251.40 vs $-1,121.17). Results in the second and third column of Panel 2 show similar findings.

Furthermore, the fathers in the nonresident group need more time than the fathers in the resident group do to get benefits from the effectiveness of CSE system. More specifically, the moderation effects of CSE enforcement become significant for fathers in the nonresident group when the elapsed time reaches to 7 years, whereas those fathers in the resident group need only 3

years. These results suggest that the improvement of performance on CSE system is more effective in reducing the arrears for the fathers in the resident group than those fathers in the nonresident group.

Supplemental Analysis

The study also uses instrumental variable techniques to remove possible measurement errors that could bias the estimates upward. In each panel of the Table 5, the first row presents the results from the first-stage equation predicting performance measures. As the results for both performance measures are similar to one another, the regression results for the current collection measure is the only one presented. The results from the first row suggest that a one standard deviation increase in expenditures on child support systems is associated with a 0.1 to 0.14 standard deviation increase in current performance measure, indicating that the present instrument yields a reliable estimation of performance measures. The results from the second row to the fifth row of the 2SLS show the estimated amount of arrears reduced by the moderating effect of performance measures, which have been instrumented with the expenditure variable. The predicted performance measures obtained from the first stage of 2SLS have significant marginal effects on the accumulation of child support arrears. However, as expected, the standard error on performance measures have also increased slightly compared to the model without IV regression. The moderating effects of the predicted performance measures have increased slightly compared to the Tobit model without IV regression, suggesting that this supplemental analysis has corrected for upward bias induced by measurements errors.

V. DISCUSSION

The last step of the child support enforcement process is to collect accrued child support payments owed either to custodial families or to the government. Theoretically, states' efforts to

collect current or delinquent child support payments on the growth in individual's child support arrears are as important as other microeconomic factors, such as fathers' ability and willingness to fulfill their child support responsibilities. However, relatively little research has been carried out on the policy intervention associated with long-term arrears accumulation. Moreover, many previous studies ignore fathers who were nonresident at the time of the child's birth. The main contribution of this paper is to close these gaps by examining how the improvement of CSE system alters the long-term trajectories of the accumulation of child support arrears using recent data from the Fragile Families and Child Wellbeing Study. The CSPIA's performance measures were used as a proxy measurement for the effectiveness of CSE system.

Consistent with previous research, the current study found that the accumulation of arrears showed, on average, a continuous increase after the establishment of the child support order. This is because once the arrears are accumulated, the amount will continue to snowball due to the interest charged on the arrears (Sorensen et al., 2007). The study was also the first to provide support for the notion that effectiveness of CSE system contributes to a faster reduction of arrears. That being said, fathers living in states with less efficient child support enforcement were estimated to accumulate more arrears over time than those fathers living in states with more efficient enforcement. Furthermore, the longer the time has elapsed since the order was established, the greater the amount of arrears will be reduced when the performance measure increases. These findings provide the evidence that states' effort to collect overdue child support payments could be one of the factors that determine diverse patterns of arrears accumulation. These patterns, as introduced by Kim et al. (2015), include "a continuous increase" or "a continuous increase then decrease at some point."

The long-term trajectories of arrears accumulation varied substantially depending on the fathers' residential status during childbirth. The results obtained indicate that fathers who did not live with their child at the time of the birth were more likely to fall further behind in paying-off their child support debts over time, compared to those fathers who lived with their child at birth. One of the potential reasons for the discrepancy in results between these two groups may be that the fathers in the nonresident group might be obligated to pay retroactive child support after the order is set, and as a result, may suffer more from arrears burden than those fathers in the resident group. Testing this hypothesis was beyond the scope of this study, but hopefully will be addressed in future research. Another potential reason may be that fathers in the nonresident group are economically more vulnerable than those fathers in the resident group do because of their limited ability to access labor markets. This hypothesis was consistent a recent study by Nepomnyaschy and Garfinkel (2010).

The study also showed that states' efforts to collect delinquent child support payments for fathers in the nonresident group were not as successful as such efforts targeting for those fathers in the resident group. For instance, suppose these two groups of fathers have the same elapsed time since the order was established. If the performance measures increase by one standard deviation from its mean, fathers who were resident at birth will accumulate smaller amounts of arrears than those fathers who were nonresident at birth. Part of the reason for such discrepancy may be that those fathers who become high debtors are likely to have an unstable relationship with the mother at birth and are not eligible to apply for child support programs that reduce the existing arrears. For instance, the eligible population for such arrears reduction program is, in general, restricted to noncustodial fathers with less arrears burden and who have no history of late payment within last six months. If the noncustodial fathers have arrears owed to custodial

mothers, the local child support agency must contact to those mothers to ask for a voluntary compromise of arrears. If the custodial mothers do not agree to the compromise, then the noncustodial fathers must pay full amount of arrears owed to custodial parents. Therefore, those fathers who are not in the stable relationship with the mother of their child will face great difficulty getting benefits from this program and as a result, would fall further behind in paying off their debts.

