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Family Structure Changes and Children´s Health, Behavior, and Educational Outcomes

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Abstract

More and more children do not grow up in traditional nuclear families. Instead, they grow up in single-parent households or in families with a step-parent. Hence, it is important to improve our understanding of the impact of "shocks" in family structure due to parental relationship dissolution on children. In this study I empirically test whether children are traumatized both in the short and the long run by shocks in the family structure during childhood. I focus on educational, behavioral, and health outcomes. A population sample of Danish children born in January to May 1985 is used for the analysis. The empirical cross-sectional analysis indicates a negative relation between the number of family structure changes and children's health, behavior, and educational outcomes. These results are confirmed by a differences-in-differences analysis of health outcomes. This suggests that there is not only a selection effect, but also a causal effect on children of shocks in the family structure.

JEL Classification: D13, I12, I21, J12

Keywords: Family structure, child outcomes, health, crime, education

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1 Introduction

More and more children do not grow up in traditional nuclear families. Instead, they grow up in single-parent households or in families with a step-parent. Hence, it is important to improve our understanding of the impact of "shocks" in family structure due to parental relationship dissolution on children. To give an example of the severity of this problem, we can look at a western country like Denmark. In 1980, almost 83% of all Danish children in the ages 0 to 17 lived with both of their biological parents, but this number steadily decreased to 73% in 2005 as shown in Figure 1. That is, more than 25% of all Danish children did not live with both of their biological parents in 2005. In many other western countries the divorced population is increasing as well, and for these countries we expect to see a similar picture as that depicted in Figure 1 for Denmark.

The topic of family structure changes has been studied extensively in the psychology and sociology literature and recently also in the economics literature. International studies mainly suggest a negative relationship between non-nuclear family structures and child outcomes. There are two potential explanations for this. First, families that split up may possess characteristics that are different (and worse) than what is seen in nuclear families, i.e. non-nuclear families are a *selected* group of families.[1] Another explanation is that there may be negative *causal* effects of separation.[2]

To analyze the effect of a change in family structure on child outcomes properly, detailed data are required. Many international studies only have access to datasets where family structure is observed once during a child's life and this "value" is then extrapolated to the entire childhood.[3] This

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[1] Studies pointing in this direction are Björklund and Sundström (2006) and Björklund et al. (2007).

[2] See Ermisch and Francesconi (2001).
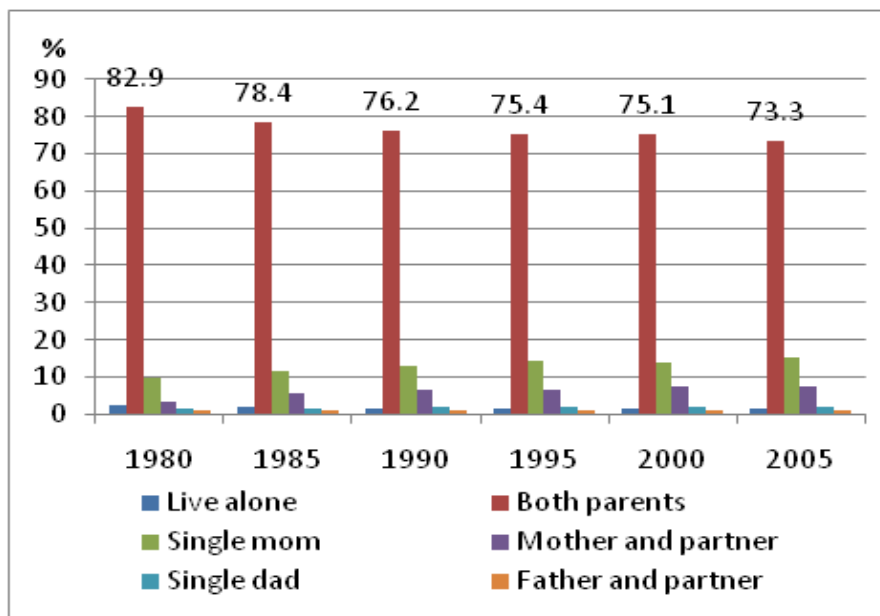
[3] E.g. Manski et al. (1992).

Figure 1: Type of family for children aged 0-17. Denmark, 1980-2005. Source: Statistics Denmark

approach leads to imprecise results and is known as the "window problem" (Wolfe et al. (1996)). Danish register data makes it possible to avoid the window problem and to make quantitative economic analyses which can shed light on the selection and causation explanations. However, until now, register data from Denmark has not been exploited systematically to analyse family structure and its relation to child outcomes.

Thus, this study is an empirical study of the relation between family structure changes and several different child outcomes using an administrative register dataset consisting of the entire population of Danish children born from January to May 1985. These children are followed on a yearly basis until 2005, i.e. until they are 20 years old. The study is partially descriptive, but it also attempts to identify causal effects of family structure changes. A differences-in-differences analysis is used for the latter purpose

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for the health outcomes.

Though descriptive in its nature, this study contains multiple contributions to the Danish and international literature. One contribution is to use detailed data for the quantitative economic analyses to avoid the window problem and obtain more precisely identified results. Some other studies are also using panel data, but they do not have a population sample of children available for their analyses. Using a population sample implies a lot of observations and thus more precision in the empirical analysis. Another contribution is to illuminate new aspects of family structure by investigating a variety of short- and long-term child outcomes. In particular, I focus on the relation between family structure and child outcomes such as health (hospitalizations), behavior (crime), and education (high school enrolment and high school GPA). A third contribution is to propose new questions to this area such as the importance of the timing of family dissolution, the short- and long-term impact of multiple family structure changes, and the time spent in a single-parent household. This study can be used as a reference point for further studies.

To preview the results, in the descriptive analysis I find a negative relation between all three types of child outcomes and family structure changes. The results further indicate that the number of family structure changes might be more important for child outcomes than the years spent in a single-parent household. The differences-in-differences analysis continues to show a negative effect on health from a family structure change, thus indicating a negative causal effect on children of experiencing a family structure change.

The remainder of the paper proceeds as follows. In Section 2, a literature review is presented and in Section 3 the estimation strategy is explained. Section 4 gives an introduction to the datasets used in the analysis, and the empirical results are presented in Section 5 along with a sensitivity

analysis. Finally, the results are summarized and a brief discussion of policy implications is presented in Section 6.

