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The effect of parental separation on educational achievement: An instrumental variable analysis

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ABSTRACT

Parental separation is associated with a range of negative outcomes for children experiencing it, and there is ongoing scholarly and public interest in whether these associations reflect causal effects of parental separation. We estimate the effect of parental separation on children's educational achievement in Sweden using the proportion of male colleagues at the maternal workplace as an instrumental variable for parental separation. We discuss our instrumental variable approach in the context of the literature on the heterogeneous effects of parental separation. In the empirical analysis, we use population register data on 387,411 Swedish children born between 1990 and 1996 and measure educational achievement through their grade point averages in the final year of compulsory schooling. We find that parental separation does not have a negative effect on educational achievement and that this result is robust across a range of specifications. We argue that our results are informative of the effects of a large share of parental separations, in which parents dissolve relatively well-functioning unions.

1. Introduction

Children whose parents divorced or separated during childhood have on average more behavioral problems, lower psychological well-being, and poorer educational outcomes than children whose families remained intact (Amato 2000, 2010; Fomby and Cherlin 2007; McLanahan and Sandefur 1994; McLanahan et al., 2013). These findings have been reproduced for many countries, and the associations do not appear to have changed over time, even as the acceptance and occurrence of parental separation have increased (Amato and James 2010; Gähler and Palmtag 2015; Sigle-Rushton et al., 2005). A central question in this literature, as well as in the surrounding public debate, is whether these associations are due to underlying negative causal effects of parental separation on children's well-being. Research using sophisticated statistical analyses generally concludes that parental separation has a negative effect on children's outcomes but that this effect is weaker than the bivariate association (Amato 2000, 2010; McLanahan et al., 2013; Härkönen et al., 2017; Raley and Sweeney 2020).

Related literature has moved away from a uniform view of the effects of parental separation to analyze which children are (most)

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affected by parental separation (e.g., Kim 2011; Amato and Anthony 2014; Bernardi and Radl 2014; Grätz 2015; Brand et al., 2019a). Several studies have assessed variation in the effects of parental separation across sociodemographic groups, whereas others have analyzed whether parental separation effects vary depending on the family environment, such as the level of parental conflict that preceded the separation. Although families with a persistently high level of conflict are likely to separate and the effects of these separations can be positive for the children involved (Amato et al., 1995; Dronkers 1999; Hanson 1999; Booth and Amato 2001; Härkönen et al., 2017), a large segment and perhaps even most separations are from "good enough" (Amato, 2001)relationships that could have remained intact. Previous research has argued that parental separation is most likely to have negative effects on children when parents dissolve a family with relatively low levels of conflict (Härkönen et al., 2017), which characterizes many "good enough" partnerships. However, these results come from studies that are largely correlational, raising the possibility of bias from unmeasured confounding.

The present study contributes to the research on the causal effects of parental separation on children's performance by estimating the effects of parental separation in "marginal" families (Frimmel et al., 2016), in other words, those whose decision to separate was triggered by factors external to the family. Since the separation decision was triggered by external factors, we argue that many of these separations are of reasonably well-functioning couples, that is, "good enough" partnerships (Amato, 2001). We contribute to the literature by providing estimates of the causal effects of parental separation for this theoretically and socially relevant subpopulation. These families are unlikely to be particularly disadvantaged—either socioeconomically, or because of severe family dysfunction (which are at a high risk of dissolution in any case)—but because their dissolution is triggered by external factors, they constitute a group that is likely to respond to policies or social sanctions that regulate the likelihood of separation.

We use an instrumental variable design—using the share of male colleagues at the maternal workplace as the instrument—to estimate the effect of parental separation on children's educational achievement. Instrumental variables induce exogenous variation in the independent variable (parental separation) to estimate its causal effect (Angrist and Pischke 2009; Morgan and Winship 2015). Workplace sex ratios affect divorce and separation (Svarer 2007; Åberg 2003, 2009; also, McKinnish 2004, 2007; Uggla and Andersson 2018) by potentially increasing the likelihood of finding a new partner at work. We argue that it is unlikely that the share of opposite-sex colleagues at the workplace—particularly after our extensive set of controls—has a direct effect on GPA that does not operate through parental separation, making the sex ratio a valid instrumental variable.

Importantly, instrumental variable techniques estimate the causal effect of a treatment among those whose treatment status was changed by the instrument, in our case, those who separated because of a higher proportion of male colleagues at the maternal workplace. Instrumental variables are therefore ideal for our purpose of estimating parental separation effects in families that would have remained intact in the absence of exposure to a biased workplace sex ratio. Even though our estimates generalize to separations triggered by the workplace sex ratio, we believe that these separating families are likely to share many characteristics with many other couples who separate from reasonably well-functioning partnerships.