Due to limited resources, many local enforcement agencies may not be able to provide appropriate services to all nonresident fathers who are struggling to pay off their child support obligations. Therefore, the agencies sometimes may have to reluctantly decide which practices or strategies they should employ to achieve the goals. Based on these considerations, suppose that the state-level child support agencies have limited resources that could be used for improving either the current or the arrearage collection performances. According to the findings from the current study, the reduction in arrears caused by a one-percentage point increase in arrearage performance measure is much larger than that reduction caused by the same percentage point increase in current performance measure.

However, we do not know how much it would cost for local agencies to raise a one-percentage-point on each performance measurement. Therefore, we cannot determine which of the performance measures is a more effective tool to reduce arrears.

In sum, the results from current study have several implications for child support policy. The study found strong evidence that efficient child support enforcement leads to long-term decrease in the accumulation of arrears. This study also finds strong evidence that more efficient child support enforcement policies convey greater benefits to children who lived with their father at birth than children who did not. These findings align with the efforts from policymakers and

researchers who have sought to find various strategies to encourage fathers to attend the birth of their child.

Despite the encouraging findings of this study, it is worth mentioning a few caveats. First, as aforementioned in the previous section, measurement errors on the dependent variable due to the use of the mother's report of the father's child support debt may slightly reduce overall statistical power. Therefore, the results of this study can be replicated when new data that contains complete information on the actual amount of arrears owed by fathers is available. Second, although the study used the two-stage least square method to account for potential bias occurring from measurement error of performance measure, the instrumental variable used in this method was not strong enough to minimize the variance of the resulting estimator. Therefore, future research could explore additional instrumental variables to minimize the variance of the estimator.

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Table 1. Descriptive statistics for outcomes, time-invariant and time-varying covariates

	Baseline						Year 1		Year 3		Year 5		Year 9	
	Full		Resident		Nonresident		Full sample							
	M/%	(SD)	M/%	(SD)	M/%	(SD)	M	(SD)	M	(SD)	M	(SD)	M	(SD)
Panel A														
Amount of arrears accumulated [0-$90,000]							226.7	(1,059)	661.4	(1,998)*	1,305	(4,307)*	2,605	(7,413)*
Number of elapsed years since order establishment (year) [0-10.65 years]							0.12	(0.33)	0.50	(0.92)*	1.31	(4.31)*	2.60	(7.41)*
Panel B														
Fathers' time-invariant characteristics														
Age in years [15-54]	26.94	(6.79)	27.86	(6.64)	25.81	(6.80)*								
Number of Kids [1-18]	2.12	(1.49)	2.16	(1.51)	2.08	(1.46)*								
Intelligence (WAIS_R) [0-15]	6.39	(2.71)	6.42	(2.75)	6.34	(2.66)								
Depressive Symptom (CIDI) [0-1]	0.17	(0.37)	0.16	(0.36)	0.18	(0.38)								
% White	14%		19%		7%									
% Black	54%		42%		68%	*								
% Hispanic	28%		34%		22%									
% Other	4%		5%		3%									
% Less than high school degree	34%		33%		35%									
% High school degree	39%		35%		44%	*								
% Some college	20%		22%		18%									
% College degree	7%		10%		3%									
Time-varying covariates														
Fathers in jail status [0-1]							0.11	(0.32)	0.13	(0.34)*	0.12	(0.33)*	0.15	(0.36)*
State unemployment rate [.02-.11]							0.05	(0.01)	0.05	(0.01)	0.06	(0.01)	0.05	(0.01)
State poverty rate [7.20-17.30]							10.73	(2.81)	10.85	(2.79)	12.09	(2.52)*	12.23	(2.61)*
% of children in single parent [.25-.38]							0.30	(0.02)	0.30	(0.02)	0.30	(0.02)	0.32	(0.02)
% of people went to college [.12-.32]							0.18	(0.03)	0.19	(0.03)*	0.19	(0.04)*	0.21	(0.04)*
% of people born in U.S. [.71-.98]							0.88	(0.07)	0.87	(0.08)	0.87	(0.08)	0.85	(0.08)
# of Observations	3,351		1,854		1,497		1,834		2,172		2,504		2,999	

Note: The range of variable is presented in block parentheses. For simplicity, the descriptive statistics were calculated based on the first set of imputed data. Results were similar for other 4 imputed samples. Chi-square test for categorical variables and t-test for continuous and binary variable were used to assess the statistical difference between resident and nonresident samples. T-test was used to assess whether the time-varying covariates increase or decrease over time. *Significant at $P<.05$

Source: Fragile Families and Child Well-being Study (FFCWS), Wave 1-5.

