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How to cite this publication

Please cite the final published version:

Rasmussen, A.W. & Stratton, L.S. Rev Econ Household (2016) 14: 829.

<https://doi.org/10.1007/s11150-016-9338-9>

Publication metadata

Title:	<i>How Distance to a Non-Resident Parent Relates to Child Outcomes</i>
Author(s):	<i>Rasmussen, A.W. & Stratton, L.S.</i>
Journal:	Review of Economics of the Household
DOI/Link:	10.1007/s11150-016-9338-9
Document version:	Accepted manuscript (post-print)

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How Distance to a Non-Residential Parent Relates to Child Outcomes*

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May 2016

Abstract. Family courts now encourage both parents to maintain contact with their children following separation/divorce, believing this is in the child's best interest. We use geographical distance between non-residential parents and their children to test how such distance is related to educational and behavioral outcomes within a population sample of children from nonnuclear families in Denmark. As this distance is a choice, non-residential parents may choose where to live in part based on expected child outcomes; results that fail to take endogeneity into account will be biased. We use instrumental variable techniques to control for this potential endogeneity. The results indicate educational outcomes are somewhat better for all and behavioral outcomes are at least no worse for girls who live at a greater distance from their non-residential parent. Failing to control for endogeneity seems to bias the results for behavioral outcomes in favor of more proximate parents. Thus, policy efforts to keep separated parents geographically closer for the sake of their children may in fact not be advantageous.

JEL Classification: J12, J13, I21, D13.

Keywords: Child outcomes, parental separation, distance, non-residential parent

*Acknowledgement: Financial support from The Danish Social Science Research Council is gratefully acknowledged. We would like to thank participants at the seminar series at SOFI, Stockholm University, 2011; SFI, Copenhagen, 2013; DIW, Berlin, 2015; the University of Sydney, 2016; and the Life Course Center at the University of Queensland, 2016 for all their comments. Furthermore, comments from participants at ESPE 2010, EEA 2010, the Danish Microeconomic Network meeting in Skagen, 2010, and the Economics of the Family Conference in Paris, 2011, are gratefully acknowledged. All errors remain our own.

This paper has been accepted for publication by *Review of Economics of the Household* (June 2016). The final publication is available at Springer via <http://dx.doi.org/10.1007/s11150-016-9338-9>.

1. Introduction

A substantial and growing fraction of children in both Europe and the US live in households with only one parent. At the same time there has been a growing tendency to grant joint physical as well as legal custody or otherwise ensure that children of divorced parents spend time with each of their parents. This shift away from maternal custody is based on the belief that having contact with each parent is in the child's best interest. In this paper we use detailed data on children in Denmark who live with only one biological parent to examine the relation between the physical distance separating children from their non-residential parents and child educational and behavioral outcomes. As this distance is likely endogenous, we expand upon the extant literature by presenting instrumental variable results.

Marriage rates in the EU-27 fell from 7.9 to 4.4 per 1000 population from 1970 to 2010. The rate of marital dissolution is around 50% in Germany, France, and the UK and only slightly lower (42%) in the Netherlands and Denmark. In the US, marriage rates fell from 10.6 per 1000 population in 1970 to 6.8 in 2012 and the ratio of divorces to marriages hovered around 50% between 1980 and 1998, but has since fallen (Amato 2010). An increasing fraction of couples are opting to live together without marriage, but the dissolution rate of cohabiting relationships is higher still than that of marriages (Svarer and Verner 2008). Stable couple relationships are on the decline.

As a result, many children are growing up in divided households. In 2007 in households with children, the fraction of single parents was 21.5% in the UK and 17.9% in Denmark (Iacovou and Skew 2010). A snapshot of the US in 2013 reveals that about 32.3% of children were living with only one biological parent (U.S. Department of the Census 2013). Furthermore, point estimates necessarily understate childhood experience. Evidence from the US indicates that up to 40% of children will experience a parental divorce, 50% will for some period of time reside with a single parent, and 33% will for some period of time live with a step-parent (Amato 2000).

Some of the most important and difficult decisions made during any parental separation are those concerning child custody. Joint legal custody is now common practice (Altindag, Nunley, and Seals forthcoming), but most children still reside with their mother (Cancian et al. 2014). However, legislation promoting shared physical custody has become increasingly common. Australia and the state of Wisconsin were among the first to pass such legislation. About twenty other US states are in the process of doing so (Jones 2015). The result has been a substantial increase in co-residence. Nielsen (2009) reports that while historically only 5-7% of children with divorced parents lived at least 35% of the time with each parent, that fraction has risen to 30% in Wisconsin and between 18 and 20% in Australia and Denmark. A critical research question for policy makers voting on such

legislation is how increased contact with the non-residential parent affects child outcomes.

We therefore believe the results from our study are of general interest as the empirical analysis is based on a country, Denmark, where the number of separations is high and in line with many other Western countries. Moreover, in Denmark it is common for parents to split the responsibility for the child after a separation, implying that children spend the weekend or even half the time (the so-called 7/7 agreement) with the non-residential parent. Such agreements are becoming more common in the Western world where fathers are generally taking more responsibility for raising their children, exemplified when fathers take parental leave. Denmark has taken this a step further with legislation, effective October 2007, establishing co-parenting as the norm. This legislation has made the 7/7 agreement even more widespread and distance between parents clearly matters for the feasibility of a 7/7 agreement. There is, however, limited information on the impact of distance to a non-residential parent on child outcomes. Is it in the child's (or the parents') best interest to keep short distances between the parents after a separation? Our study indirectly provides information about the possible consequences for children of such agreements as we investigate the impact on children of the distance to the non-residential parent. The results suggest that children have no worse outcomes (and potentially better outcomes in some dimensions) when their parents are not living close to each other after a separation.

Contact with the non-residential parent is measured in this study by the distance between the municipalities where the child and the non-residential parent reside. As distance is a choice variable that may itself be related to child outcomes, endogeneity may be an issue. We use instrumental variables to address this possibility. The instruments we employ are based on the distance between the municipalities where the parents attended school, with the premise being that while investing in human capital, men and women are also developing geographic-specific human capital in the form of friends, familiarity with the physical environment, and labor market contacts. We present evidence which clearly shows such connectivity, as well as evidence regarding the relation between these distance measures, child outcomes in nuclear households, and the probability and timing of separations. Reassuringly, the evidence shows that at least one of these distance measures is not significantly related to child outcomes for children in nuclear households, is not predictive of the timing of separation, and is only marginally related to the probability of separation and then only for the subsample of girls. This measure is significantly related to distance to the non-residential parent and so, we believe, constitutes a good instrument.

2. Literature Review

There exists a substantial literature addressing the impact of divorce on children's outcomes (Amato 2000, 2010 provide a review). These studies generally suggest a negative relation between non-nuclear family structure

and child outcomes, and many focus on determining whether divorce has a negative causal effect or whether divorce mainly happens in negatively selected families. Our analysis falls into the literature examining factors affecting children's adjustment to divorce and as our focus is on the impact contact with the non-residential parent has on child outcomes, our analysis is restricted to non-nuclear families. Some of the literature suggests that child outcomes are better in the case of joint versus sole custody arrangements (Amato 2000). Presumably contact is greater in the case of joint arrangements. Amato (2000) and Amato, Kane, and James (2011), however, report that there is little evidence that frequent contact with the non-custodial parent has any impact on child outcomes. Even the impact of an almost complete loss of contact with the non-residential parent is unclear: Amato (2010) states that loss of contact is generally associated with lower children's well-being, while Amato et al. (2011) find no difference in grades but better behavioral outcomes for children who have little contact with their non-residential parent as compared to children who have frequent contact (with little conflict) post-divorce.¹

An important concern in this literature is the definition of 'contact'. Some studies use child-reported closeness to the non-residential parent (typically the father) (for example White and Gilbreth 2001; King 2006; Yuan and Hamilton 2006). However, feelings of closeness are subject to a number of measurement problems and are difficult to compare across individuals. An alternative metric for 'contact' is shared activities or time (King 2006; Yuan and Hamilton 2006), though the type of activity also appears to matter (Amato et al. 2011). Shared leisure activities have less impact than time spent working together on homework, for example. Such metrics are typically measured at only one point in time. Observed values at this one point in time are then assumed to be representative of parent-child contact for the duration of the separation, but with only one observation of contact per parent-child, that value is likely imprecise. This problem is known as the "window problem" (Wolfe, Haveman, Ginther, and An 1996).