We analyze the effect of parental separation—which includes parental dissolutions from both marital and non-marital unions—on grade point averages (GPAs) observed in the ninth and final year of compulsory schooling using data from 387,411 Swedish children born between 1990 and 1996. Sweden, in addition to providing population-level register data, is an interesting country to analyze the effect of parental separation on children's education because of its liberalism regarding family decisions and the generous welfare state. The free and universal provision of education in Sweden may in theory reduce the impact of parental separation on children's educational careers. Previous research found parental separation penalties in educational performance in Sweden similar in size to those found in other countries (Jonsson and Gähler 1997), although an influential study argued that this result was due to selection effects and disappeared once family-fixed effects models were applied (Björklund and Sundström 2006). The availability of population-level register data in Sweden allows us to obtain precise estimates of the effects of parental separation using our IV approach.

2. The causal effects of parental separation on child education: previous research

The debate on whether parental separation has a negative causal effect on children's outcomes has witnessed conclusions ranging from strong negative effects to none (Cherlin 1999). The key question in research into the effects of parental separation has been whether all the confounding factors affecting both the separation and the children's outcomes in question could be controlled for. Parents who separate tend to be younger, more urban, and in many countries, including Sweden, less educated than those who do not separate (Lyngstad and Jalovaraa, 2010), and their pre-separation family lives are more likely to be characterized by conflict and detachment (e.g., Hanson 1999; Gähler and Garriga 2013).

Because it is unlikely that all confounding can be removed by adjusting for observed variables, recent decades have seen an increase in empirical analyses using research designs that control for unobserved variables, including individual (Sun and Li 2002; Aughinbaugh et al., 2005; Sanz-de-Galdeano and Vuri 2007; Amato and Anthony 2014) and sibling fixed effects models (Sandefur and Wells 1999; Ermisch and Francesconi 2001; Ermisch et al., 2004; Björklund and Sundström 2006; Sigle-Rushton et al., 2014; Grätz 2015). The findings of these studies are mixed. Some report no effects of parental separation (Aughinbaugh et al., 2005; Sanz-de-Galdeano and Vuri 2007; Björklund and Sundström 2006), whereas others found weak to moderate negative effects on various academic and psychological well-being outcomes (Sun and Li 2002; Amato and Anthony 2014; Sigle-Rushton et al., 2014; Grätz 2015).

Based on this evidence, research overviews have concluded that the average effects of parental separation on children's outcomes are generally negative (Amato 2010; McLanahan et al., 2013; Härkönen et al., 2017; Raley and Sweeney 2020). The reasons for the negative average effects include economic, demographic, and social-psychological mechanisms. Parental separation can induce a decline in economic conditions, which can lead to poorer children's performance and lower levels of educational attainment

(McLanahan and Sandefur 1994; Amato 2000; Brand et al., 2019b). Many children of divorce experience stepfamily formation, family complexity, and further family instability, which can negatively impact their outcomes (Thomson et al., 1994; Jonsson and Gähler 1997; Fomby and Cherlin 2007; Brown et al., 2015; Turunen 2014). Parental separation can also be accompanied by long-lasting conflict with the parents and a deterioration of the relationship between children and their parents, with similarly negative effects on children's well-being and performance (Amato 2000; Amato and James 2010; Härkönen et al., 2017).

The effects of parental separation are not the same for all children. Instead, they vary widely and range from negative effects for some children to positive effects for others (Amato and Anthony 2014). For a large fraction, and possibly the majority, of children, parental separation has neither positive nor negative effects, at least in the long run (Amato 2010; Amato and Anthony 2014; Amato and James 2010; Demo and Fine 2010). The negative effects reported in many studies are thus averages over a wide range of effects, where typically, the fraction of children who experience a negative effect is larger than the fraction of children experiencing a positive effect.

When are the effects of parental separation likely to be negative, and when can one expect that there are no effects or even positive ones? Studies comparing the effects of parental separation between socioeconomic groups (Bernardi and Boertien 2017; Grätz 2015; Mandemakers and Kalmijn 2014) or by the estimated propensity of parental separation (Amato and Anthony 2014; Brand et al., 2019a) have yielded contradictory results. However, research on the moderating effects of the pre-separation family environment and parental conflict has more consistently concluded that the effects of parental separation are more likely to be negative when family dissolution is preceded by low levels of conflict and is relatively unexpected from the children's point of view, whereas the effects are less likely to be negative and can be positive when a high-conflict family environment is dissolved (Amato et al., 1995; Dronkers 1999; Hanson 1999; Booth and Amato 2001; Härkönen et al., 2017). Likewise, the effects are more likely to be negative if family dissolution leads to financial stress, poor parental adjustment and parenting, and continued conflict between the parents, whereas most children function reasonably well in the absence of these proximate consequences of family dissolution (Amato and James 2010:9).