Table 2. Multivariate model for assessing effects of elapsed time since the establishment of child support orders on an accumulation of child support arrears: based on Tobit analysis.

	Full (1)	Full (2)	Full (3)	Resident (4)	Nonresident (5)
Number of elapsed years since the establishment of the orders	433.43***	415.92***	407.16***	350.72***	421.80***
	(18.29)	(20.88)	(20.70)	(67.14)	(30.94)
Fathers' age in years		-23.06***	-21.40***	-26.87***	-17.60+
		(5.99)	(5.72)	(8.03)	(9.69)
Fathers' education (versus high school dropouts)					
High school degree		-11.85	-5.37	-26.52	-23.29
		(66.43)	(64.69)	(100.69)	(90.82)
Some college		-6.29	9.77	-8.46	-3.57
		(100.63)	(102.50)	(128.57)	(127.59)
College degree		-248.16	-173.80	-187.48	-174.17
		(171.43)	(176.55)	(140.31)	(313.51)
Fathers' number of kids		64.10**	61.68**	53.89+	61.13*
		(20.55)	(20.41)	(32.75)	(29.26)
Fathers' intelligence (WAIS_R)		22.00+	19.10	47.11**	-5.61
		(12.54)	(12.54)	(18.02)	(15.27)
Race/Ethnicity (versus White)					
Black		-274.01*	-203.78+	4.60	-350.91*
		(123.01)	(121.47)	(140.16)	(172.68)
Hispanic		-212.61	-130.34	55.58	-252.24
		(144.62)	(132.31)	(140.65)	(195.60)
Other		-278.64	-183.33	231.51	-586.12*
		(209.94)	(196.58)	(280.87)	(235.11)
Depressive Symptom (CIDI)		66.31	58.60	4.50	103.25
		(94.98)	(94.49)	(105.78)	(100.97)
Baseline Relationship Status (versus Nonresident)					
Cohabitation		-46.58	-40.64	—	—
		(78.68)	(72.49)		
Married		-298.04**	-225.12*	—	—
		(102.61)	(107.71)		
Fathers in jail		198.74+	207.27+	332.78**	135.26
		(118.66)	(113.11)	(120.28)	(124.96)
State poverty rate		-37.37	46.15	114.60	-77.98
		(46.64)	(79.08)	(94.54)	(120.29)
State unemployment rate		28.67	-25.19	-0.30	-40.92
		(43.40)	(93.52)	(85.88)	(99.97)
People born in the United States		34.94	-88.10	-110.62	-48.99
		(42.96)	(80.71)	(127.19)	(183.44)
children in single parent families		-14.32	-7.81	31.68	-56.35
		(34.66)	(58.28)	(68.17)	(71.57)
people who went to college		-69.81	70.29	115.20	6.24
		(43.50)	(102.51)	(114.12)	(137.11)
State Fixed Effects	N	N	Y	Y	Y
Interview Year Fixed Effects	N	N	Y	Y	Y
Observations	*9,509*	*9,509*	*9,509*	*4,465*	*5,044*

Note: Results are presented as marginal effects on the expected value for arrearage outcomes for both censored and uncensored observations. *** p<0.001, ** p<0.01, * p<0.05, + p<0.10
Source: Fragile Families and Child Well-being Study (FFCWS), Wave 1-5.

Table 3. Moderating effect of performance measure on the relationship between a number of years since the child support orders were established and the accumulation of arrears: based on Tobit analysis.

Panel 1: For current collection measure

	Changes from the Mean to +1SD (from .60 to .69)		
	(1) Full	(2) Resident	(3) Nonresident
Elapsed Time at			
1 year	25.59	25.10	26.29
	(54.31)	(61.60)	(59.77)
3 years	-242.90+	-357.34*	-125.66
	(136.54)	(159.30)	(151.22)
5 years	-918.23**	-1,407.37***	-505.98
	(304.37)	(392.92)	(332.24)
7 years	-2,034.07***	-3,251.40***	-1,121.17+
	(555.31)	(758.91)	(594.08)

Panel 2: For arrearage collection measure

	Change from the Mean to +1SD (from .60 to .64)		
	(1) Full	(2) Resident	(3) Nonresident
Elapsed Time at			
1 year	-5.51	-38.92	10.62
	(42.61)	(70.33)	(52.47)
3 years	-193.08+	-353.80	-88.27
	(103.61)	(220.53)	(123.84)
5 years	-637.87**	-1,123.81*	-328.17
	(220.52)	(523.86)	(256.82)
7 years	-1,356.21***	-2,415.23*	-713.07
	(391.80)	(964.79)	(446.83)

Table 4.