Physical distance is a more concrete metric. When a relationship ends, at least one partner must typically physically move. Moving further away increases the cost of maintaining physical contact and so reduces its probability. Contact can, of course, also be maintained by other means. Cooksey and Craig (1998) find a negative relation between physical distance and physical contact using a select sample of children and non-residential parents from the second wave of the National Survey of Families and Households (NSFH), but also report a negative relation between physical distance and telephone contact. Together this suggests that physical distance might be a reasonable proxy for all types of contact. Our own calculations using data on all non-residential parents in the first

¹ Children who have contact but whose parents are in conflict do have lower grades (Amato et al. 2011). Generally, the degree of conflict both before and after separation as well as the use of shared parenting techniques are significantly associated with child outcomes (Amato 2010).

two waves of the NSFH indicate significant correlations of between 0.6 and 0.7 between physical and other contact, of -0.4 between physical contact and distance, and of between -0.15 and -0.2 between distance and other contact. Furthermore, Viry (2014) in a study of 144 children of divorce in Geneva finds that distance is positively correlated with behavioral problems, even after controlling for more direct measures of contact. A longer distance could result in less parental supervision and thus result in the child spending less time in productive activities like education and more time in dangerous or criminal activities, regardless of the degree of other contact.

As physical distance and contact are choices, it may be inappropriate to assume that distance/contact causes child outcomes. Amato (2000) and Fehlbeg, Smyth, Maclean, and Roberts (2011) warn that such choices could bias the comparison of children in joint versus sole custody cases. Divorced parents with joint custody may get along better than other divorced parents, and that better relationship may drive observed outcome differentials. Similarly, parents who get along better may choose to live in closer proximity. Alternatively, non-residential parents may choose their residence based on their relationship with their children. Hawkins, Amato, and King (2007) find evidence that non-residential fathers are more likely to maintain contact with children who are doing well, than with children who are troubled. That Cheadle, Amato, and King (2010) find increasing distance reduces the frequency of contact, alleviates but does not eliminate this concern as non-residential parents who perceive their children are faring worse may choose to move farther away to avoid contact. In the analysis that follows, we use distance from the non-residential parent to proxy for contact, but also control for selection with instrumental variables estimation. As distance measures are available for every year post-separation in our data, the common “window problem” is also substantially reduced.

Theoretically, there are many arguments linking child outcomes to distance to a non-residential biological parent. For example, greater distance may be associated with greater parental conflict or a lower time investment from the non-residential parent and thus worse child outcomes (Becker and Tomes, 1986). Or longer distance may moderate parental conflicts and so reduce stress for children or reduce the frequency of inter-household moves and so provide more stability in children’s daily routines. Both less stress and more stability may improve child outcomes (Amato 2010; Kalil, Mogstad, Rege, and Votruba 2011; Lamb, Sternberg, and Thompson 1997).² Distance to the non-residential parent may also have no association with child outcomes. If the parental relationship dissolves because the match is of poor quality or due to one of the parents having poor parenting

² Greater distance may also reflect greater power in the hands of the residential parent and such power could be wielded to produce better child outcomes. Interpreting the results as a consequence of distance per se may in this case be inappropriate. That we control for each parent’s education level and earnings should help mitigate this possibility.

abilities, then contact with/distance to the non-residential parent may be of no importance (Becker, Landes, and Michael 1977). Finally, distance to a non-residential parent may have heterogeneous effects depending on the child's and the parents' characteristics. For example, contact with a non-residential father is potentially more important for boys than for girls if same gender parents are more important role models for children. These hypotheses are discussed in more detail by Kalil et al. (2011), and we examine some of the more likely ones in the discussion of our results.

The extant literature employs a variety of child outcome measures. Educational outcomes are one of the most common (Amato and Gilbreth 1999; Hofferth 2006; King 2006). Educational outcomes are important as they are closely connected to future labor market success. Most sociological studies also include a measure of general behavior (Amato and Gilbreth 1999; White and Gilbreth 2001; Hofferth 2006; King 2006; Yuan and Hamilton 2006); some studies model criminal behavior (Cobb-Clark and Tekin 2014). Outcomes related to behavior are able to capture non-cognitive effects of distance to a non-residential parent. We therefore examine both educational and behavioral, specifically criminal, outcomes.

The most similar work in this field is that by Kalil et al. (2011), who use Norwegian registry data on a five year cohort of children whose parents were married at the time of their birth but divorced before their thirteenth birthday to compare outcomes for children whose fathers were either always proximate or always distant.³ They find that children with distant fathers have significantly better educational outcomes, particularly when their fathers are well educated. Supplemental survey data indicate that highly educated proximate fathers both spend more time with their children and report a higher level of post-divorce conflict. Thus, Kalil et al.'s work suggests that distance is associated with child outcomes via its impact on stress.

Our work will extend this literature in three ways. First, and most importantly, we carefully address the issue of endogeneity of distance to the non-residential biological parent. There are two relevant sources of endogeneity: omitted variables bias and non-random movement. We address omitted variables bias by estimating models with varying numbers of covariates to assess the robustness of the results. Kalil et al. (2011) followed the same strategy, and as we use data from a neighboring Scandinavian country, we expect our results to be similarly robust. Non-random movement is relevant to address since each parent chooses his/her place of residence and may do so based on expected child outcome. If parents are more likely to move farther away from one another when they believe their child is going to do well, then estimates that do not take into account such endogeneity are likely

³ Proximate non-residential fathers live in the same economic region as their child for more than 90 percent of the time. In Norway, there are 46 economic regions, each with an average population of about 86,000 people.

to find that children whose parents are more distant have better outcomes. If non-residential parents move further away when they believe their child is doing poorly in order to distance themselves, then estimates that do not take endogeneity into account are likely to find that children whose parents are more distant have worse outcomes. In order to control for such endogeneity bias, we provide instrumental variables estimates.

In Scandinavia cohabitation and premarital childbirth are common (Svarer and Verner 2008). A second extension of the literature is therefore to include children of both married and unmarried couples. Thirdly, we analyze educational outcomes, but we also have information on criminal outcomes that have not previously been studied. As results may differ across measures (Fomby and Cherlin 2007), and behavioral outcomes likely capture different effects of family separation than educational outcomes, it is important to analyze multiple child outcomes.

3. Data

Our empirical estimates are based on an administrative register dataset consisting of the entire population of Danish children born between January and August 1985 - 36,495 children born in Denmark of a known biological mother. These individuals are observed annually from 1985 until 2007 (when the children turn 22) in the Danish tax and income registers maintained by Statistics Denmark, provided they are alive and reside in Denmark. Each annual record provides detailed information regarding the composition of the family with which the child resides. About 5% of the population is dropped either because the children are not regularly observed (likely because of movement abroad) or because they do not regularly reside with a biological parent.

Throughout this study, family structure changes are defined as *any change in the biological or social parents with whom the child is residing up till age 18*. After this age, the individual is considered an adult. The term ‘*social parent*’ is used to describe any partner of the biological parent with whom the child resides, be he/she the other biological parent or not. Every individual has a unique identifier so all changes in family composition are observed. Married partners are clearly coded as such, but we do not restrict our analysis of family structure changes to legal changes only.⁴ Thus, any observed change in the number or identity of the ‘parents’ in the household where the child resides from one year to the next can be coded as a family structure change. Neither intrayear absences nor changes within the household of the non-residential biological parent are observed, and single year absences are ignored.