Our study contributes to the literature on the causal effects of parental separation by using an instrumental variable (IV) approach to estimate the parental separation effect on educational achievement. More specifically, our contributions are twofold. First, IV estimation provides a novel approach to estimate the causal effects of parental separation on children's education. Despite the common conclusion that the effects of parental separation are negative on many outcomes, the variation in results calls for continued research because the results may depend on the assumptions behind the methods used (McLanahan et al., 2013; Härkönen et al., 2017; Raley and Sweeney 2020). As we argue in more detail below, the proportion of male colleagues at the maternal workplace fulfills the requirements of a valid IV. Using this IV, we can estimate the causal effect of parental separation on educational performance.

Second, the IV approach estimates the causal effect of parental separation for a subpopulation of children, namely, those whose parents' separation was triggered by working at a workplace with a high ratio of men to women, which we argue affects parental separation primarily through the mother finding a new partner or at least increases her confidence in doing so. These parents would not have separated otherwise. Not only does this design provide a more specifically defined counterfactual explanation than other research designs, but it also estimates the effect of parental separation for a theoretically and socially relevant group of families, whose separation could in theory have been prevented (Frimmel et al., 2016). As we spell out below, we expect to find a weak negative effect of parental separation in these families. To the extent that our estimates can be generalized to other families whose separation could have been prevented, our estimates provide evidence of parental separation effects for an important part of the distribution of parental separation effects.

3. Instrumental variable estimation of the effects of parental separation

We analyze the effects of parental separation on children's grade point averages measured at age 15, using variation in the share of male colleagues at the maternal workplace at the time of the birth of the child as an instrumental variable (IV). Here, we discuss the logic of estimating parental separation effects with instrumental variables as well as the kinds of family dissolutions that are likely to be involved. We present the more technical aspects of the estimation in the *Data and Variables* section.

In an IV setting, an exogenous source of variation, which is not directly related to the outcome of interest, induces some parents to separate but leaves some otherwise similar parental relationships intact. The challenge is to find an instrument that affects parental separation but that influences children's outcomes only through its effect on parental separation. We use the proportion of male colleagues at the maternal workplace, measured when the child was born, to instrument parental separation. The workplace sex ratio has been identified as a predictor of parental divorce and separation in Denmark (Svarer 2007) and Sweden (Åberg 2003, 2009). Similarly, McKinnish (2004, 2007) and Uggla and Andersson (2018) showed that sex ratios within industries and occupations predicted divorce in the United States and Denmark, respectively, and South et al. (2001) reported that a high fraction of men in the wife's occupation increased divorce in the United States, whereas there was no effect of the sex ratio in the husband's occupation. The share of closely aged female colleagues at the father's workplace was also used by Frimmel et al. (2016) as an instrumental variable for parental divorce in Austria, and the authors found that parental divorce lowered boys' attainment of education and employment and increased their risk of early death and lowered girls' attainment of education and increased their probability of early motherhood.

These studies argue that workplaces and occupations with a higher share of coworkers of the opposite sex increase the risk of separation by increasing the probability of meeting a new partner at the workplace or at least by increasing confidence in finding a new partner should one separate (South et al., 2001). Many couples have met at the workplace (Kalmijn and Flap 2001; Rosenfeld and Thomas 2012), and the workplace can be a particularly important setting for meeting a new partner for parents already in a partnership, who typically do not engage in an active search for partners and who spend less time in alternative partner markets, such as bars, discotheques, and dating sites (Svarer 2007). As support for this argument, Svarer (2007) found that the new partners of

previously partnered individuals were twice as likely to be coworkers as the partners of previously single individuals.

In addition to affecting the risk of separation, the central identifying assumption allowing us to interpret the estimates of our IV models as causal effects is that the proportion of male colleagues at the maternal workplace is related to children's educational success only through its effect on the parental propensity to separate but does not affect children's outcomes through other pathways. This exclusion restriction assumption is untestable (Imbens and Angrist 1994). We argue that the probability of violation of the exclusion restriction is small. However, one such possibility is that a higher share of men at the mother's workplace may increase her risk of a romantic affair with a coworker without leading to a separation. In this case, a high share of male coworkers at the mother's workplace affects children's outcomes through a deterioration of the family environment even if the family remains intact. Given that we measure the proportion of male colleagues at the maternal workplace at childbirth, one can argue that many parents whose long-term relationship quality was affected by infidelity (or suspicions thereof) would eventually have separated by the time school grades of their children were measured at age 15, even if the partnership survived in the short run. On the other hand, if the shock to the family environment was short term, measuring school grades at age 15 would allow children to recover from the negative effects of parental separation.

Another possibility is that women sort into occupations and workplaces with a higher share of male coworkers based on their characteristics, such as ability and career aspirations, which also affect their children's educational achievement (Frimmel et al., 2016). We minimize the risk of such confounding with an extensive set of control variables. However, some variables that affect sorting into workplaces, such as attitudes about work-life balance and personality traits, are very difficult to observe in general and are not observable at all in our register data. This is a limitation of our analysis. A further way in which the exclusion restriction could be violated is that women with more male coworkers may more often experience sexual harassment. This experience of sexual harassment could potentially affect their relationships and have spillover effects on the children as well.