2   Literature Review

Human capital (HC) theory provides an explanation of family structure's (causal) effect on child outcomes (Becker (1991) and Becker (1993)). The intuition is that households are time- and money-constrained. With fewer adults in the household there is less time and money to invest in children and this may reduce child outcomes through decreased parent-child interaction and fewer goods. Becker's theories of the family suggest that two adults can pool their resources and specialize in tasks within and outside the household, thereby increasing total market and household production.

However, HC theory cannot explain why children growing up in non-nuclear families seem to have lower outcomes even with a step-parent present (Gennetian (2005)). Possible explanations include *asymmetric information and monitoring* (Weiss and Willis (1985)) or different *bargaining power* among biological and step-parents (Lundberg and Pollak (1996)). The latter explanations imply that biological mothers may act to ensure that a child living with a stepfather is no worse off than biological children of both adults in the household. If the stepfather allocates less resources to a stepchild, but the mother thereafter redistributes resources to make all children equally well off, in total these children will be worse off than children living in a nuclear family. This holds despite there being two adults in the household.

Recent theoretical studies on child development and child outcomes suggest that skills beget skills and capabilities today foster future capabilities through *self-productivity* and *dynamic complementarity*. That is, higher stocks of skills in one period create higher stocks of skills in the next period, and stocks of skills acquired in one period make investments in future pe-

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riods more productive (Cunha and Heckman (2007) and Heckman (2008)). Thus, early investments in children are often most fruitful and even more so if they are followed up by later investments, but this depends on the exact technology of skill formation. Cunha and Heckman (2007) demonstrate that some periods may be more effective in producing certain skills (*sensitive periods*), or it may be the case that only one period is effective in producing a certain skill (*critical period*). With this theory in mind, the timing of family structure changes might be extremely important for child outcomes. An early family structure change might affect children more negatively than if they experience a family structure change in their teens. I return to this question in the hypotheses and the empirical analysis, in particular by looking directly at family structure changes in different age brackets. Finally, the sociological and psychological literatures have also developed theories of the relation between family structure and children's outcomes. One example is *loss of parental control theories* which focus on trauma or shocks experienced during childhood, e.g. changing family structure. I will refer to this theory as the *stress theory.* Ginther and Pollak (2004) summarize the latter and related theories in more detail.

In general, the empirical literature cannot agree on whether *selection* or *causation* (or maybe both) explain how children's outcomes are related to family structure. The selection theory claims that families that split up may possess characteristics that are different (and worse) than what is seen in nuclear families, i.e. non-nuclear families are a selected group of families. Children from non-nuclear families will thus have worse outcomes than children from nuclear families both before and after a family structure change. Studies pointing in this direction are Björklund and Sundström (2006), Björklund et al. (2007), and Piketty (2003). On the other hand, Ermisch and Francesconi (2001) and Steele et al. (2009) argue among others

for causal effects of separation, i.e. negative effects on child outcomes caused by a change in family structure. The potential causal effect of separation may be visible even before the separation formally occurs, especially if the parents argue or fight a lot before the actual separation (Amato (2000)).

Furthermore, a practical issue pointed out in Manski et al. (1992) emphasizes that assumptions about the actual process generating family structure and child outcomes are important for the estimation strategy. Strong assumptions lead to more precisely estimated effects, but at the cost of maybe being less realistic. Thus, we need to consider this when choosing the estimation strategy.

The main problem in empirical analyses of family structure is specification of a counterfactual to divorce and separations (Ginther and Pollak (2004)). "No divorce" is not a reasonable counterfactual since parents cannot be forced to live together. This problem of identifying the effect of divorce or separation can be solved by using an instrument, e.g. a quasi-experiment such as a reform in the rules of divorce. It has been done in the studies by Gruber (2004) and Francesconi et al. (2005), but unfortunately it is difficult to find suitable reforms and thus good instruments. Furthermore, using divorce laws as an exogenous cause of divorce does not solve the problem that changes in divorce regimes may directly affect the nature of intrafamily bargaining, and this may lead to different implications for the children (Stevenson and Wolfers (2006)). Alternatively, one can consider the death of one parent as an exogenous shock to family structure as in Corak (2001) and Francesconi et al. (2005). The problem with using this 'exogenous' shock is, that it might not be completely exogenous if, for example, the parent's death is the result of several years of sickness. Then it might be perfectly expected and the effect on the child of losing a parent might be reduced due to 'preparation' for the event. If the parent's death is due to

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e.g. a traffic accident, the loss is truly an exogenous and unexpected event. However, loosing a parent permanently due to parental death may not be comparable to loosing a parent due to divorce. In the latter case the parent is still alive and may still participate actively in the child's daily life.

In this current study (as in most of the existing studies in the literature), the problem of not having a reasonable counterfactual is ignored and the results of the empirical analysis in Section 5 thus have to be interpreted with some caution. For reasons of comparison, I will carry out simple cross-section estimation strategies, but also do a differences-in-differences (D-i-D) analysis as done by Sanz-de Galdeano and Vuri (2007) to get closer to the causal effects. The D-i-D analysis makes it possible to control for commonalities during the time periods for both children that do experience family structure changes and those that do not. Moreover, fixed characteristics of the same child is also differenced away in this panel D-i-D. Thus, this leads to results far beyond the simple cross-section analysis and thereby gives some indication of the causal effects of family structure changes.

3   Empirical Model

In the empirical analysis I attempt to test the stress theory, i.e. whether children are traumatized in the short and the long run by shocks in family structure during childhood. I investigate how the timing and sum of family structure shocks affect children to get information on negative impacts (stress) accompanying a change in family structure. Furthermore, by comparing the importance of years in a single-parent household to the importance of the number of family structure changes experienced during the entire childhood, I give some evidence on the validity of Beckers human capital theory. The main hypotheses analysed in the empirical study are the following:

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Hypothesis 1 A family structure change is a (negative) shock for the child and thus has negative implications for the child's outcomes both in the short and long run.

Hypothesis 2 The number (and timing) of family structure changes affect child outcomes by stressing the child.