Those children who experience no family structure changes (61.5% of the sample), those who experience a

⁴ Cohabiting persons who share biological children are clearly identified by Statistics Denmark. Other adults are classified as cohabiting couples if they reside in the same household, are no more than fifteen years apart in age, are of opposite gender, and are not in any way related.

family structure change while abroad (since the number they may have experienced is unknown), those whose biological father is not identified, those who experience a parental death before they turn 18, and less than 500 others in unusual living arrangements or missing key variables are dropped, yielding a sample of 11,053 children. Following Kalil et al. (2011), we also restrict our analysis to children who experience an initial family structure change before the age of 13 and whose parents remain separated for the child's teenage years.⁵ This leaves a final estimation sample of 8,175 children. Further details regarding the sample construction are available upon request.

Two dependent variables are employed in the analysis that follows, one capturing educational attainment and another capturing behavior. As it is very popular among Danish youth to take a sabbatical year(s) between high school and college, higher educational goals may not be clear when the children are age 22. When investigating educational outcomes we therefore focus on completion of high school (not including vocational training), as of the last year observed. The behavioral outcome analyzed here is criminal activity. The age of criminal responsibility is 15 in Denmark in the time period we analyze, so we cannot investigate this behavioral outcome before age 15. As criminal behavior likely relates more to one's peers as one ages rather than to one's household characteristics, our measure of criminal activity focuses on behavior prior to age 18.

Table 1 presents sample means for the full sample and separately by child gender. The final column identifies variables that have significantly different means by gender. The first rows show mean values for the outcome measures. According to the sample statistics, about 40% of the children have completed high school (not including vocational training) by the time they were last observed. Gender differences are substantial with only 31% of the boys but 48% of the girls having a high school degree. Conversely, 12% of the entire sample, 19% of boys but only 4% of the girls, have been convicted by age 18. Outcomes for girls are significantly better in both cases, as has been reported elsewhere (see Jacob 2002 for education and Cobb-Clark and Tekin 2014 for criminal behavior). Outcomes for children in nuclear families are also better on both measures (with graduation rates of 60.8% and conviction rates of 5.9%).

The key variable of interest is the child's *Cumulative Distance to Non-Residential Parent*. To construct this measure we sum the number of kilometers between the child's and the non-residential biological parent's municipality of residence over all the years following parental separation. Denmark is a relatively small country and in no case can this distance measure exceed 481 kilometers in a year when both parties are living in Denmark.

⁵ Eight percent of the parents in our sample reunite. This number is in line with the 10% rate at which formal divorces are annulled in Norway (Steele, Sigle-Rushton, and Kravdal 2009).

For those years when the non-residential parent is abroad, we set the value to 500.⁶ Just about 26% of non-residential biological parents always reside in the same municipality, in which case the distance is zero. The average cumulative distance measure is 576 kilometers. This corresponds to an average annual post-separation distance of 40 kilometers, 54 for those ever at a positive distance. Even in larger cities it is unlikely a child could commute alone and even with a car the time necessary to travel such a distance is significant.

Also of particular interest are the instruments we use to test and control for the possible endogeneity of the *Cumulative Distance* measure. These instruments are based on the distance between where the parents were educated prior to separating. One instrument is the distance between the municipalities where each parent last completed some education (henceforth called the *Distance Between Education* or *DBE* for short); another substitutes the high school municipality in lieu of that for higher education where available (henceforth called the *Distance Between High School Plus* or *DBHP* for short).⁷ Use of the high school municipality has the advantage that this municipality is less likely to be subject to individual choice as high school students are typically living with their parents rather than choosing their own residence. However, information on the highest completed level of education is more accurately registered and validated than that for intermediate levels of education and is less likely missing, especially for younger cohorts (Jensen and Rasmussen, 2011). In constructing DBHP we are able to substitute high school location data for over 60% of parents with information on a municipality of higher education. Constructing these measures is quite data intensive as it requires information on education *and* the municipality where that education was obtained, for each biological parent. As a result, these measures are missing for almost 28% of the sample. Were we to require use of high school data for those last completing a higher level of education, data would be missing for 34% of the sample. A comparison of sample means between those for whom this information is and is not available suggests these data are not missing at random⁸, however such missing values are not unique to the nonnuclear sample. These variables are missing about as frequently (31%) for nuclear households. Furthermore, in both the nuclear and non-nuclear households for which *DBE* is available, the sample average *DBE* is about the same (48 to 49 kilometers) and in both samples 34 to 35% of parents were educated in the same municipality. Our IV results are presented only for the sample with an instrument and our non-IV results for

⁶ Different distances are further investigated in the sensitivity analysis in Section 6.

⁷ As we do not know the location of education acquired abroad, persons last educated abroad are included in our analysis only based on where in Denmark they received their education.

⁸ Most notably children missing information are more likely not Danish, less likely to be first born, and more likely to have older and somewhat more educated parents. This is not surprising since education information for those completing their education before 1974 and for those obtaining all their education outside of Denmark originate from the *Population and Housing Census* and *Immigration Census*, respectively, and is self-reported and therefore likely imperfect (Jensen and Rasmussen 2011).

the full sample. However, our non-IV results are robust to estimation on the IV sample. We present further information regarding the strength and validity of these instruments in Section 5.

The remainder of Table 1 provides sample statistics for our rich set of control variables. As the data come from the Danish administrative registers, they are substantially complete, with no variable missing more than five percent of the time. Dummy indicator variables were constructed to identify missing data, while data values were set equal to zero for discrete variables and to the remaining sample mean for continuous variables.

Our substantial set of covariates includes information specific to the child, specific to the biological parents, and specific to the household in which the child resides. Child-specific variables include indicators for county of birth, gender, and nationality, as well as birth weight and age when last observed. County of birth is included as a common demographic in order to ensure that the distance measure is not driven by outlying geographical areas (means available upon request). The gender dummy helps address the substantial gender differences in the dependent variables. Nationality is included to control for family background, birth weight as a rough control for health. Age last observed is important in modeling the schooling outcome. Some children in the sample are only observed until age 20; most are observed till age 22.

Information on each biological parent includes age, marital status, education, income, and criminal record and rarely differs by child gender. Age and education were obtained from the registers in 1983, i.e. 1 to 1.5 years before the child's birth.⁹ Marital status was obtained from the 1985 records, and criminal records were obtained from the 1980 to 1984 records, i.e. the five year period before the child's birth. Income is deflated to 2011 values and calculated as the average of the 1983 and 1984 values or, if one such measure is missing, the non-missing value. About 47% of parents were married in 1984 when the child was age zero, reflecting the high rate of cohabitation in Denmark and highlighting the importance of including non-marital relationships in the data. Educational attainment is captured using a dummy to identify parents who completed high school (not including vocational training) as our focus is on children's high school completion. About 24% of mothers and 22% of fathers had done so. Not surprisingly, on average fathers have higher pre-birth annual incomes than mothers (221K 2011 DKK versus 140K 2011 DKK). We assume these pre-birth income measures will control for the potential resources available from the biological parents. Information on the criminal record of each biological parent may be particularly pertinent as a predictor of child criminal behavior. Six percent of mothers and 30% of fathers had a criminal record in the five year period before the child was born, measures that are about three times as high as those of nuclear households in which 2% of mothers and 12% of fathers have a criminal record.

⁹ In the case that pre-birth education is missing, post-birth values are used.

A wide array of variables is available to control for the characteristics of the household in which the child resides. We distinguish between those characteristics that are determined at or before the first family separation and those determined after. Parental decisions post separation may be driven in part by unobserved factors related to child outcomes, making post-separation measures potentially endogenous. We estimate specifications excluding as well as including post-separation measures of family composition. If distance is proxying for some other post-separation measure, these specifications should yield different results.

Two household-related variables that are determined at or before the time of separation are the age of the child at the time of separation and the household characteristics at the time of birth. If having both biological parents present in the household improves child outcomes, we expect age at first separation to have a positive coefficient. Average age at first separation is just over four years. There exists a substantial literature (see Price 2008 for a review) indicating that first born children have better outcomes than those who follow. To control for first born children, we include a dummy variable to identify children who are born into households with no older children. This is the case for 55% of our sample.