Even if all the identifying assumptions were met, our IV estimates identify the effect of parental separation only for a specific subpopulation. Under the local average treatment effect (LATE) interpretation of IV estimates, our estimates represent the effect of parental separation on children whose parents separated because of the proportion of male colleagues at their mothers' workplaces but who would not have separated otherwise (Imbens 2010; Imbens and Angrist 1994). These families are called "compliers" in IV parlance (Imbens and Angrist 1994), as their treatment status (family dissolution) can be altered by exposure to the instrument.

Who are these compliers? First, it is important to distinguish them from those families that would have dissolved in any case (the "always-takers") as well as those who would never separate only because of the proportion of male colleagues at the mother's workplace ("never-takers"). The treatment status of both of these groups is unresponsive to the share of male colleagues at the maternal workplace, and IV estimates therefore do not generalize to these groups. The first group is overrepresented by families where the family functions badly and that are plagued by parental conflict, whereas the second is overrepresented by families with high religious or other barriers to family dissolution.

The fourth group, the "defiers", would act exactly the opposite way to what we would expect, that is, be more prone to separate if working in a workplace with more same-sex than opposite-sex coworkers. If the partner market explanation is correct, this would probably refer to those finding a same-sex partner after being in an opposite-sex relationship and having children. This is most likely a small group. Another group of defiers would be women who value their existing relationship more if they are surrounded by more male coworkers. This could be the case if their male colleagues seem less attractive to them than their own partner and they decide not to separate for this reason. Again, this is likely to be a small group.

Complier families are found between the two extremes of "always-takers" and "never-takers". Research on infidelity has found that, as expected, partners engaging in extradyadic affairs have reduced marital quality and higher detachment from their partners (Allen et al., 2006). The lower partnership quality in these couples places the partners at a higher risk of engaging in extradyadic relationships, and the workplace setting can provide an opportunity to do so. Women have typically been less likely to engage in extradyadic affairs than men, and relationship quality has been a stronger predictor for their extradyadic affairs (Allen et al., 2006), which underlies the compromised relationship quality in many of the complier families. However, because the separation of these complying parents was triggered by the proportion of male colleagues at the maternal workplace, these parents likely had a "good enough" (Amato, 2002) partnership, as they would not have separated otherwise. This rules out separations that were the next to inevitable culmination of severe dissension and estrangement, as well as those where engagement with a coworker was the final means to dissolving a union that would have ended in any case. However, extradyadic romantic engagement with a coworker is likely to increase the acrimony and conflict that characterize the separation process both before and after the factual separation event. It is also likely to lead to faster stepfamily formation (Svarer 2007), especially if the child remains primarily with the mother.

Although the complier families appear to form a rather special subpopulation of family dissolutions, they are likely to share many features with other dissolved families. Infidelity is a major stated reason for divorce (Amato and Previti 2003; De Graaf and Kalmijn 2006; Lampard 2014), and a large share of separated partners report that they themselves or their partners had extradyadic relationships (South et al., 2001; Allen and Atkins 2012). Likewise, a large share of current divorces and separations are from "good enough" marriages and partnerships (Amato, 2002; Amato and Hohmann-Marriott 2007; Gähler and Palmtag 2015). For example, Gähler and Palmtag (2015) reported that less than half of Swedish respondents born in the 1970s and 1980s whose parents had separated reported "severe dissension" in their childhood homes, down from two-thirds and above among those born in the 1950s and before. Regarding stepfamily formation after family dissolution, Andersson et al. (2017) estimated from the Generations and Gender Surveys that 40 percent of Swedish children from dissolved families experience stepfamily formation within six years.

Based on their characterization, what can we expect in terms of parental separation effects in these complier families? The dissolution of "good enough" families is likely to lead to a loss in children's resources and separations triggered by meeting a new partner often lead to stepfamily formation. Parental conflicts during the separation process, including those before the factual

separation event that were caused by the mother's extradyadic engagement—which should thus be considered part of the total effect of the parental separation, rather than a confounder of its effect—are likely to have a negative effect on the children (Cherlin et al., 1991; Dronkers 1999; Hanson 1999; Booth and Amato 2001). All of these reasons lead us to expect a negative effect of parental separation on children's school outcomes. On the other hand, Swedish single parents have low poverty rates (Maldonado and Nieuwenhuis 2015), which should dampen the negative separation effects because of the economic consequences of the separation (Brand et al., 2019b). Additionally, because we include all parental separations experienced by age 15, when the outcome is measured, it is likely that parental separation effects on educational performance become weaker over time (Sun and Li 2002). Altogether, we would expect a weak negative effect of parental separation on school performance of children of the compliers, which is also in line with several other findings from causally oriented studies (cf. Amato, 2010; McLanahan et al., 2013; Härkönen et al., 2017).