Panel 1: For current collection measure

	Changes from the 60 to 65 percent		
	(1) Full	(2) Resident	(3) Nonresident
Elapsed Time at			
1 year	25.16	32.19	18.77
	(30.70)	(36.18)	(32.79)
3 years	-115.41	-159.59+	-66.92
	(76.56)	(90.57)	(82.94)
5 years	-483.38**	-715.70**	-286.26
	(170.09)	(225.28)	(182.69)
7 years	-1,100.36***	-1,712.29***	-643.43*
	(309.55)	(432.47)	(326.78)

Panel 2: For arrearage collection measure

	Changes from the 60 to 65 percent		
	(1) Full	(2) Resident	(3) Nonresident
Elapsed Time at			
1 year	-3.83	-32.01	9.27
	(35.44)	(60.18)	(43.46)
3 years	-161.00+	-303.85	-73.55
	(88.81)	(198.47)	(104.00)
5 years	-540.41**	-974.37*	-275.92
	(191.52)	(478.23)	(216.96)
7 years	-1,149.86***	-2,088.23*	-600.36
	(340.31)	(871.95)	(377.32)

Table 5. Instrumental Variable Estimates

For current collection measure

	Changes from the Mean to +1SD (from .60 to .69)		
	(1) Full	(2) Resident	(3) Nonresident
2SLS- 1st Stage			
Effect of standardized expenditure on current collection	,12*	.10+	.14**
	(.039)	(.050)	(.042)
2SLS- 2nd Stage			
Elapsed Time at			
1 year	51.129	48.687	54.033
	(139.952)	(155.730)	(176.405)
3 years	-233.651	-368.628	-95.051
	(299.710)	(343.019)	(378.834)
5 years	-981.376+	-1,551.896*	-499.821
	(539.770)	(644.361)	(676.783)
7 years	-2,233.861**	-3,649.664***	-1,174.725
	(830.352)	(1,020.634)	(1,026.901)

Figure 1. Distribution of mothers against the amount of arrears owed by the fathers.