The post-separation control variables are constructed with an eye to measuring the average resources available in the household, the average resource needs of the household, and the stability of the household but are included in only a few test cases given the concern that these measures may be endogenous. These variables are constructed using annual observations from birth till the child leaves the parental household or age 17. The more resources available for the focal child and the more stable the household, the better we would expect child outcomes. Measures of the fraction of time the focal child is observed to be the only child in the household, the average number of other children in the household, the number of family structure changes, the household structure, and the education and income levels of the social parents are created. Household structure is recorded as the fraction of time spent with both parents, a single mother, a single father, a mother and her partner, a father and his partner, or neither biological parent (by construction extremely rare). An income level of zero is assumed when a social parent is not in residence.

4. Multivariate Analyses

We begin by estimating simple linear probability models of the relation between physical distance and child outcomes, using robust estimation to control for heteroskedasticity. Coefficient estimates for the cumulative distance measure and child gender are reported in Table 2 for several specifications. Specification (1) includes no other controls except, in the case of the education measure, age last observed. As the criminal behavior measure is constructed based on convictions prior to age 18, and all children are observed till age 18, age last observed is not

included in the model of criminal behavior. Specification (2) adds controls for the other child-specific variables, the biological parents' characteristics, the age at first separation, and the indicator for first born children. These constitute all the variables that are determined at or before the parental separation. Coefficient estimates for other covariates are reported in Appendix A. Specification (3) adds all the remaining controls for household composition and the characteristics of the social parents. The results for education are reported first, followed by those for criminal behavior.

The results regarding education outcomes indicate that there is uniformly a positive correlation between the cumulative distance to the non-residential parent and high school completion that is statistically significant at the 8% level in specification (1), at the 6% level in specification (2), and at the 12% level in specification (3). As our comparison group is children whose non-residential parents have always lived in the same municipality, this result matches that found in Kalil et al. (2011). Children whose parents live farther apart are more likely to complete high school, thus greater distance and hence presumably less contact with the non-residential parent is associated with better outcomes. The magnitude of the effect suggests that increasing the cumulative distance to the non-residential parent by 1000 kilometers increases the probability of completing high school by between 0.8 and 1.0 percentage points, differing little when we add controls for household structure and social parents, suggesting that our cumulative distance measure is not proxying for other post-separation family characteristics. Gender has a substantial and significant effect, with boys being about 17 percentage points less likely to complete high school than girls, but we are unable to reject the hypothesis that boys and girls can be pooled, which is in line with Amato (2010). Probit estimates yield similar results.

In the case of the behavioral outcome, we reject pooling and present results separately by gender. We find cumulative distance is not significantly or substantially associated with criminal behavior before the age of 18 in any specification. Again, probit estimates are substantially the same.

5. Instrumental Variable Analyses

As discussed earlier, if parents choose a distance in part based on expected child outcomes or factors like conflict that may be associated with child outcomes, results that fail to take this endogeneity into account will be biased. To avoid such a bias we employ instrumental variable (IV) techniques.¹⁰ Instruments should be related to

¹⁰ Other techniques to control for endogeneity (given feasible data) include taking an individual or sibling fixed-effects approach, investigating growth curve models, using propensity score matching, or using lagged dependent variables (McLanahan, Tach, and Schneider, 2013). Sibling fixed-effects models are a common choice for studying educational outcomes, but Sigle-Rushton, Lyngstad, Andersen, and Kravdal (2014) show that this method can lead to biased results if all relevant factors are not taken appropriately into account.

the variable for which they are instrumenting, here *Cumulative Distance*, but not to either household structure or child outcomes in order to be valid. We begin by presenting evidence regarding the relevance, power, and validity of our instruments, and then present the IV results.

When a couple separates, one of the pair has to change his/her place of residence. The locational choice will depend upon the perceived costs and benefits associated with the move. Location-specific capital in the form of ties to children, employment, family, social networks, and even simply geographical familiarity all can play a role. Such location-specific capital often keeps non-residential parents in the same locality. Indeed in our sample, 26% of non-residential parents always remain in the same municipality as their children. Those moving will likely choose to move to municipalities where they have some location-specific capital. Some evidence suggests that individuals whose parents live close by are less likely to move away following a separation than those whose parents do not live close by (Mulder and Wagner 2012). This evidence could favor use of *DBHP*¹¹ as an instrument as *DBHP* is more likely to capture where the parents themselves grew up. Other research (Winters 2011; Haussen and Uebelmesser 2015) suggests that students develop location-specific capital in the area where they went to college. This research supports the use of *DBE*.

An examination of the data reveals that the fraction of years each parent reports living in the same municipality where he/she last completed some schooling is higher for women than for men and on average eight percent higher for women and six percent higher for men in the years after as compared to the years before separation. Even couples who last completed school in the same municipality have a higher probability of residing in that municipality after separating. If both parents are more likely to live where they last completed school, then distance between the municipalities where they last completed school will be correlated with distance to the non-residential parent. By contrast women are only about three percent more likely and men no more likely to be living in the municipality from which *DBHP* is calculated in the years after as compared to the years before separation. Thus, our data favor the link to *DBE* over that to *DBHP*.

To statistically assess the correlation between *DBE/DBHP* and the distance to the non-residential parent, consider the results from the first stage IV regressions, i.e. the regressions of cumulative distance to non-residential parent against all the covariates from specification (2) and the instrument. As reported in the top panel of Table 3, both the *DBHP* and *DBE* measures are significantly and positively associated with the distance to the non-residential biological parent for the full sample as well as for boys and girls separately. The partial F values for this

¹¹ Remember, *DBE* measures distance between the municipalities where each parent last completed some education prior to separating, whereas *DBHP* uses distance between parents' high school municipalities (if the information is available), else distance between last municipality of education.

stage are between 27 and 108, above the 8.96 critical value suggested by Stock, Wright, and Yogo (2002) for a single instrument model. Thus, these instruments have reasonable power. The R-squared measures for the first stage model are all around 0.32 – indicating that distance is modeled quite well with these covariates. Additional output from the first stage regressions is available in Appendix B.

We now focus on the validity of the instrument. To be a valid instrument, it is important that the variable be (conditional mean) independent of our outcome variables. This is fulfilled if the instrument is not directly related to child outcomes (exogeneity) and further does not belong in the structural equation (exclusion restriction). These requirements are not possible to test directly. Theoretically, they are reasonable. If these distance measures were related to child outcomes, children whose parents were educated in municipalities close to each other would somehow be systematically different from children whose parents were educated further away from each other. This would be the case if less educated children or children with criminal records tended to have parents who were always educated close to (or far from) each other. An empirical analysis of our instruments suggests *DBE* is more likely to satisfy these conditions than *DBHP*. An analysis of child outcomes for those raised in nuclear households indicates *DBE* is not significantly associated with either outcome while *DBHP* is negatively associated with criminal activity for boys (p-value 0.03). As reported below, our IV results indicate no significant association between distance and criminal activity for boys, so that latter finding is perhaps not a significant concern. While we also find that *DBE* is not significantly related to the age at separation for either the pooled sample or separately by gender, higher values of *DBHP* are, at least for boys, negatively related to age at separation. This finding casts further doubt upon the validity of *DBHP* as an instrument. For the sample for which *DBE* is reported, *DBE* is not significantly associated with family structure (nuclear vs. not) for boys but is marginally associated with family structure for girls (p-value > 0.04 in a sample size of almost 10,000). *DBHP* is significantly positively associated with parental separation for all samples (p-value 0.000).¹² We present results using both instruments below, but favor *DBE* in the sensitivity results that follow given its greater validity.

Linear IV estimates of the effect of distance to non-residential parent on child outcomes are presented in the bottom panel of Table 3. Probit IV results are substantially the same. In the case of the education outcome, a Wald test of exogeneity soundly fails to reject (p-value > 0.20) for each instrument, indicating that it is not

¹² Testing the relation between these instrument values and household structure may be particularly important if partners who are educated apart are 'stronger', more independent minded types who are perhaps less similar to one another and therefore more likely to separate. *DBE* does not appear to be strongly indicative of such personality types.

necessary to instrument for distance to the non-residential parent when focusing on the education outcome.¹³ We therefore focus on the behavioral outcome in the discussion that follows.