4. Data and variables

4.1. Data and sample selection

We analyze administrative register data on seven birth cohorts of children born in Sweden between 1990 and 1996 for whom we have information on their grade point average (GPA) in ninth grade, which is the final year of compulsory school, in the years 2006–2012. The data come from the Sweden in Time: Activities and Relations (STAR) register database, which is maintained at Stockholm University.

Our IV uses information on the maternal workplace. The workplace is the unit where people work within private and public organizations. This information is not available for all workplaces but for all public workplaces, all bigger private workplaces, and a random sample of smaller private workplaces. Given that the nature of the sampling of small private workplaces is random, the reduced sample should not lead to sample selection bias.

Since we are interested in estimating the effect of parental separation and not the effect of single parenthood, we restrict the sample to children born into two-parent families. This means that we drop children who were born to single mothers from the analysis sample. In addition, we only include children with mothers working at a workplace with five or more employees in the analysis sample. At smaller workplaces, the proportion of opposite-sex colleagues at the workplace is a worse predictor of parental separation because small changes in the number of persons at the workplace can drastically change the sex ratio (Svarer 2007).

A limitation of our approach is that we can only estimate the effect of parental separation on children's academic performance using a sample of children with working mothers. We do not have information on the workplace for mothers who are unemployed or inactive. Due to this sample selection, we may underestimate the effects of parental separation. However, we expect that such bias will be rather small due to the small numbers of unemployed and inactive mothers in Sweden.

The size of our analytical sample is also reduced by missing values on some of the variables used in our analysis. Table 1 gives an overview of the evolution of the analytical sample based on our sample selection criteria.

4.2. Variables

Parental Separation. We measure parental separation based on the household structure in which the children lived during childhood. In other words, parental separation occurred if the child did not live in the same dwelling with both of her or his parents (Thomson and Eriksson 2013). We define parental separation as occurring when the child was younger than 16 years at separation, corresponding to the age at which she or he receives her or his GPA.

Educational achievement. We measure educational achievement through the grade point average (GPA, "*meritvärde*") in the ninth grade of compulsory school (*grundskola*). This is a continuous variable and commonly used in research on educational inequalities in Sweden (Erikson and Rudolphi 2010; Rudolphi 2013). According to Rudolphi (2013), more than 75% of inequality in educational opportunity is covered by GPA so that final educational attainment highly correlates with GPA. Children are approximately 16 years old when GPA is measured. We standardize GPA first within each year to control for grade inflation. We then standardize GPA using the full sample so that it has a mean of zero and a standard deviation of one. This allows us to interpret the estimates of the effect of parental separation on children's GPA in terms of standard deviations.

Instrumental variable. Our instrumental variable (IV) is the proportion of male coworkers at the maternal workplace (measured in percentage). A workplace is the physical location where people work. To avoid endogeneity due to reverse causality, we use information on the maternal workplace in the child's birth year. Since we focus on parental separations after birth, we can ensure through this definition that the information on the sex composition of the workplace precedes parental separation.[2]

In contrast to Frimmel et al. (2016), who used the share of female colleagues at the paternal workplace as an instrumental variable, we use the share of opposite-sex colleagues at the mother's workplace. We also estimated the effect of the share of female colleagues at the paternal workplace on parental separation. In our data, the correlation between the proportion of female colleagues at the paternal workplace and parental separation was, however, close to zero. Since a strong instrument is required to obtain unbiased estimates of parental separation, we focus on the share of male colleagues at the maternal workplace as our sole instrument. Additionally, unlike

[2] We measure the sex ratio at the workplace at the birth of the children. Prior to the birth, the sex ratio at the workplace could affect who has children. Giving birth can be understood as a sign of the stability of a relationship. However, it should be noted that our study focuses on the effects of parental separation on children's education; for that reason, this question only applies among the population of parents.

Table 1
Evolution of sample size according to sample selection criteria.

Sample selection criteria	Number of observations remaining in the analytical sample
Valid observations of GPA	712,054
Children living with both parents at birth	653,137
Children with valid information on the country of origin of the parents	652,973
Children with valid information on highest level of parental education	627,302
Children with valid information on maternal educational field of study	547,622
Children with mothers at workplaces with more than 5 employees	518,494
Children with valid information on maternal workplace composition	387,411

Frimmel et al. (2016), we do not impose an age restriction on male coworkers. First marriages and unions—many of which have been formed in age-homogeneous social settings such as schools—are more age-homogamous than later ones (Svarer 2007). Thus, age restrictions may overly restrict the pool of potential partner candidates for mothers already in a relationship.[3]