Estimates are based on a linear version of the education production function model (Todd and Wolpin (2003)). Assume that achievement for child i, T_i, can be expressed as a linear function of the explanatory variables

$$T_{ija} = \beta_0 + \beta_1 D_{ija} + \beta_2 F_{ij}(a) + \gamma_j + \nu_{ija}, \tag{1}$$

where T_{ija} is the outcome for child i from family j at age a (education, behavior (criminal activity), or health); D_{ija} is a family structure change (measured as year-to-year changes); F is a vector with child and family background information (child's birthweight and gender, ethnicity, number of siblings at age 10, age at first separation, parental work experience, annual wage income, and level of education); γ_j is a family fixed effect, e.g. norms and values in the family; and, finally, ν_{ija} is an error term.

Child outcomes depend on the child's unobservable endowed ability which I proxy by birthweight. This is a common way of dealing with unobserved endowed ability in the literature (e.g. Behrman et al. (1994)). To get consistent estimates, I include information on both contemporaneous and historical inputs. Relevant background information such as labor market information for the "social" parents (the parents living in the household) is included in the analysis, as well as information on the child, siblings, child's age at the time of the first shock, etc.

As outcome measures I use education, measured as high school enrolment and high school grade point average. Further, behavioral measures such as

criminal activity are used, and finally health outcomes (hospitalized in a year, number of sickdays) are investigated. By studying this wide variety of outcomes, different aspects of the effect of family structure changes are illuminated.

I also apply a differences-in-differences model for the health outcomes in which I assume there are only two time periods, 1 and 2. Family structure changes are now expressed as

$$D\left(i,t\right) = \begin{cases} 1 & \text{if divorce or separation in period } t \\ 0 & \text{if no divorce or separation in period } t \end{cases}$$

Changing the notation slightly, we get the following expression for child achievement as a function of family structure changes:

$$T\left(i,t\right) = \beta_0\left(t\right) + \beta_1 D\left(i,t\right) + \gamma\left(i\right) + v\left(i,t\right), \tag{2}$$

where $\beta_0\left(t\right)$ is a time-specific component; β_1 is the impact of parental divorce or separation; $v\left(i,t\right)$ is a serially uncorrelated transitory component; and $\gamma\left(i\right)$ is an individual-specific component representing unobserved pre-disruption characteristics, e.g. stress associated with an unhappy family life. $D\left(i,t\right)$ is probably correlated with $\gamma\left(i\right)$, i.e. we cannot identify the effect of parental divorce or family dissolution from OLS estimates of this equation.

Differencing Equation (2) with respect to t and adding covariates implies:

$$T\left(i,2\right) - T\left(i,1\right) = \beta_0 + \beta_1 D\left(i,2\right) + \beta_2 X\left(i\right) + \left(v\left(i,2\right) - v\left(i,1\right)\right), \tag{3}$$

where $\beta_0 = \beta_0\left(2\right) - \beta_0\left(1\right)$, $\beta_2 = \beta_2\left(2\right) - \beta_2\left(1\right)$ and $X\left(i\right)$ is a vector of observed characteristics assumed uncorrelated with $v\left(i,t\right)$.

The model in Equation (3) is identified if the conditional restriction is fulfilled

$$P\left(D\left(i,2\right)=1\mid X\left(i\right),v\left(i,t\right)\right) = P\left(D\left(i,2\right)=1\mid X\left(i\right)\right)$$
$$for \ \ t = 1,2,$$

i.e. there is identification if changes in the outcome variable over time would have been exactly the same in both treatment and control groups in the absence of divorce or separation (parallel trend assumption) at least when including the covariates.

The D-i-D approach follows Sanz-de Galdeano and Vuri (2007). The control group consists of those children that do not experience any family structure change during childhood, and the treatment group is the children that have experienced a family structure change from period 1 to period 2. The dataset has to be set up in a certain way for this to work. First, in period 1, none of the children must have experienced a family structure change, i.e. children who do not have (typically) their father in the household during the first time period of their life have to be deleted from the sample. Children most often stay with their mother in the year after a family structure change, but few, especially older children, choose to stay with their father the year after a family structure change. Figure 2 shows the distribution for Denmark in 2008. For families that break up, about 14.5% of the children live with the father the following year, whereas more than 80% of the children live with their mother. Some of the oldest children choose not to live with either parent the following year.

Secondly, the D-i-D strategy is only possible for the health outcomes using my datasource since D-i-D requires outcome measures that are observed over time along with the changes in family structure. The educational outcomes are not observed until the child is quite old, and thus the effect of
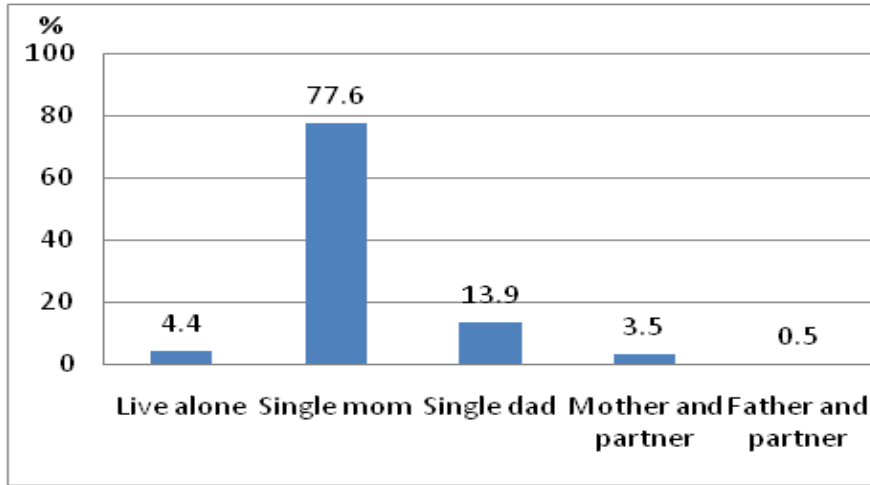
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Figure 2: Family type for children who lived with both mother and father the previous year, but not in the current year, Denmark 2008. Source: Statistics Denmark

early family structure changes cannot be analysed on the educational outcomes. Observations on criminal activity start when the child is 15 years old and thus also quite late. Health outcomes are available from the child is 6 years old and therefore health outcomes are preferred for the D-i-D analysis. Due to the richness of the data, having yearly observations, it is possible to define the two time periods in the D-i-D analysis in different ways. I use ages 0 to 11 as period 1 and ages 12 to 20 as period 2 in the main specification. To test the robustness of the results and the importance of the timing of family structure changes, I also repeat the analysis using ages 0 to 7 as period 1 and 8 to 20 as period 2.