IV results for the behavioral outcome fail to reject exogeneity for the sample of boys (p-values > 0.8), but exogeneity is soundly rejected using *DBE* (p-value 0.02) and more weakly rejected using *DBHP* (p-value 0.10) for girls. That behavioral outcomes but not educational outcomes would cause parents to locate differently is not entirely surprising. Hawkins, Amato, and King (2007) show adolescents who externalize behavior, i.e. behave badly, at t1 have fathers who interact less at t2, but also that adolescents who internalize behavior, i.e. appear depressed or have low self esteem, at t1 do not receive significantly different paternal attention at t2 (where $t2 > t1$). Thus, parents may be more likely to disassociate themselves from children with some types of problems than others. That responses may differ by the gender of the child could reflect the fact that fathers are more likely to be non-residential than mothers and feel they have less to contribute to the upbringing of girls. For girls, the *DBE* (*DBHP*) IV estimates indicate a negative relation between distance to the non-residential parent and criminal convictions prior to age 18 that is significant at the 4% (10%) level. The results indicate that a 1000 km increase in cumulative distance to the non-residential parent (the equivalent of moving from the 50th to the 75th percentile of the distribution) reduces the likelihood a girl will be convicted by 4.7 percentage points using *DBE* and 2.7 percentage points using *DBHP*. Practically speaking this reduces the probability close to zero. These results suggest that failing to control for endogeneity may lead to a biased estimate of the impact of distance upon criminal convictions, particularly for girls. Overall these results suggest that greater distance may be associated with better educational and, for girls, behavioral outcomes. This is perhaps a surprising result, and contrary to policy makers' beliefs. It suggests at the least that child outcomes are not worse when non-residential parents live further away (and likely have less physical contact).

Parameter estimates for other covariates from the OLS models are presented in Appendix A, while Appendix C contains the same from the IV models. They show that children whose biological parents are more educated and have higher earnings are more likely to have completed high school. Children whose fathers have a criminal history are more likely to have been convicted before the age of 18 and less likely to have completed high school. Children who weigh more at birth (and hence are likely to be healthier) and children whose mothers are older (which is positively correlated with level of education and likely with favorable unobserved characteristics),

¹³ For completeness, IV estimates for the educational outcome are reported in the first column of Table 3. Results using instrument restricted samples to model educational outcomes without IV are similar to the results for the full estimation sample, but with larger standard errors as expected. Thus, the differences observed between the OLS and IV results are not a function of sample composition.

have better education outcomes. Boys with older mothers and more educated parents also have better behavioral outcomes. First born children tend to have better education and behavioral outcomes. Children with married parents have better education outcomes. These results are robust to alternative measures of parental marital status such as ever married or married at age two. Boys whose parents were married at age two also have a significantly lower probability of being convicted as a child.

6. Sensitivity Analysis

A number of sensitivity tests were performed to check the robustness of these results using the OLS specification for education and the IV specification with *DBE* for criminal behavior. First, we estimated models with alternative distance measures. This analysis is important because we somewhat arbitrarily treated residence abroad as a distance of 500. A concern here is that Denmark is a small country and some non-residential parents who live abroad may be living just over the border in Germany or in Malmo, Sweden, in which case we are potentially overstating distance for these persons and, given the sensitivity of OLS to outliers, causing our results to be driven by these populations. Looking at the residence of children in years when a non-residential parent is living abroad, we find that fewer than five percent are living close to the German border and the fraction living in Copenhagen is similar to the fraction of the population living there. We cannot observe the actual residence of parents abroad, but at least it is reassuring that the children themselves are not more frequently located close to the border than expected. To further investigate the importance of the chosen distance for parents abroad, we estimated the results using different assumptions. Our results are robust to using a measure of 400 km and similar though less significant when substituting a measure of 300 or 200 (see the second row of results in Table 4 for the results using a distance of 300). In order to reduce further the reliance on outlying values, we tested two additional measures of cumulative distance, one that recodes distance to zero when there is only a single year absence and another that discards the greatest single distance measure recorded for each child. The latter results are more conservative yet still yield the same results (see the third row of results in Table 4). As cumulative distance is necessarily related to age at separation, we also estimated a specification using average distance post-separation (see the fourth row of results in Table 4). Although these coefficients are not directly comparable given that average and cumulative distance have a different magnitude, they are similar in terms of sign and significance with a p-value of 0.14 in the case of the education outcome and 0.03 in the case of the girls' behavioral outcome.

We also explored the sensitivity of our results to the sample composition. First, we excluded the sample of non-Danish children (see the fifth row of results in Table 4). This constitutes another check on the sensitivity of our results to non-residential parents living abroad. Over 25% of children who are not Danish had a father living

abroad at some point, compared to just over 6% of Danish children. Very few mothers ever live abroad, but again, the probability is more than five times as great for non-Danish children. Our results are robust to this sample selection criterion. To further investigate the importance of having parents abroad, we have repeated the analysis omitting children whose parents ever live abroad.¹⁴ The coefficient to distance maintains the same sign but becomes insignificant in the case of the education outcome. The behavioral results are fully robust to this sample. These results suggest that the education results may be sensitive to having parents abroad, but we cannot rule out that the imprecisely estimated coefficients are due to the smaller sample size, the reduced variation in the distance measure, or the peculiar nature of this sample in the context of Denmark's small size and open economy. Restricting our sample only to those whose parents are never registered as living/working abroad likely creates a quite selective sample. Overall, our results do not appear to be especially sensitive to alternative measures of distance.

Second, we re-estimated the model selecting on father's education in order to compare our results to those of Kalil et al. (2011). These results are presented in Table 4 (the sixth and seventh row of results). Unlike Kalil et al., who find that the positive association between child outcomes and distance to non-residential parent is strongest for children with more educated fathers, our results indicate that the association between distance and education may have a greater marginal effect for those with less educated fathers, though the smaller sample size has reduced the statistical significance and the differences are not statistically significant.

Unlike previous work in this area, our data include both married and cohabiting couples, allowing us to split our sample along this dimension and test for differences by relationship status (the eighth and ninth row of results in Table 4). We find the association between educational outcomes and distance to the non-residential parent is statistically significant only for children whose parents were married in the year they were born, despite the fact that the number of children born to cohabiting parents is larger. Similarly, while the association between criminal convictions and distance to the non-residential parent is statistically significant for all girls, it is more significant and 50% greater for girls whose parents were married. It may be that because cohabiting relationships are generally shorter lived, less is expected of the non-residential parent than in married households and so distance matters less for those who were cohabiting. Overall, evidence of differences by marital status is weak as in no case is it possible to say the effect of distance is significantly different between the married and the cohabiting samples.

Finally, we examined the possibility that moving between households might be disruptive to children. Such moves are less likely when the parents live at a greater distance from one another and particularly less likely

¹⁴ This amounts to about 600 observations. However, our number of parents abroad is probably a lower bound as it only captures those who are registered as living abroad for a significant amount of time.

for school aged children whose non-residential parent lives abroad. To this end we reestimated the results for the sample of children who only ever live with their mother (the final estimates in Table 4).¹⁵ These results show by far the weakest evidence of a relation between distance to non-residential parent and child outcomes. The coefficients to distance decline about 50% in magnitude in the equations modeling education and girls' criminal behavior, the equations where distance is typically significant. These results suggest that moves may be important, though of course the sample selection criteria in this case are clearly endogenous.

We also checked whether the results were robust to alternative IV specifications. IV Probit analysis yielded similar results. Instruments based on the distance to the non-residential parent's municipality of last education (rather than the distance between or *DBE* measure) were also constructed. If the residential parent does not move following separation, this instrument may be more closely related to the distance to the non-residential parent. Statistically this appears to be the case as the power of this instrument is substantially greater than the power of *DBE* in stage 1. Unfortunately, results from the sample of nuclear children revealed that the probability a child completes high school is positively related to the distance to each parent's municipality of last education, likely because more educated individuals face a national rather than local labor market and so are more likely to move. Examination of quadratic measures of distance did not indicate a significantly better fit, nor did use of a dummy identifying non-residential partners who always live in the same municipality.