Fig. 1 demonstrates that with an increasing share of colleagues of the opposite sex, the mean of parental separation goes up. For the purpose of the graph, we split the workplace sex ratio variable into ten groups ranging from 0.0 to 0.09, 0.1–0.19, …, 0.9–1.0. We then plot the mean of parental separation for these ten groups. Finally, we estimate a regression line describing the relationship between the workplace sex ratio and the share of separations. The regression line is increasing. This means that with an increasing share of opposite sex colleagues at the maternal workplace, the probability that a child experienced parental separation goes up.[4]

Control Variables. As control variables, we use gender, birth order, maternal age, child's birth cohort, and parental countries of origin in all models. Even though these variables are only weakly correlated with our instrument, they help to explain the variance in GPA and to reduce the standard errors of our IV estimates. Furthermore, we report the estimates of gender and birth order as estimates of the effects of other important factors that influence children's education to which we can compare the size of the parental separation penalty. In addition to a linear term of maternal age, we also control for its squared term and for children's birth cohort via a set of dummy variables. Finally, we control for parental country of origin via a set of dummy variables indicating maternal and paternal country of origin.

More importantly, to ensure the exogeneity of our IV, we control for maternal educational attainment (via a set of dummy variables distinguishing seven levels of education based on a Swedish classification that is similar to ISCED), educational field of study (via a set of dummy variables distinguishing between seven fields of study), workplace size, whether a mother works at a private (as opposed to a public) workplace, the interaction between workplace size and private workplace (to account for the fact that the sex ratio could be measured only for a random sample of smaller private workplaces), and the region in which the mother lives (via a set of dummy variables distinguishing between 25 regions). These controls take up the effects of sex segregation into occupations and any selection into workplaces with specific sex ratios. In addition, we estimate effects within regions to control for regional variations in workplaces and separations. Because of these control variables, we essentially provide within-educational-group, within-educational-field, within-private/public domain, and within-region estimates. For that reason, our IV strategy relies on the assumption that the distribution to workplaces within levels of education, educational fields, private/public workplaces, and regions is random.

In addition, we report the IV estimates before introducing these control variables to demonstrate that adding these control variables does not affect our IV estimates. The comparison of the results before and after the controls are introduced shows few differences, suggesting that the exogeneity assumption may be fulfilled without these control variables.

Table 2 reports descriptive statistics on our analytical sample. Approximately 33% of the children in our sample experienced parental separation before GPA was measured. This number is in line with previous research estimating the frequency of the experience of parental separation for these birth cohorts (Thomson and Eriksson 2013).

5. Results

5.1. Baseline estimates of the associations between parental separation and Children's GPA

We start the analysis by presenting results on the association between parental separation and GPA in ninth grade. Table 3 reports OLS regression models with GPA as the outcome variable and parental separation as our explanatory variable. These results serve as the baseline estimates to which we will compare our IV estimates. They also make our analysis comparable to earlier research, which

[3] We tested a specification corresponding to the one employed by Frimmel et al. (2016), employing as an instrument the sex ratio of colleagues of a similar age at the workplace whilst controlling for the overall sex ratio at the workplace. However, in our data this specification resulted in a negative (and not a positive) effect of an increasing ratio of opposite-sex colleagues of a close age at the workplace on separation as well as a weak first stage (see Table S2 in the Online Supplement). This negative effect can potentially result from the strong collinearity between the general sex ratio and the age-specific one, both of which were included in the same model. Therefore, we could not employ the same specification as Frimmel et al. (2016).

[4] Two things should be noted. First, there are only very few cases with a very unbalanced sex ratio, therefore not too much emphasis should be put on the extremely low and extremely high values of the sex ratio. Second, the figure shows the bivariate association, that is the association obtained without controlling for the large number of control variables, which account for the selection into parental separation, used in the main analysis.

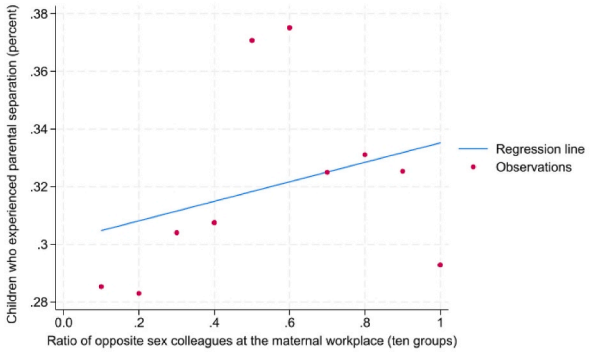

Fig. 1. Graphical display of the relationship between the ratio of opposite sex colleagues at the maternal workplace and the share of children who experienced parental separation.

Table 2
Descriptive statistics.

Variable	Mean	SD	*N*
Grade Point Average (GPA)[a]	0.18	0.89	387,411
Female	0.49	0.50	387,411
Parental separation	0.33	0.47	387,411
Birth order	1.83	0.90	387,411
Maternal age	29.30	4.70	387,411
Proportion of male co-workers at the maternal workplace (in percent)	0.33	0.25	387,411
Size maternal workplace	579.94	1419.51	387,411
Proportion of male workers in the mother's industry branch	0.38	0.23	386,942

Notes.
[a] The standardization of GPA was done on the full sample before implementing the sample selection criteria described in Table 1.
Source: Sweden in Time - Activities and Relations (STAR) register database.