When empirically analyzing the effect of family structure on child outcomes, there are some challenges related to finding the best specification of the empirical model. The problem arises because family structure is clearly not random and thus simple OLS or probit parameter estimates may be

biased. OLS is nevertheless used in most of the existing literature and will therefore also be used here for comparison. In addition to OLS and probit estimation of Equation 1, I use D-i-D analysis to difference away unobserved individual-specific components. These might be components that can be related directly to family dissolution decisions and thus would bias a simple cross-section analysis. In other words, the D-i-D analysis allows for the possibility that parental divorce or separation is correlated with unobserved family characteristics that may influence child outcomes. A family or siblings fixed effects analysis is employed in several studies in the literature, but the advantage of D-i-D compared to a family fixed effects analysis is that also children without siblings are analyzed in the D-i-D framework. Analyzing only families with siblings and only in cases where the siblings have experienced different family structures reduces the external validity of the study as pointed out by Moffitt (2005). Thus, a D-i-D analysis is easier to generalize to larger groups of the population.

4 Data

Estimations are based on an administrative register dataset consisting of the entire population of Danish children born from January to May 1985.[4] About 50,000 children were born *per year* in Denmark in the mid-1980's. Due to seasonality in childbirths, I have about 36,000 unique children in the dataset. The data source contains yearly, rich information on family background along with other information on children, parents, and siblings. This rich datasource implies more reliable estimates of the effect of family

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[4]I also have access to the population sample of children born in January to May 1983 and January to May 1984. To simplify the analyses, I only show results for the 1985-cohort in the tables. Sample statistics for the other two cohorts are very similar to those for the 1985-cohort and are available from the author upon request. One difference between the cohorts, however, is that years living with a single father increase slightly across cohorts and thus depict a cultural change.

structure changes on child outcomes than what is seen in most existing studies. Family structure changes are observed until the child reaches the age of 18. After this point in time, the child is registered as an adult whether or not the child still lives with his/her parents.

In the Danish tax and income registers created by Statistics Denmark, the children and their parents are followed on a yearly basis from the year of birth to 2005 if they have not left the country or died. Parental figures are identified each year based on the household characteristics of that year. If the child lives with both biological parents, parental information concerns the biological parents. If, on the other hand, the child lives with one biological parent and one step-parent, then the parental information collected is for these individuals. I will distinguish between biological and non-biological parents by referring to either 'biological' or 'social parents'.

At this point it is useful to define precisely what is meant by a family structure change. Throughout this study, family structure changes will be defined as follows unless explictly noted:

Definition 1 *A family structure change is any change in the composition of biological or social parents that the child experiences. It does not have to be a legally binding change, such as divorce or remarriage.*

Thus, any observed change in the number or identity of the (biological or social) parents in the household from one year to the next is considered a family structure change. This can be a reduction in the number of 'parents', but also an increase in the number of 'parents'.

The registers provide information on the parents' and children's marital status, residence, education, income, labor market activities, health, criminal activity, etc. This includes information on the number of hospitalizations and days in hospital, whether the individual has been convicted of a crime, the children's highest completed level of education, whether they are

currently enrolled in education, and their grade point average if they have completed high school. While most Danes complete high school at age 20, some Danish children take an optional 10th grade before enrolling in high school and they may therefore still be enrolled in high school at the age of 20. It is also very popular among the Danish youth to take a sabbatical year between high school and college. Thus, higher educational goals may not be clear in 2005 when the children are 20 years old. When investigating educational outcomes, I therefore focus on high school enrolment and high school completion, which in short will be referred to as high school enrolment.

Furthermore, information on criminal activity and health is available in the data, which enables analyses of both short and long-term outcomes, cognitive and non-cognitive. I measure children's health in two ways; an indicator for being hospitalized during the year in question and the number of days in the hospital. In some cases I aggregate this information into an indicator for ever being hospitalized as this provides less noisy information. Health information is available from 1991 on. Thus, health outcomes can be investigated on a yearly basis beginning when the child is 6 years old. For criminal activity I use a dummy for being convicted in the year in question, but in some cases I also aggregate the information into an indicator for ever being convicted. The age of criminal responsibility is 15 in Denmark so I cannot investigate this behavioral outcome before the child is 15 years old. Educational, health, and behavioral outcomes are important outcomes both for the children themselves and more generally for society. These variables are therefore the focus of this study.

Table 1 shows mean values for selected variables for the children and their parents in 2005. We see in Table 1 that about 50% of the children do not enrol in high school compared to about 70% of their parents. The children's grade point average (GPA) after completing high school is fairly close to the

Variable	mean	std.dev	obs
Outcomes			
No high school (0/1)	0.48	0.50	35,270
High school GPA (6;12)	8.25	1.00	13,370
Hopitalized during the year (0/1)	0.08	0.27	34,996
Ever hospitalized (0/1)	0.47	0.50	35,270
Hospitalizations (1;29)	1.40	1.28	2702
Days in hospital (1;285)	3.59	9.51	2702
Conviction during the year (0/1)	0.07	0.26	35,270
Ever convicted (0/1)	0.19	0.40	35,270
Family structure			
Total changes (0;13)	1.08	1.66	35,270
Yrs with single parent (0;18)	2.77	4.59	35,270
Yrs with single mother (0;18)	2.44	4.42	35,270
Yrs with single father (0;18)	0.33	1.51	35,270
Yrs with single mother, age 0-2	0.27	0.73	35,270
Yrs with single mother, age 3-5	0.39	0.90	35,270
Yrs with single mother, age 6-10	0.71	1.52	35,270
Yrs with single mother, age 11-16	0.92	1.89	35,270
Yrs with single father, age 0-2	0.01	0.11	35,270
Yrs with single father, age 3-5	0.03	0.25	35,270
Yrs with single father, age 6-10	0.08	0.54	35,270
Yrs with single father, age 11-16	0.17	0.83	35,270
Child's age at first separation	5.82	5.29	14,897
Child and parental characteristics			
Child is a boy (0/1)	0.51	0.50	35,270
Siblings at age 10 (0;9)	1.19	0.85	35,037
High school, mother (0/1)	0.33	0.47	35,244
High school, father (0/1)	0.28	0.45	34,710
Ann. wage inc., mother /100,000 (DKK)	2.01	1.29	35,244
Ann. wage inc., father /100,000 (DKK)	2.74	2.18	34,710
Work experience in years, mother (0;38)	16.38	7.99	35,244
Work experience in years, father (0;38)	19.76	8.53	34,710

Note: Mean values for children are from 2005, whereas mean values for parents are from 1983. The sample includes children born between January and May 1985.