In general, our results are quite robust. We find only weak evidence that the effect of distance differs with the education level of the father and at best weak evidence that the marital status of the parents matters. Our tests on different distance measures suggest that we are likely not substantially overestimating the effect of distance due to outliers or due to our perhaps arbitrary choice of a distance of 500 km for parents living abroad. Tests of the exogeneity of distance fail to reject the null in the case of the education outcome and generally reject the null in those cases where the coefficient estimates to distance are statistically significant in the behavioral models.¹⁶ Except in the case of boys whose fathers have a high school education, our instrument has substantial power in all subsamples. These results support the conclusion that greater distance to the non-residential parent may lead to better educational and, in the case of girls, better behavioral outcomes for children. If our instruments are valid, they indicate that distance is endogenous in the case of criminal behavior, with non-residential parents apparently locating further away when they believe the behavioral outcome for girls will be worse, thus inducing a bias to non-

¹⁵ The sample of children living only with their father is too small to provide meaningful results (sample size of only 446: 169 girls, 277 boys). However we find substantially similar results to those reported for children only living with mothers when we also include those only living with fathers.

¹⁶ Exogeneity is not rejected at the 10% level in the case of girls whose fathers' have a high school education. The sample size in this case is very small.

IV estimates. Still unexplained is the mechanism underlying the relation between distance and child outcomes, a question we investigate in the next section.

7. Potential Mechanisms

The positive relation we observe between distance and child outcomes could arise because longer distance reduces parental conflicts and so minimizes stress for children or because longer distance provides stability in children's daily routines and thereby improves child outcomes as suggested by Lamb et al. (1997).

Kalil et. al. (2011) present survey evidence that suggests more educated parents in Norway engage in more conflict, a result that could explain why distance has a positive association with child outcomes for Norwegian children with more educated fathers. We find that children with less educated fathers have somewhat better outcomes when living further away from their non-residential parent than children with more educated fathers, but the differences are not significant. To investigate if this mechanism is important, information on parental conflict is necessary, but is not available in the Danish data.

Physical moves are another possible source of stress for children. These may be particularly disruptive as regards education outcomes since children moving between municipalities will generally have to enroll in different schools, but the disruption of social networks may also affect behavior, potentially not in the same way for girls and boys.¹⁷ Controls for the frequency with which the child moved prior to the first separation indicate that both educational and behavioral outcomes are worse for children who move more often, but the impact of distance to the non-residential parent remains unchanged. Furthermore, children whose parents live in the same municipality post-separation move less than those whose parents live at a greater distance and this would suggest that greater distance should be associated with worse rather than better outcomes. Our results do not appear to be driven by physical movement.

Alternatively, it may not be all physical moves but only moves between parents that cause stress and poor child outcomes. It is reasonable to assume that movement between parents is easier when the distance is smaller and the practicalities are easier to handle. The data indicate that children who always reside with one parent in fact also reside at a greater average distance to their non-residential parent than children who move between their parents. If movement between the parents is to blame for poor child outcomes, then distance should matter less

¹⁷ Uusitalo-Malmivaar and Lehto (2013) report qualitative differences in the predictors of happiness between genders. A great number of friends predicts high happiness for boys. For girls, instead, good relationships with other people (girl/boy friend, friends of the same sex, teachers, etc.) are related to high happiness. For both girls and boys, a small number of friends predicts low happiness. Disruptions of networks likely affect both the number of friends and the number of close ties.

when the sample is restricted to children who always reside with a single parent. This is precisely the effect we observed when restricting the sample to only those children who always reside with their mother. To test whether child outcomes are related to the frequency with which biological parents exit and reenter the household, we estimated the non-IV models including a measure of the average number of such changes per year post separation. The results for the full sample and separately by gender indicate that the greater the average number of such household changes the worse are both educational and behavioral child outcomes. The coefficient to the average number of household changes is statistically significant while that to the distance measure becomes insignificant in every case. Clearly, however, this variable is highly endogenous and as our instruments were constructed to address distance they have no power to explain such moves. Further research is necessary to explain such inter-household moves and their impact on child outcomes, especially in relation to the weekly or bi-weekly moves due to joint physical custody agreements between parents.¹⁸

Finally, the last mechanism in the literature review suggests heterogeneous effects of distance to a non-residential parent depending on the child's and potentially also the parents' characteristics. We do, in fact, find differential effects by gender in the effect of distance on criminal behavior: girls but not boys with more distant fathers seem to have better behavioral outcomes. Work by Uusitalo-Malmivaara and Lehto (2013) finds that marital conflict has a greater impact on 12 year old girls than on boys. If more proximate parents engage in more conflict than less proximate parents, girls in particular may be better off when parents are further apart. We do not, however, observe different educational outcomes by gender. If mothers serve as closer role models for girls, and fathers for boys, then distance may have a different impact based on the gender of both the child and the non-residential parent. The fact that we do not observe a significant impact of distance on boys' behavior could be because distant fathers do not provide good role models and that negative effect counteracts the positive effect of distance seen for girls. Unfortunately, there are too few observations of boys living only with their fathers to explore this hypothesis.

8. Conclusion

There is a growing movement to encourage both parents to share physical custody of their children following parental separation and divorce. Indeed there is evidence from both Australia, one of the first countries to move in this direction, and Denmark that this effort has been successful. The percentage of Australian children

¹⁸ It is notable that some research in Denmark finds that even when parents sharing physical custody of a child are only a short distance apart, some children moving between their parents' households report that they feel they are 'living in a suitcase'. Furthermore, these children also have to adjust to household-specific rules and guidelines each time they move (Ottosen, Stage and Jensen, 2011).

from non-nuclear households spending at least one of every five nights with their non-residential parent rose from 12.2% to 21.5% between 2006 and 2011 (Hahn and Wilkins 2014), while the percentage of Danish eleven year olds spending at least 30% of their time with their non-residential parent increased from 4% in 1994 to 17% in 2009 (Ottosen et al. 2011). The impetus for this movement is based on a belief that such contact is in the best interest of the child. We use information on the distance between the child and the non-residential parent to analyze educational and behavioral outcomes for a cohort of children from nonnuclear families in Denmark in order to test this assumption.

Contrary to popular belief, we find no evidence that children who live a greater distance from their non-residential parent experience worse outcomes. Indeed our OLS results suggest that educational outcomes are perhaps even better and behavioral results no different for children who live farther away from their non-residential parent. Recognizing that distance to the non-residential parent is a decision variable that may be endogenous to child outcomes, we employ instrumental variables to check these results. Our preferred instrument, based on the distance between the municipalities where the parents last completed some education, has substantial power in explaining distance to the non-residential parent but is not itself significantly associated with child outcomes in a sample of nuclear families. Using this instrument, we reject the hypothesis that distance is exogenously determined in the case of behavioral but not educational child outcomes. Our IV results indicate that failure to control for endogeneity biases estimates of the relation between distance and behavioral outcomes towards finding a more negative effect (closer to zero in our model), particularly for girls. This finding suggests that non-residential parents may distance themselves from girls with behavioral problems – a result similar to that reported in Hawkins, Amato, and King (2007). After controlling for possible endogeneity, we find girls with more distant non-residential parents have better, definitely not worse, behavioral outcomes. Sensitivity analysis indicates that our results are quite robust to alternative measures of distance, different samples, and alternative instruments. However, as our results in some cases have weak power, we are more comfortable concluding that greater distance does not lead to worse outcomes. Further evidence is necessary to reach the conclusion that greater distance leads to better outcomes.

These results call for an explanation. One possibility is that children are exposed to greater conflict between their parents when they live in closer proximity. We are unable to explore this possibility with the administrative register data at hand but believe it deserves further consideration. Another possibility is that the distance to the non-residential parent is related to physical moves by the child and that more frequent moves cause stress and worse child outcomes. We find that while physical moves have a negative impact on child outcomes, there is no evidence that this explains the relation between distance and child outcomes. However, movement

between parental households may be more common when parents live nearby and could be disruptive even if there is no change in municipality as children are in a different location interacting with different household members. We find some evidence that such interhousehold moves are associated with worse child outcomes. The finding that girls but not boys are more likely to be convicted when their non-residential parent lives nearby could be attributed to girls' greater average sensitivity to parental conflict or to boys benefiting from a closer male role model (an effect that may counteract the disruptive impact of interhousehold moves or of greater parental conflict). Further research regarding the role of parental conflict, interhousehold movement, and child gender is necessary to fully understand the observed relations between child outcomes and distance to non-residential parents. Though legislative action to change the norm of maternal physical custody may itself alter parental decisions about separation and the household division of labor and hence directly affect child outcomes (Altindag et al. forthcoming), our results suggest that forcing parents to remain in close proximity for the sake of the children may not be advantageous.