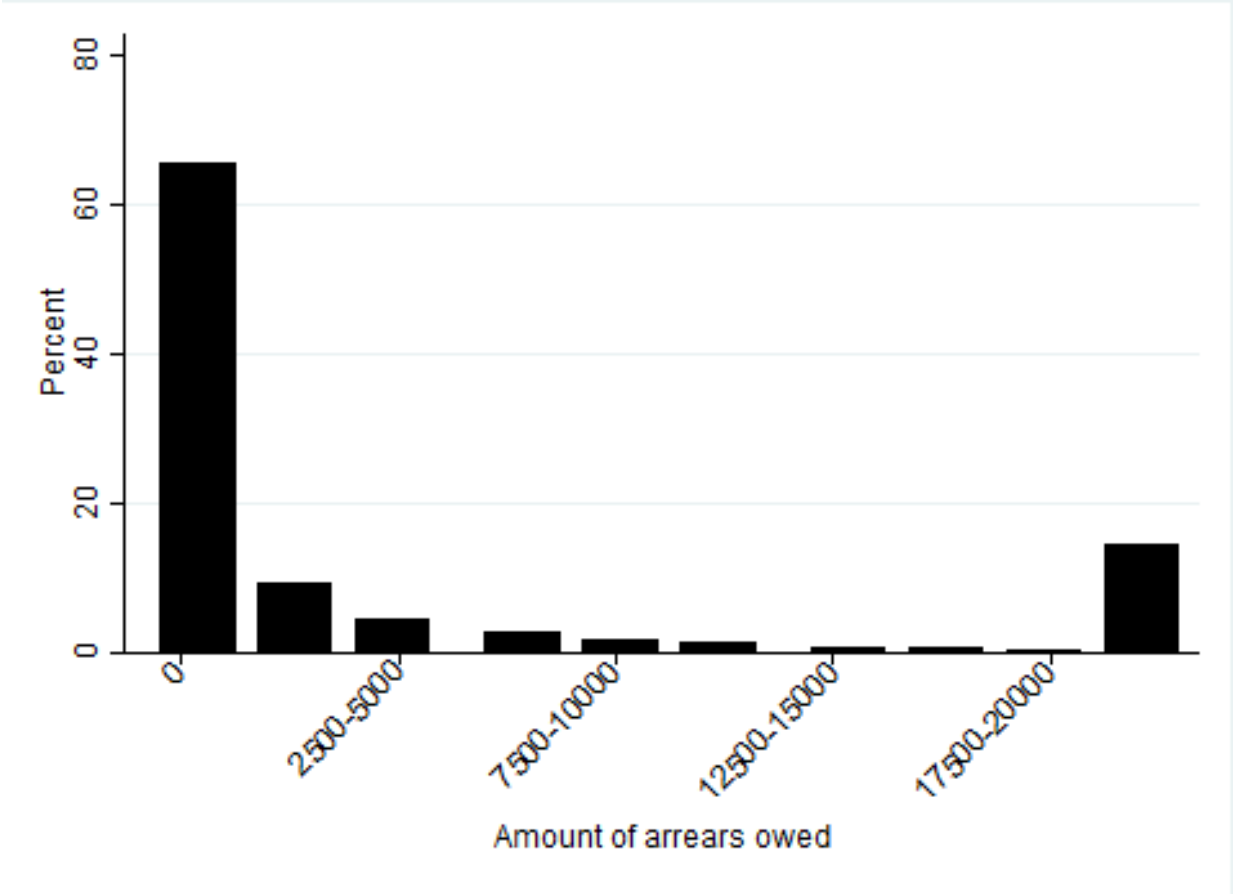


Figure 2. Average Percentage of Performance Measures, 1999 to 2010

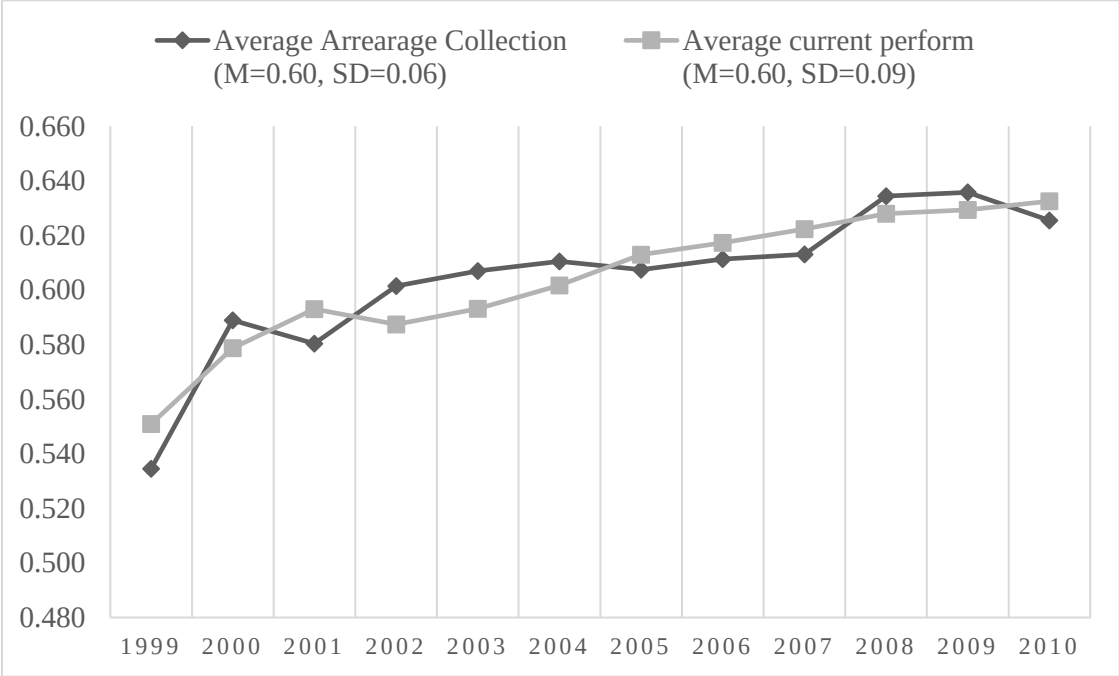
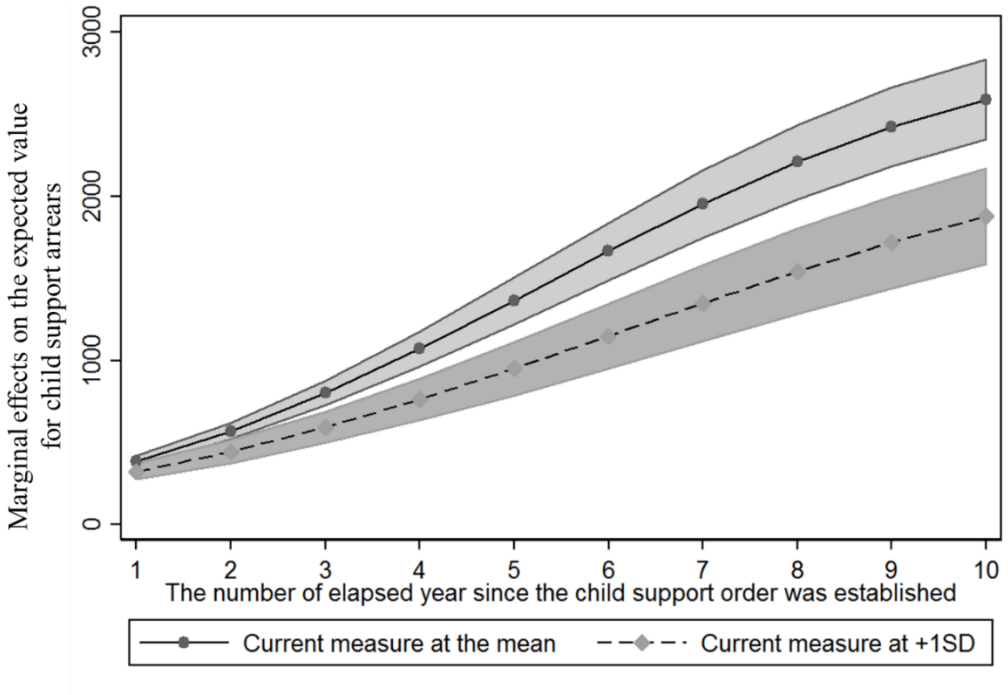
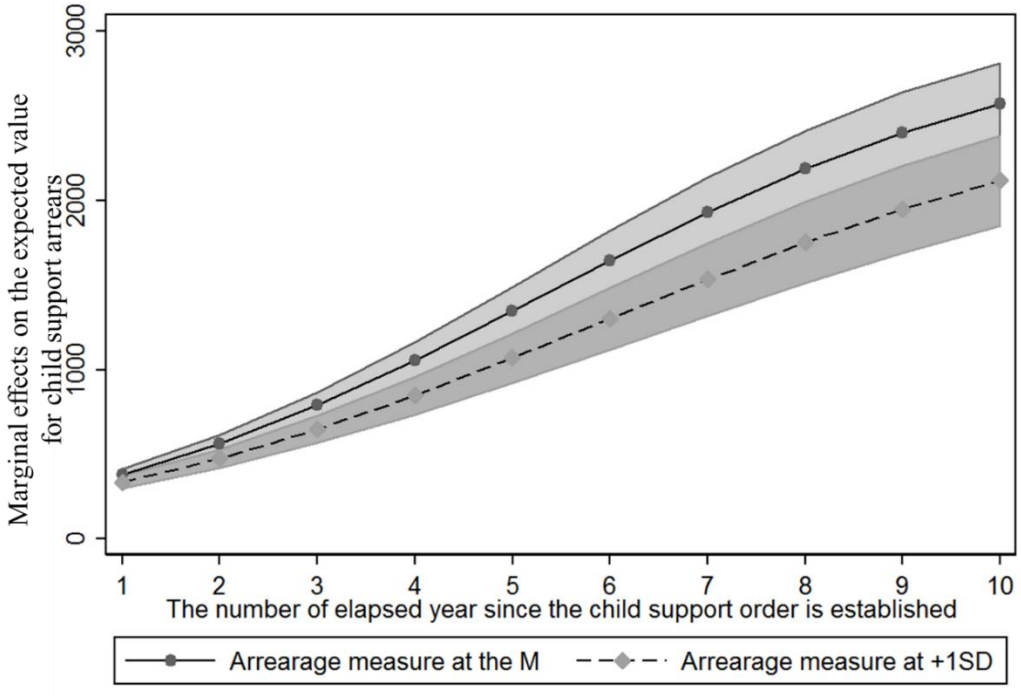