Table 1: Sample statistics in 2005.

mean, which in the Danish system by 2005 is 8. In Denmark, GPAs from high school range from 0 to 13 with 8 as the middle grade. 6 is equivalent to passing the exam. However, by looking at the number of observations it is clear that we only have a measure of GPA for those who actually have completed high school by age 20. Thus, it seems reasonable to use high school enrolment as the main outcome variable for education instead of the GPA from high school. It is also clear from the table that only 8% of the children are hospitalized during 2005, whereas 47% of the children have ever been hospitalized. When hospitalized, they spend 3.6 days in hospital on average. The most common reason for being hospitalized is problems during a pregnancy (for girls). 7% of the children are convicted of a crime during 2005, but 19% have ever been convicted. However, the gender distribution is very uneven as only about 2% of girls get a conviction in 2005.

After a separation, most of the children live with their mother. The children that live with their father are usually in the group of 11- to 16- year-olds, i.e. the oldest children. On average, children growing up in non-nuclear families experience their first family structure change at age 6. Finally, fathers have a higher annual wage income than mothers, and fathers' work experience is also higher. Most of the children have one sibling by the age of 10 and the gender composition of the sample is almost 50/50.

In Table 2 the distribution of family structure changes for the sample is shown. The highest number of (observed) family structure changes for a child is 13[5], but it is not common to experience such a high number of family structure changes. Even when collecting 8 and more family structure changes into one single category, only 1% of the sample is present here. The most common number of family structure changes is 0, i.e. the child grows

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[5]This is a lower bound as family structure changes are observed on a yearly basis. Thus, if more than one family structure change occur within one year, this will only be counted as one.

Total family structure changes	percent of sample
0	58
1	13
2	14
3	6
4	5
5	2
6	1
7	1
≥ 8	1

Table 2: Total family structure changes during childhood by 2005.

up in a nuclear family. 27% of the children have experienced 1 or 2 family structure changes during childhood, implying that they have experienced the parents separate and potentially also experienced a step-parent moving into the household afterwards. In some cases, the children with 2 family structure changes experience one parent moving out of the household and then the same parent returns some years later. A descriptive analysis (available from the author upon request) shows that these families are different than 'normal' nuclear families. Thus, even though it is the same biological parent who is moving back into the household, this is counted as 2 family structure changes.[6]

Focusing on descriptive evidence, Figures 3 to 5 show three different outcomes plotted against the child's age and separately by the final number of family structure changes the child experiences during childhood. The pattern from the figures is clear: the more family structure changes, the worse the children's outcomes. This can of course be a selection effect as the families with most family structure changes might be different than a typical nuclear family. This will be investigated later. But first it can be seen in

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[6]One reason for the parent to move in and out of the household could be that the parent is working abroad for some years. However, another reason could be that the parent has been in prison for a longer period of time.

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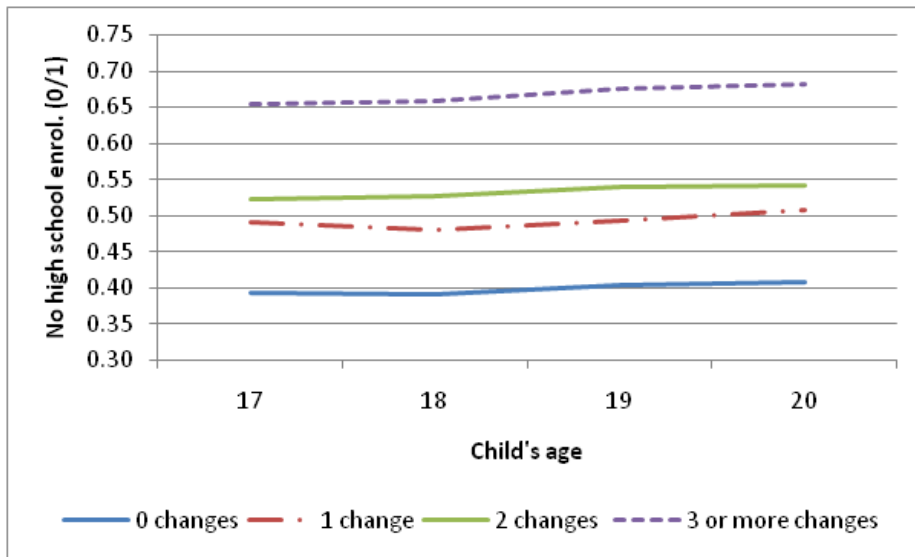
Figure 3: No high school enrolment by the age of the child and the final number of family structure changes during childhood. 1985-cohort.
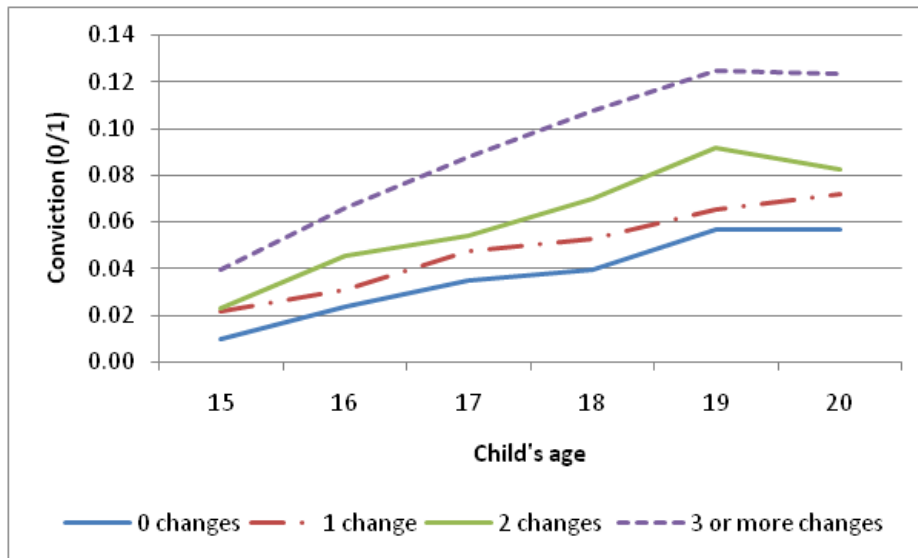
Figure 4: Convictions by the age of the child and the final number of family structure changes during childhood. 1985-cohort.
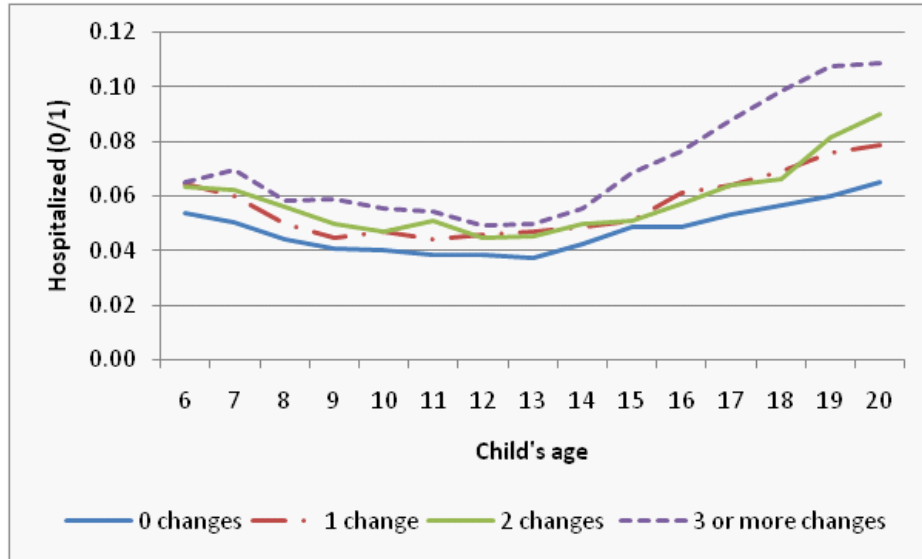
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Figure 5: Hospitalizations by the age of the child and the final number of family structure changes during childhood. 1985-cohort.