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Table 1
Sample Statistics

<u>Variable</u>	<u>Full Sample Mean</u>	<u>Boys Mean</u>	<u>Girls Mean</u>	<u>Gender Diff</u>
Dependent Variables				
Completed High School	0.40	0.31	0.48	***
Ever Convicted before age 18	0.12	0.19	0.04	***
Distance Measures				
Cumulative Distance to Non-Residential Parent (km)	576.08	572.37	579.86	
Non-Residential Parent always lives in same municipality	0.26	0.26	0.26	
Instruments				
Distance between municipalities where parents last completed school – <i>Distance Between Education (DBE)</i> (a)	49.15	49.86	48.42	
Parents educated in same municipality (a)	0.34	0.34	0.34	
<i>Distance Between High School</i> with <i>Distance Between Education</i> if missing (<i>DBHP</i>) (a)	43.46	44.27	42.62	
Parents attended in same municipality (a)	0.38	0.37	0.38	
Child-Specific Measures				
Male	0.50	1.00	0.00	
Danish Origin	0.99	0.99	0.99	
Weight at Birth (kilograms)	3.35	3.41	3.29	***
Missing Birth Weight	0.01	0.01	0.01	
Age Last Observed	21.96	21.96	21.96	
Biological Parent's Characteristics				
Mother's Age at Birth	26.47	26.37	26.57	*
Father's Age at Birth	29.63	29.56	29.70	
Parents Married When Child is Age 0	0.47	0.47	0.46	
Mother Completed High School	0.24	0.24	0.24	
Father Completed High School	0.22	0.21	0.22	
Missing Father's Education	0.03	0.03	0.04	
Mother's Average Income 1983 & 84 (/1,000 DKK) (b)	139.60	138.74	140.47	
Father's Average Income 1983 & 84 (/1,000 DKK) (b)	221.09	222.95	219.19	
Mother's Income Missing	0.01	0.01	0.01	
Father's Income Missing	0.04	0.04	0.05	*
Mother has a Criminal Record at Time of Birth	0.06	0.06	0.07	*
Father has a Criminal Record at Time of Birth	0.30	0.31	0.30	

Household Characteristics				
Only Child at Birth	0.55	0.55	0.54	
Age at First Separation	4.33	4.30	4.35	
Fraction of Time is Only Child	0.37	0.38	0.37	
Average Number of Siblings	0.88	0.88	0.88	
One Family Structure Change	0.26	0.25	0.26	
Two Family Structure Changes	0.26	0.26	0.26	
Three Family Structure Changes	0.19	0.19	0.19	
Four+ Family Structure Changes	0.29	0.30	0.28	**
Percent of Time Living with Both Parents	0.25	0.25	0.26	
Percent of Time Living with Single Mother	0.41	0.40	0.41	*
Percent of Time Living with Mother & Partner	0.26	0.25	0.26	**
Percent of Time Living with Single Father	0.05	0.06	0.04	***
Percent of Time Living with Father & Partner	0.03	0.03	0.02	***
Percent of Time Living with Neither Biological Parent	0.00	0.00	0.00	
Parents Reunited after First Separation	0.08	0.08	0.09	
Social Parents' Characteristics				
Social Mother Completed High School	0.26	0.26	0.27	
Social Father Completed High School	0.23	0.23	0.24	
Average Income of Female Partner (/1,000 DKK) (b)	170.35	167.19	173.58	***
Average Income of Male Partner (/1,000 DKK) (b)	178.51	181.35	175.62	**
Missing Social Mother's Information	0.00	0.00	0.00	
Missing Social Father's Information	0.04	0.04	0.03	
Number of Observations	8175	4124	4051	

a: For sample of 5921 children (3022 boys & 2899 girls) for whom instrument is available.

b: All income measures are deflated to 2011 values.

Table 2
OLS Models of Child Outcomes
Distance from Non-Residential Parent

Specification	(1)	(2)	(3)
<u>Completed High School</u>	Coefficient <u>Estimate</u>	Coefficient <u>Estimate</u>	Coefficient <u>Estimate</u>
Cumulative Distance (1000 km)	0.0085 * (0.0048)	0.0106 * (0.0055)	0.0086 (0.0055)
Boy	-0.1708 *** (0.0107)	-0.1715 *** (0.0098)	-0.1667 *** (0.0097)
R-squared	0.0312	0.2037	0.2263
<u>Ever Convicted before age 18</u>	Coefficient <u>Estimate</u>	Coefficient <u>Estimate</u>	Coefficient <u>Estimate</u>
Boys			
Cumulative Distance (1000 km)	0.0090 (0.0060)	0.0006 (0.0072)	0.0039 (0.0072)
R-squared	0.0006	0.0403	0.0577
Girls			
Cumulative Distance (1000 km)	0.0010 (0.0030)	-0.0012 (0.0038)	-0.0021 (0.0038)
R-squared	0.0000	0.0124	0.0276

Standard errors are reported in parentheses.

Asterisks indicate the level of statistical significance for a two-sided test: *** 1%, ** 5%, * 10%.

Specification (1) also includes a measure of age last observed in the case of the educational outcome.

Specification (2) includes all the variables in specification (1) plus controls for birth weight; Danish nationality; the biological father's and mother's age, marital status, education, income, and criminal record around the time of child's birth; a dummy variable to identify first born children; age at first separation; 13 dummy variables identifying county of birth; and dummy variables to identify missing birth weight, missing father's education, and missing parental income measures.

Specification (3) includes all the variables in specification (2) except age at first separation plus information on household composition and the child's social parents, as listed in Table 1.

Table 3
IV Models of Child Outcomes

		Completed High School	Ever Convicted Before Age 18		
			Boys	Girls	
<u>First Stage Estimates</u>					
<i>DBE</i>	Coefficient	1.7645 *** (0.2013)	1.4755 *** (0.2809)	2.0719 *** (0.2918)	
	Partial F	76.80	27.58	50.40	
	R-squared	0.3203	0.3245	0.3260	
<i>DBHP</i>	Coefficient	2.4308 *** (0.2330)	2.0767 *** (0.3209)	2.8151 *** (0.3421)	
	Partial F	108.81	41.89	67.70	
	R-squared	0.3306	0.3327	0.3387	
<u>Outcome Estimates</u>					
<i>DBE</i>	Coefficient	-0.0476 (0.0500)	0.0009 (0.0672)	-0.0474 (0.0215)	**
	P-Value for Test of Exogeneity	0.2481	0.9149	0.0198	
<i>DBHP</i>	Coefficient	0.0208 (0.0376)	0.0038 (0.0499)	-0.0265 (0.0161)	*
	P-Value for Test of Exogeneity	0.7535	0.8378	0.0947	

Standard errors are reported in parentheses.

Asterisks indicate the level of statistical significance for a two-sided test: *** 1%, ** 5%, * 10%.
These specifications also include the variables included in specification (2) of Table 2.