Figure 3. The marginal effects of elapsed time since the establishment of child support orders on an accumulation of child support arrears stratified by CSPIA's performance measures

Panel 1: For current collection measure



Panel 2: For arrearage collection measure



Appendix 1. Measurement errors on the dependent and explanatory variable

Note: Due to the extensive equations required for the proof, the work was written through LateX software)

Measurement Errors in Dependent Variable

Suppose that we have a simple regression model, such as:

$$Y_{Actial,i} = \alpha + \beta X_i + \varepsilon_i$$

Now, suppose that we cannot observe the actual value of outcome, $Y_{Actual,i}$,instead we can only observe it with measurement error: $Y_{Measured,i} = Y_{Actial,i} + \omega_i$ Note that the measurement error, ω_i, is assumed to be uncorrelated with the explanatory variable, X_i, and error term, ε_i. Lets substitute $Y_{Measured,i}$ to the original regression model:

$$Y_{Measured,i} = \alpha + \beta X_i + \varepsilon_i$$

Then the esimated β will be

$$\begin{aligned}
\hat{\beta} &= \frac{Cov(Y_{Measured,i}, X_i)}{Var(X_i)} \\
&= \frac{Cov(Y_{Actual,i} + \omega_i, X_i)}{Var(X_i)} \\
&= \frac{Cov(\alpha + \beta X_i + \varepsilon_i + \omega_i, X_i)}{Var(X_i)} \\
&= \frac{Cov(\alpha, X_i)}{Var(X_i)} + \frac{Cov(X_i, X_i)}{Var(X_i)} + \frac{Cov(\varepsilon_i, X_i)}{Var(X_i)} + \frac{Cov(\omega_i, X_i)}{Var(X_i)} \\
&= \beta \frac{Var(X_i)}{Var(X_i)} \\
&= \beta
\end{aligned}$$

Therefore, measurement errors on the dependent variable do not bias the regression results.