Figure 3 that more than 60% of children with three or more family structure changes do not enrol in high school compared to about 40% of the children in nuclear families. For convictions the picture is just as clear as shown in Figure 4. At the age of 20, more than 12% of the children experiencing three or more family structure changes have been convicted whereas less than 6% of the children in nuclear families have been convicted. When splitting the sample by gender, the numbers are even more disturbing. More than 20% of the boys with three or more family structure changes have been convicted in the year they turn 20 whereas less than 10% of the boys in nuclear families have been convicted. A similar difference is observed for girls, but at much lower levels. For hospitalizations the picture is slightly more blurred. There is not much difference in the probability of hospitalization between those experiencing one or two family structure changes, but there is still quite a big difference between children from nuclear families and children from the

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families with most family structure changes. This also holds for boys and girls separately, but with girls having more hospitalizations at the higher ages and vice versa for the youngest ages. The figures for boys and girls separately are available from the author upon request.[7]

5   Estimation Results

In the empirical analysis I first look at cross-section estimations as is common in the literature. When investigating hospitalizations, convictions, and no high school enrolment using a probit estimation procedure, I generally find highly significantly estimated marginal effects as shown in Table 3. All the estimates point to a negative relation between single-parent households (or family structure changes) and children's outcomes. Furthermore, using OLS, the relation between GPA and years in a single-parent household and the total number of family structure changes during childhood is analyzed. Again I find highly significantly estimated coefficients as shown in Table 3 and all estimates point to a negative relation between single-parent households (or family structure changes) and children's GPA after high school. These results confirm what is generally found in other empirical studies using data from both the US and Sweden, for example Björklund et al. (2007). Relatively few children live in single-father households compared to single-mother households and the marginal effects for this group are thus less precisely estimated.

Interpreting the coefficients in Table 3 as causal effects, the most inter-

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[7]The same figures have been investigated when plotting by the number of family structure changes the child has experienced *up to the given age* instead of by the *final number of family structure changes* during childhood. These figures are not shown here, but they are very similar to Figures 3 to 5, and thus selection does not seem to be a big issue for this sample. Furthermore, it does not seem to be the case that it is due to sick children or criminal behavior of the children that the parents separate. The figures are available from the author upon request.

	Ever hospitalized		Ever convicted		No high school		GPA	
Outcome variable	marg.eff.	t-stat	marg.eff.	t-stat	marg.eff.	t-stat	coeff.	t-stat
Years single mother	0.0073	12.13	0.0069	15.52	0.0162	25.77	-0.0104	-4.47
Years single father	0.0031	1.75	0.0114	9.02	0.0203	10.74	-0.0124	-1.75
Years single household	0.0071	12.24	0.0076	17.97	0.0172	28.34	-0.0107	-4.83
Family structure change (0/1)	0.0771	14.31	0.0880	20.51	0.1765	32.71	-0.1550	-8.44
# fam.structure changes	0.0277	17.00	0.0296	25.02	0.0641	36.22	-0.0667	-10.11
Obs	35,270		35,270		35,270		13,370	

Note: No covariates are added in these specifications. Marginal effects are reported from
the probit estimations.

Table 3: OLS and probit estimation results for the effect of years in a single
parent household and number of family structure changes on various child
outcomes in 2005.

esting observation is the relatively larger effect family structure changes have
as compared to the effect of years in a single-parent household. For all out-
comes, the 'effect' of a(nother) family structure change is about four times
higher than the 'effect' of living a(nother) year in a single-parent household
during the childhood. As expected, the 'effect' of experiencing a family
structure change (0/1) is higher than the 'effect' of the number of family
structure changes, as the first variable captures the 'total effect' of experi-
encing family structure changes. Thus, these results suggest that instability
of households has a greater impact on children's outcomes than potentially
a lower household income and fewer adults in the household to take care of
the children. In other words, this finding provides some evidence against
the mechanism suggested by Becker (Becker (1991) and Becker (1993)).