Table 4
Sensitivity Analysis

	Completed High School Full Sample	Ever Convicted		
		Boys	Girls	
Baseline (N = 8175, 3022, 2899)	0.0106 * (0.0055)	0.0009 (0.0672)	-0.0474 (0.0215)	**
Distance Abroad = 300 km (N = 8175, 3022, 2899)	0.0096 (0.0066)	0.0009 (0.0714)	-0.0498 (0.0224)	**
Drop Greatest Distance (N = 8175, 3022, 2899)	0.0123 ** (0.0059)	0.0010 (0.0750)	-0.0513 (0.0232)	**
Average Distance (N = 8175, 3022, 2899)	0.1212 (0.0813)	0.0138 (0.9909)	-0.7252 (0.3290)	**
Danes Only (N = 8078, 3016, 2892)	0.0093 * (0.0056)	0.0001 (0.0670)	-0.0476 (0.0215)	**
Father has High School degree (N = 1780, 732, 745)	0.0052 (0.0117)	-0.0062 (0.1491)	-0.0299 (0.0290)	
Father has no High School degree (N = 6109, 2278, 2143)	0.0082 (0.0069)	0.0236 (0.0805)	-0.0567 (0.0300)	*
Parents married at birth (N = 3810, 1407, 1297)	0.0159 * (0.0094)	0.0956 (0.1301)	-0.0661 (0.0365)	*
Parents cohabiting at birth (N = 4365, 1615, 1602)	0.0085 (0.0067)	-0.0405 (0.0775)	-0.0410 (0.0264)	
Live only with mother (N = 6233, 2207, 2263)	0.0057 (0.0060)	0.0038 (0.0714)	-0.0240 (0.0227)	

Education model is OLS. Behavioral model is IV. N stands for number of observations.

Standard errors are reported in parentheses.

Asterisks indicate the level of statistical significance for a two-sided test: *** 1%, ** 5%, * 10%.

These analyses also include all the variables included in specification (2) of Table 2.

Appendix A

Linear Models of Child Outcomes

Additional Results for Specification (2)

	Completed High School		Ever Convicted Before Age 18	
	<u>Estimates</u>		<u>Estimates</u>	<u>Estimates</u>
Danish Origin	-0.0771 (0.0535)		-0.0502 (0.0681)	0.0082 (0.0308)
Weight at Birth (kilograms)	0.0289 *** (0.0088)		0.0038 (0.0103)	0.0088 (0.0061)
Mother's Age at Birth	0.0051 *** (0.0015)		-0.0068 *** (0.0019)	0.0014 (0.0010)
Father's Age at Birth	0.0011 (0.0011)		0.0021 (0.0014)	-0.0003 (0.0007)
Parents Married When Child is Age 0	0.0350 *** (0.0109)		-0.0189 (0.0133)	-0.0040 (0.0066)
Mother Completed High School	0.2232 *** (0.0142)		-0.0391 *** (0.0146)	-0.0028 (0.0083)
Father Completed High School	0.2043 *** (0.0146)		-0.0461 *** (0.0151)	-0.0056 (0.0081)
Mother's Average Income 1983 & 84 (/1,000 DKK)	0.0003 *** (0.0001)		0.0000 (0.0001)	-0.0001 * (0.0000)
Father's Average Income 1983 & 84 (/1,000 DKK)	0.0002 *** (0.0000)		-0.0001 * (0.0000)	0.0000 * (0.0000)
Mother has a Criminal Record at Time of Birth	-0.0270 (0.0193)		0.0339 (0.0296)	0.0219 (0.0158)
Father has a Criminal Record at Time of Birth	-0.0550 *** (0.0111)		0.0769 *** (0.0148)	0.0233 *** (0.0080)
Only Child at Birth	0.0836 *** (0.0112)		-0.0485 *** (0.0143)	-0.0054 (0.0070)
Age at First Separation	0.0027 * (0.0015)		-0.0036 * (0.0018)	-0.0014 (0.0009)
Number of Observations	8175		4124	4051

Standard errors are reported in parenthesis.

Asterisks indicate the level of statistical significance for a two-sided test: *** 1%, ** 5%, * 10%.

Also included in the specification are 13 region dummies; dummy variables to identify those missing birth weight, missing information on biological fathers, and missing information on parental income; a constant term; and the cumulative distance to non-residential parent. Age last observed is included in the education model.

Appendix B

Other Covariates for First Stage IV Models

	Completed High School		Ever Convicted Before Age 18	
	<u>Estimates</u>		<u>Estimates</u>	<u>Estimates</u>
Danish Origin	448.1645 (441.3888)		981.0610 (535.4225)	* -104.5168 (612.1098)
Weight at Birth (kilograms)	-34.1013 (21.2756)		-59.0715 (29.0929)	** 2.5951 (30.7526)
Mother's Age at Birth	2.5714 (4.4847)		4.8662 (6.0434)	-0.3734 (6.6140)
Father's Age at Birth	1.5282 (3.8679)		1.1017 (4.9982)	1.4629 (5.9530)
Parents Married When Child is Age 0	13.7154 (22.9906)		2.1321 (31.6419)	23.9660 (32.8149)
Mother Completed High School	-1.4974 (29.6669)		-35.6944 (42.4317)	22.2202 (41.2116)
Father Completed High School	106.7187 (33.2301)	***	150.6819 (47.7051)	*** 66.4726 (46.1173)
Mother's Average Income 1983 & 84 (/1,000 DKK)	-0.0160 (0.1411)		-0.2730 (0.1908)	0.2350 (0.2056)
Father's Average Income 1983 & 84 (/1,000 DKK)	-0.0362 (0.0914)		-0.0208 (0.1246)	-0.0544 (0.1313)
Mother has a Criminal Record at Time of Birth	48.1812 (52.4856)		27.1098 (74.1484)	76.2708 (74.3048)
Father has a Criminal Record at Time of Birth	17.9499 (25.4821)		14.4977 (35.4958)	22.2481 (36.6905)
Only Child at Birth	25.9899 (24.7889)		28.0182 (34.1598)	20.8866 (35.9175)
Age at First Separation	-64.2441 (2.8626)	***	-61.2844 (3.8051)	*** -66.8592 (4.3713)
Number of Observations	5921		3022	2899

Standard errors are reported in parenthesis.

Asterisks indicate the level of statistical significance for a two-sided test: *** 1%, ** 5%, * 10%.

Also included in the specification are 13 region dummies; dummy variables to identify those missing birth weight, missing information on biological fathers, and missing information on parental income; a constant term; and the cumulative distance to non-residential parent. Age last observed is included in the education model.

Appendix C

Other Covariates for IV Models

	Completed High School		Ever Convicted Before Age 18		
	<u>Estimates</u>		<u>Estimates</u>	<u>Estimates</u>	
Danish Origin	0.0954 (0.1189)		-0.1837 (0.2059)	0.0204 (0.0272)	
Weight at Birth (kilograms)	0.0222 ** (0.0107)		0.0107 (0.0126)	0.0062 (0.0069)	
Mother's Age at Birth	0.0070 *** (0.0023)		-0.0088 *** (0.0027)	0.0000 (0.0014)	
Father's Age at Birth	0.0047 ** (0.0018)		0.0012 (0.0024)	-0.0002 (0.0012)	
Parents Married When Child is Age 0	0.0396 *** (0.0128)		-0.0239 (0.0151)	-0.0011 (0.0072)	
Mother Completed High School	0.2064 *** (0.0174)		-0.0483 *** (0.0163)	0.0000 (0.0097)	
Father Completed High School	0.2046 *** (0.0181)		-0.0303 (0.0194)	-0.0014 (0.0087)	
Mother's Average Income 1983 & 84 (/1,000 DKK)	0.0003 *** (0.0001)		-0.0001 (0.0001)	-0.0001 (0.0000)	*
Father's Average Income 1983 & 84 (/1,000 DKK)	0.0002 *** (0.0001)		0.0000 (0.0001)	0.0000 (0.0000)	
Mother has a Criminal Record at Time of Birth	-0.0210 (0.0237)		0.0078 (0.0340)	0.0281 (0.0186)	
Father has a Criminal Record at Time of Birth	-0.0533 *** (0.0133)		0.0712 *** (0.0170)	0.0160 (0.0090)	*
Only Child at Birth	0.1018 *** (0.0137)		-0.0353 ** (0.0169)	-0.0025 (0.0083)	
Age at First Separation	-0.0013 (0.0037)		-0.0031 (0.0047)	-0.0036 (0.0018)	**
Number of Observations	5921		3022	2899	

Standard errors are reported in parenthesis.

Asterisks indicate the level of statistical significance for a two-sided test: *** 1%, ** 5%, * 10%.

Also included in the specification are 13 region dummies; dummy variables to identify those missing birth weight, missing information on biological fathers, and missing information on parental income; a constant term; and the cumulative distance to non-residential parent. Age last observed is included in the education model.