Measurement Errors in the explanatory Variable

Now, suppose that we have a measurement error in the explanatory variable., $X_{Measured,i}$. If u_i is an measurement error, then

$$X_{Measured,i} = X_{Actual,i} + u_i$$

Lets substitute $X_{Measured,i}$ to the original model:

$$\begin{aligned} Y_{Actual,i} &= \alpha + \beta X_{Actual,i} + \varepsilon_i \\ &= \alpha + \beta(X_{Measured,i} - u_i) + \varepsilon_i \\ &= \alpha + \beta X_{Measured,i} + (\varepsilon_i - \beta u_i) \\ &= \alpha + \beta X_{Measured,i} + e_i \\ \therefore \text{If } Cov(X_{Measured,i}, e_i) &\neq 0 \longrightarrow Biased \end{aligned}$$

If the explanatory variable $X_{Measured,i}$ and the error term e_i are positively correlated, then the estimated β will be biased upward. To see this is true, let's assume that **the actual coefficient β is negative.** When u_i increases, then both the $X_{Measured,i}$ and the e_i also increase, resulting in a positive explanatory variable/error term correlation.Therefore,**when β is negative, then the slope of the actual explanatory variable is steaper than those of the measured one.** This applies in the same way to regression models with interaction terms.

Appendix 2. *CSPIA Performance Measure for Current and Arrearage Collection*

Performance Measure	**How to measure**
Percent of Current Collection	$\frac{\text{Amount of current support collected in IV} - \text{D}}{\text{Amount of current support owed in IV} - \text{D}}$
Percent of Arrearage Cases	$\frac{\text{Number of cases paying towards arrears in IV} - \text{D}}{\text{Number of cases with arrears due in IV} - \text{D}}$

Appendix 3-1.CSPIA Performance measure by years across states: arrearage collection

ST	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	State Average
IL	0.326	0.488	0.508	0.523	0.514	0.582	0.459	0.513	0.537	0.592	0.626	0.613	0.523
MI	0.343	0.600	0.582	0.608	0.590	0.556	0.532	0.543	0.554	0.567	0.595	0.571	0.553
TN	0.466	0.479	0.497	0.545	0.573	0.592	0.600	0.606	0.594	0.609	0.599	0.575	0.561
IN	0.439	0.514	0.511	0.526	0.548	0.562	0.580	0.588	0.596	0.642	0.647	0.641	0.566
CA	0.598	0.534	0.563	0.549	0.554	0.549	0.560	0.565	0.571	0.591	0.594	0.603	0.569
VA	0.520	0.542	0.565	0.564	0.575	0.574	0.578	0.581	0.585	0.596	0.583	0.605	0.572
NY	0.370	0.598	0.607	0.604	0.598	0.591	0.590	0.588	0.600	0.612	0.606	0.592	0.580
MA	0.519	0.553	0.570	0.583	0.604	0.588	0.579	0.585	0.593	0.621	0.620	0.607	0.585
MD	0.575	0.599	0.606	0.643	0.624	0.621	0.639	0.637	0.623	0.629	0.636	0.616	0.620
WI	0.620	0.660	0.617	0.611	0.620	0.643	0.642	0.590	0.605	0.620	0.618	0.621	0.622
NJ	0.607	0.562	0.585	0.612	0.656	0.633	0.632	0.638	0.639	0.657	0.659	0.624	0.625
OH	0.563	0.579	0.418	0.675	0.663	0.663	0.665	0.673	0.671	0.682	0.665	0.640	0.630
TX	0.633	0.634	0.630	0.645	0.623	0.635	0.652	0.673	0.673	0.686	0.666	0.645	0.650
FL	0.799	0.818	0.750	0.628	0.646	0.658	0.667	0.637	0.599	0.623	0.604	0.599	0.669
PA	0.639	0.673	0.697	0.707	0.715	0.710	0.735	0.752	0.758	0.788	0.818	0.831	0.735
Year Average	0.534	0.589	0.580	0.601	0.607	0.610	0.607	0.611	0.613	0.634	0.636	0.626	0.604

Appendix 3-2. CSPIA Performance measure by years across states: current collection