It is also interesting to note that the effect of family structure changes on
children's outcomes is linear for all outcomes, but high school GPA. When
including dummies for 1 family structure change, 2 changes, 3 changes, and 4
or more changes and comparing to children with no changes in the analyses,
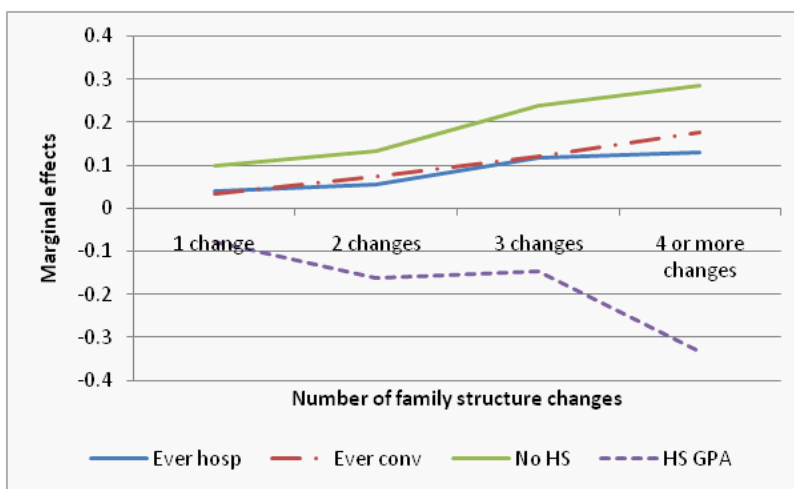it turns out that the marginal effects are linear as shown in Figure 6. Includ-

Figure 6: Marginal effects for ever hospitalized, ever convicted, no high school enrolment, and high school GPA by the number of family structure changes.

ing squared or cubic terms of the total number of family structure changes in the different specification also reveals the same picture; the coefficients for the squared and cubic terms are insignificant, whereas the coefficient for the linear term is highly statistically significant. The marginal effects for high school GPA is not as clearly linear as for the other outcomes, but this may be explained by the fact that the children with a high school GPA is a smaller and positively selected sample. Thus, they are not representative for the full sample and I will therefore not rely heavily on the potential non-linear pattern shown by this outcome measure. Instead, I will continue to include a variable for the total number of family structure changes in the estimations as this measure seems to be linear for the main sample.

Now focusing only on years in a single-mother household as in most of the literature and again investigating cognitive and non-cognitive child outcomes in 2005 by OLS and probit, we see in Table 4 that for the different

	Ever hosp.	t-stat	Ever conv.	t-stat	No HS	t-stat	GPA	t-stat
Years with single mother								
Age 0-2	0.0166	3.47	0.0278	7.74	0.0549	11.13	-0.0356	-1.84
Age 3-5	0.0181	3.88	0.0096	2.64	0.0254	5.39	-0.0370	-2.04
Age 6-10	0.0096	3.25	0.0084	3.61	0.0170	5.74	-0.0062	-0.56
Age 11-16	-0.0003	-0.15	-0.0005	-0.33	0.0042	2.12	-0.0002	-0.03
Obs	35,270		35,270		35,270		13,370	

Note: No covariates are added in these specifications. Marginal effects are reported from the probit estimations.

Table 4: OLS and probit estimation results for the effect of years in a single-mother household at different ages on various child outcomes in 2005.

outcome variables the 'effects' differ by the age of the child. This confirms what has also been seen previously in the literature. The age groups are defined based on the type of care the child receives besides parental care. For example, children in the ages 0-2 are eligible for daycare, children in the ages 3-5 usually attend preschool, and children aged 6 and older are in school. For hospitalizations and convictions, living in a single-mother household in the first three age groups seems to be important. The marginal effects are generally higher for the younger age groups. For GPA, the period 3-5 years of age seems to be most important, whereas for high school enrolment all age groups are important, but the marginal effects are again higher for the younger age groups. Thus, living in a single-mother household in the earliest childhood seems to have the most detrimental effect on most outcomes.

Families that split up may be a selected group. Thus, many studies include covariates in their cross-sectional estimations to control for this selection. If the significance of the coefficient for family structure change disappears after including the covariates, this is interpreted as evidence for selection being the explanation of negative effects of family structure changes. That is, if the coefficient turns insignificant, there is no evidence of a causal effect of family structure changes on children's outcomes. I have also in-

cluded covariates[8] in all the estimations shown in Tables 3 and 4, but the significance of the coefficient for family structure change does not disappear. However, the size of the coefficient decreases somewhat.[9] Since there is no evidence for selection being the main explanation for the negative relation between child outcomes and family structure changes, I decided to show the most raw numbers in the tables, i.e. without the covariates included.

Another way of investigating the selection and causation explanations is to carry out a differences-in-differences (D-i-D) analysis of the health outcomes. The parameter of interest is the coefficient to the interaction between treatment (experiencing parental divorce or separation) and the age dummy (aged 12 or older). The comparison age group consists of those between the ages of 6 and 11.[10] Any statistically significant coefficients on this interaction term are interpreted as a causal effect of family structure changes. The D-i-D analysis is possible solely for the health outcomes, since this is the type of outcome for which there is information for most years (from the child is aged 6 and on). The two outcomes that are depicted in Table 5 are first a variable counting the total number of years a child has been hospitalized in each period and, secondly, the total number of days spent in hospital by period. Results are shown both with and without a list of covariates that includes the child's birthweight, gender, ethnicity, number of siblings at age 10, parental work experience, parental annual wage income, and parents' level of education.

The parameter of interest shows a statistically significant positive effect

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[8] Child's birthweight and gender, ethnicity, number of siblings at age 10, age at first separation, parental work experience, annual wage income, and level of education.

[9] These results are available upon request.

[10] Since health information is not available before the child is 6 years old, I have to drop all observations for individuals from age 0 to 5. Furthermore, I drop all individuals that experience parental divorce or separation before they turn 11. This is necessary in order to compare 'period 1' to 'period 2', where period 1 is 6- to 11- year-olds and period 2 is 12- to 20-year-olds.