Table 3
OLS regression models of the association between parental separation and child GPA.

	(1) Full sample	(2) Full sample	(3) Male	(4) Male	(5) Female	(6) Female
Parental separation	−0.31***	−0.26***	−0.30***	−0.26***	−0.32***	−0.27***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Female	0.34***	0.34***				
	(0.00)	(0.00)				
Birth order	−0.20***	−0.14***	−0.20***	−0.13***	−0.21***	−0.14***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Controls for maternal age, maternal age square, cohort of child (dummy variables), and parental countries of origin (dummy variables)	Yes	Yes	Yes	Yes	Yes	Yes
Controls for maternal level of education, field of study, workplace size, private/public workplace, interaction between workplace size and private/public workplace, and region	No	Yes	No	Yes	No	Yes
N	387,411	387,411	197,961	197,961	189,450	189,450

Note: OLS regression models. Standard errors in parentheses.
* $p < .05$; ** $p < .01$; *** $p < .001$ (two-tailed tests).
Source: Sweden in Time - Activities and Relations (STAR) register database.

most of the time has reported estimates of the association between parental separation and academic performance of a similar size.

Model 1 in Table 3 reports the association between parental separation and children's GPA, only controlling for children's sex, birth order, maternal age, and child birth cohort, as approximately one-third of a standard deviation. Controlling additionally for maternal level of education, field of study, size of the maternal workplace, a dummy for a workplace in the private sector, the interaction between workplace size and private workplace, and region slightly reduces the size of the parental separation penalty. According to Model 2, children who experienced parental separation scored approximately one-quarter of a standard deviation lower in their GPA than children whose parents stayed together. This result suggests a moderate negative association of parental separation with children's education. This negative association is of a similar size as the negative association of being the third-born compared to being the

first-born child or being male compared to being female.

Models 3 and 4 in Table 3 analyze gender differences in the association between parental separation and GPA. We find no evidence that there is heterogeneity in the parental separation penalty by a child's gender. The coefficients in the male and female subsamples are nearly identical.

5.2. First stage results of the instrumental variable regression

To be able to use the share of male colleagues at the maternal workplace as an IV for parental separation, we must demonstrate that it affects the probability of parents separating. In Table 4, we report linear probability models that estimate whether a child in our sample has experienced parental separation. We prefer to report LPM because of the easier interpretation of these models and because they can be integrated easily into a 2SLS framework (Angrist and Pischke 2009).

We find a positive and statistically significant effect of the share of male colleagues at the mother's workplace on separation risk. The Kleibergen–Paap Wald F-statistic, a test of the strength of the instrument, is in all regressions larger than 130; therefore, our IV is not considered weak by key references in the IV literature (Andrews et al., 2019; Staiger and Stock 1997; Stock and Yogo 2005).

5.3. Instrumental variable estimates of the effect of parental separation on Children's GPA

Table 5 reports the IV estimates of the effect of parental separation on children's academic performance using the share of male coworkers at the maternal workplace as an instrumental variable for parental separation. The estimates for the full sample are statistically nonsignificant and close to zero. They have also switched signs compared to the baseline models reported in Table 3. These results suggest that, on average, children are not negatively affected by parental separations induced by sex ratio imbalances at the maternal workplace.

How precisely are these null effects estimated? Based on the information provided in Table 5, we can estimate 95% confidence intervals to answer this question. These 95% confidence intervals are graphically shown in Fig. 2. If we select our preferred Model 2, the estimate of 0.14 has a 95% confidence interval running from −0.08 (lower bound) to 0.36 (upper bound). In other words, we cannot completely rule out a small negative effect of parental separation on children's GPA. However, the estimated negative causal effect of parental separation on children's education is in any case much smaller than the baseline association (−0.26) reported in Table 3. We also cannot fully rule out a moderate positive effect of parental separation of 0.2–0.3 standard deviations. Such a positive effect goes, however, against our theoretical expectations and most prior empirical research, which found a negative effect of parental separation.

Models 3 to 6 in Table 5 report results separately by children's gender. These estimates indicate no gender differences in the effect of parental separation on children's GPA. For both boys and girls, we find statistically nonsignificant, substantively small, and mostly positive effects of parental separation on academic performance. Therefore, our findings show that parental separation has a negative effect on educational performance for neither boys nor girls.

5.4. Robustness checks

To test the robustness of our result that parental separation does not affect children's academic performance in Sweden, we report two robustness checks with alternative IV specifications. First, as our IV estimate may be weakened by the fact that separations

Table 4
Linear probability models of the effects of the proportion of male colleagues at the maternal workplace on parental separation.