ST	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	State Average
CA	0.405	0.400	0.410	0.424	0.452	0.480	0.493	0.504	0.515	0.528	0.534	0.560	0.475
IN	0.146	0.442	0.468	0.485	0.505	0.510	0.528	0.538	0.548	0.566	0.575	0.583	0.491
IL	0.516	0.365	0.376	0.391	0.470	0.492	0.533	0.518	0.531	0.554	0.580	0.579	0.492
TN	0.446	0.449	0.483	0.504	0.537	0.547	0.554	0.557	0.558	0.540	0.526	0.519	0.519
FL	0.486	0.499	0.521	0.564	0.564	0.567	0.567	0.544	0.518	0.524	0.520	0.522	0.533
VA	0.537	0.565	0.582	0.590	0.597	0.600	0.609	0.616	0.620	0.626	0.621	0.620	0.598
TX	0.501	0.651	0.620	0.599	0.577	0.585	0.605	0.623	0.634	0.645	0.636	0.634	0.609
MI	0.660	0.672	0.603	0.594	0.557	0.602	0.605	0.614	0.622	0.620	0.624	0.625	0.616
MD	0.569	0.585	0.603	0.620	0.632	0.618	0.631	0.642	0.638	0.646	0.649	0.645	0.623
MA	0.547	0.587	0.636	0.597	0.609	0.626	0.638	0.654	0.664	0.668	0.676	0.679	0.632
NJ	0.616	0.631	0.646	0.650	0.650	0.649	0.653	0.656	0.657	0.657	0.635	0.651	0.646
NY	0.700	0.736	0.766	0.651	0.647	0.647	0.651	0.649	0.656	0.663	0.670	0.669	0.676
OH	0.711	0.664	0.680	0.668	0.673	0.679	0.690	0.691	0.689	0.688	0.674	0.666	0.681
WI	0.771	0.766	0.785	0.727	0.677	0.676	0.690	0.706	0.706	0.707	0.706	0.706	0.719
PA	0.652	0.666	0.716	0.747	0.748	0.744	0.747	0.746	0.780	0.789	0.813	0.832	0.748
Year Average	0.551	0.579	0.593	0.587	0.593	0.602	0.613	0.617	0.622	0.628	0.629	0.633	0.604

Appendix 4. Proof: why two-stage least squares has larger variance than least squares.

(Note: Due to the extensive equations required for the proof, the work was written through LateX software)

Suppose that y is an outcome variable, X is a vector of covariates, and Z is a vector of instrumental variables. To estimate b_{2SLS}, I consider the following standard regression estimator

$$\beta_{2SLS} = (\hat{X}'\hat{X})^{-1}(\hat{X}'y)$$

where $\hat{X}$ is a predicted X, which can be derived by regressing X on Z. or

$$X = Z'\beta_{IV} + \varepsilon, or$$
$$\hat{X} = Z\beta_{IV}$$

Assume that the vector of instrumental variables is (1) predictive of the X, and (2) unrelated to the outcome variables except through the X. To be valid, T-tests or F-tests on the vector of instrumental variable must be statistically significant AND $E[Z|\varepsilon] = 0$. Therefore,

$$\begin{aligned} Z'X &= Z'Z\beta_{IV} + Z'\varepsilon_i \\ \beta_{IV} &= (Z'Z)^{-1}(Z'X) \\ \therefore \hat{X} &= Z(Z'Z)^{-1}(Z'X) \\ &= (I - M_Z)X \end{aligned}$$

Where M_z is the "residual maker" because $MzX = (I - Z(Z'Z)^{-1}Z')X = X - Z'b_{IV} = e(resid)$, since $b_{IV} = (Z'Z)^{-1}(Z'X)$.
Note that M_z is an idempotent matrix, therefore $(\hat{X}'\hat{X}) = X(I - M_z)X$
Under homoskedastic errors, the Asymptotic variance for β_{2SLS} will be

$$\begin{aligned} Asy.var[2SLS] &= E[(\beta_{2SLS} - \beta)(\beta_{2SLS} - \beta)'] \\ &= (\hat{X}'\hat{X})^{-1}\hat{X}'\varepsilon\varepsilon'\hat{X}(\hat{X}'\hat{X})^{-1} \\ &= \sigma^2(\hat{X}'\hat{X})^{-1} \\ &= \sigma^2(X'(I - Mz)X)^{-1} \end{aligned}$$

Which is larger than the Asymptotic variance for standard β_{LS}: $Asy.Var[LS] = \sigma^2(X'X)^{-1}$
Proof

Compare inverse →If negative, then Asy,Var[LS] is less precise than Asy.Var[2SLS]

$$\begin{aligned} &Asy.Var[LS]^{-1} - Asy.Var[2SLS]^{-1} \\ &= \frac{1}{\sigma^2}[X'X - X'(1 - M_z)X] > 0 \in \forall \text{ R} \end{aligned}$$

If M_z is closed to zero, then we can minimize the difference. M_z being closed to zero means Z is almost perfectly predicting X (That being said a residual maker makes no residual).
Therefore, the "weak instrument" is responsible for large variance in $Asy.var[2SLS]$