	Yrs hospitalized		Days in hospital	
aged 12+ (0/1)	0.1815	0.2016	0.6255	0.7411
	(0.0070)	(0.0078)	(0.0653)	(0.0785)
treatment group (0/1)	0.0287	0.0194	0.1120	0.0680
	(0.0124)	(0.0123)	(0.1022)	(0.1007)
aged 12+*treatment group	0.0658	0.0645	0.5408	0.5467
	(0.0221)	(0.0222)	(0.2312)	(0.2338)
constant	0.2648	0.4117	0.9214	1.6364
	(0.0040)	(0.0289)	(0.0369)	(0.2648)
controls†	no	yes	no	yes
obs	46,799	46,622	46,799	46,622

Note: Dependent variables are years with hospitalizations and number of days in hospital. The control group includes children who never experience a family structure change and the treatment group consists of children who experience a family structure change at age 12 or older. Robust standard errors in parentheses.

†: child's birthweight, gender, ethnicity, number of siblings at age 10, parental work experience, annual wage income, and level of education.

Table 5: Differences-in-differences estimates of the effect of experiencing a family structure change at age 12 or older on children's health outcomes.

on child outcomes. This can be interpreted as the causal effect of experiencing a family structure change after age 12. Thus, children who experience that their parents divorce or separate when they are 12 years old (or older) have worse health outcomes (more often hospitalized, more days in hospital) than children that do not experience a family structure change during their childhood. The results do not change remarkably after including a wide array of covariates which again indicates that selection is not the main explanation for the effect of family structure changes on children's health. That is, children's lower outcomes in families that incur family structure changes are not caused by remarkably worse characteristics of these families compared to nuclear families. This is somewhat surprising and does not support the findings in many of the studies in the literature. However, it does support the finding in Francesconi et al. (2005).

	Yrs hospitalized.		Days in hospital	
aged 8+ (0/1)	0.5044	0.5449	1.6845	1.9211
	(0.0072)	(0.0095)	(0.0672)	(0.0971)
treatment group (0/1)	0.0195	0.0084	-0.0061	-0.0390
	(0.0055)	(0.0056)	(0.0422)	(0.0412)
aged 8+*treatment group	0.0940	0.0912	0.7499	0.7249
	(0.0178)	(0.0179)	(0.1913)	(0.1934)
constant	0.1034	0.2421	0.3990	1.0546
	(0.0023)	(0.0278)	(0.0273)	(0.2617)
controls†	no	yes	no	yes
obs	51,147	50,868	51,147	50,868

Note: Dependent variables are years with hospitalizations and number of days in hospital. The control group includes children who never experience a family structure change and the treatment group consists of children who experience a family structure change at age 8 or older. Robust standard errors in parentheses.
$\dagger$: child's birthweight, gender, ethnicity, number of siblings at age 10, parental work experience, annual wage income, and level of education.

Table 6: Differences-in-differences estimates of the effect of experiencing a family structure change at age 8 or older on children's health outcomes.

For testing the robustness of the results I have carried out a series of sensitivity tests. First, I have excluded all children whose parents are immigrants, i.e. the children were born in Denmark in the relevant time period to biological parents not born in Denmark. The reason for excluding these children from the sample is that these families may have a different culture in particular with respect to whether or not it is acceptable to divorce or separate. However, excluding the children born by immigrants does not change the main results.[11]

As shown in Table 6, I have also tried to change the definition of the age brackets for the time periods. The descriptive evidence in Table 4 suggested, that the timing of family structure changes might be important for most of the outcomes, in particular for the health outcomes. Thus, I have now

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[11] The results are not shown here but are available from the author upon request.

defined time period 1 as children aged 6 to 7 and time period 2 as children aged 8 to 20. By changing the time periods, I only exclude individuals that experience parental divorce or separation before they turn 8. Moreover, I can assess the effect of much earlier family structure changes, i.e. when the children have just started in school. By comparing Tables 5 and 6, we see that the parameter of interest is still significant and positive. The size of the coefficient is even bigger in Table 6 than in Table 5 implying that earlier family structure changes might be more detrimental to child outcomes than later family structure changes. It might also be the case that what we see in the table is that the result of moving the age bracket 4 years down makes it possible to experience even more family structure changes during childhood. This might be causing the 'stronger' effect on child outcomes.

6   Conclusion

More and more children do not grow up in traditional nuclear families. Instead they grow up in single-parent households or in families with a step-parent. Hence, this paper aims at improving our understanding of the impact of "shocks" in family structure due to parental relationship dissolution on children. Today, in some countries, more than 40% of all children do not grow up in a household with both of their biological parents.

Using a Danish administrative register dataset, I find in the empirical analysis that children who have experienced family structure changes during childhood seem to have worse educational outcomes and a higher propensity of being hospitalized and convicted of a crime. The children in the dataset experience up to 13 family structure changes during childhood. More family structure changes imply worse outcomes and might actually be more important than the number of years a child has spent in a single-parent household. Also the age at which the family structure change occurs seems to be im-

portant as separations at younger ages are more negatively related to the outcomes. Finally, the D-i-D analyses show that there seems to be a causal effect of family structure changes on health outcomes. A causal effect on child outcomes is also found by Francesconi et al. (2005) using German data. However, the results are in contrast to studies using Swedish and U.S. data, which find only a selection effect of family structure changes (for example Björklund and Sundström (2006) and Björklund et al. (2007)).

Particularly for studies using Danish or Scandinavian data, this study is thought to be a useful reference study for further research on the topic of family structure changes. Many of the analyses in other studies in the literature are replicated and extended in this study and I use both short- and long-run outcomes as well as cognitive and non-cognitive outcomes. This study, like most of the studies in the literature, ignores the problem of having a reasonable counterfactual to separation or divorce. Thus, in future research I expect to look more into families that are already separated to avoid the problem of the 'missing' counterfactual.

The lack of a clear counterfactual makes it difficult to give policy recommendations. The study clearly shows that family structure changes cause negative effects on children's outcomes, but despite this finding it is not necessarily a better option for the child that the parents do not separate. However, for ethical reasons, it is not possible to investigate this question further as we cannot force families to either split up or remain together.

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