	(1) Full sample	(2) Full sample	(3) Male	(4) Male	(5) Female	(6) Female
Proportion of male colleagues at the maternal workplace	0.075***	0.054***	0.075***	0.053***	0.075***	0.055***
	(0.003)	(0.003)	(0.004)	(0.005)	(0.004)	(0.005)
Female	0.008***	0.007***				
	(0.001)	(0.001)				
Birth order	0.038***	0.029***	0.038***	0.029***	0.039***	0.029***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Controls for maternal age, maternal age square, cohort of child (dummy variables), and parental countries of origin (dummy variables)	Yes	Yes	Yes	Yes	Yes	Yes
Controls for maternal level of education, field of study, workplace size, private/public workplace, interaction between workplace size and private/public workplace, and region	No	Yes	No	Yes	No	Yes
N	387,411	387,411	197,961	197,961	189,450	189,450
Kleibergen-Paap rk Wald F statistic	627.255	266.309	319.883	130.189	304.850	136.514

Note: Linear Probability Models. Robust standard errors in parentheses.
* $p < .05$; ** $p < .01$; *** $p < .001$ (two-tailed tests).
Source: Sweden in Time - Activities and Relations (STAR) register database.

Table 5
2SLS estimates of the effects of parental separation on child GPA, using the proportion of male colleagues at the maternal workplace as an IV for parental separation.

	(1) Full sample	(2) Full sample	(3) Male	(4) Male	(5) Female	(6) Female
Parental separation	0.04 (0.07)	0.14 (0.11)	0.10 (0.10)	0.03 (0.15)	−0.02 (0.11)	0.24 (0.16)
Female	0.34*** (0.00)	0.34*** (0.00)				
Birth order	−0.22*** (0.00)	−0.15*** (0.00)	−0.21*** (0.00)	−0.14*** (0.00)	−0.22*** (0.00)	−0.16*** (0.01)
Controls for maternal age, maternal age square, cohort of child (dummy variables), and parental countries of origin (dummy variables)	Yes	Yes	Yes	Yes	Yes	Yes
Controls for maternal level of education, field of study, workplace size, private/public workplace, interaction between workplace size and private/public workplace, and region	No	Yes	No	Yes	No	Yes
N	387,411	387,411	197,961	197,961	189,450	189,450

Note: Second stages of 2SLS IV regression models. Parental separation instrumented by ratio of opposite sex co-workers at the maternal workplace. Robust standard errors in parentheses.
* $p < .05$; ** $p < .01$; *** $p < .001$ (two-tailed tests).
Source: Sweden in Time - Activities and Relations (STAR) register database.

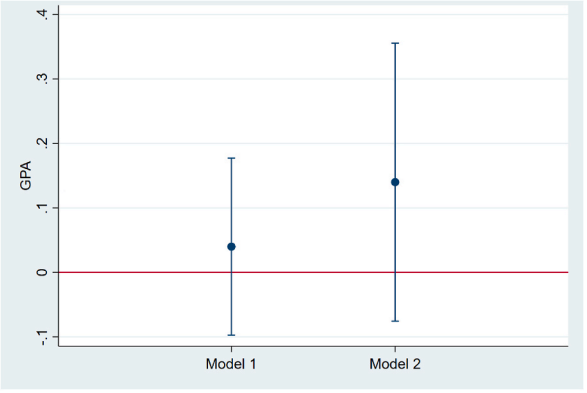

Fig. 2. Graphical display of the effects of parental separation with 95% confidence intervals.
Source: The graph shows the estimates of the effects of parental separation from Models 1 and 2 reported in Table 5, including the 95% confidence intervals.

occurred a long time after the share of opposite sex colleagues at the workplace was determined, we tested whether considering only earlier separations affected our estimates. We report these results in Table 6. In these models, we only include children who experienced parental separation before age six and compare them to the children who did not experience parental separation during childhood (age zero to 15). Children who experienced parental separation between ages six and 15 are dropped from the sample for this analysis.

The results show very similar estimates of the effect of parental separation on school grades to the main specification reported in Table 5. The estimates of the effects of parental separation on GPA are generally statistically not significant and substantively close to zero. The only exception is the model for female children without control variables, which indicates a negative effect of parental separation (Model 5). However, adding control variables results in a positive, statistically nonsignificant, and substantively small effect of parental separation even among female children (Model 6). In summary, these results clearly support the view that parental separation has no negative effect on children's education in our sample of Swedish children.

Second, we use the share of male coworkers in the maternal industry branches as an alternative instrument for parental separation (McKinnish 2004, 2007). The idea is that this instrument relies on a different assumption than the instrument that we use in the main specification reported in Table 5. Parents may be less able to change the industry they work in than their workplace during their professional career, making it less likely that this variable changes if parents are not satisfied with their relationships.

Table 7 reports the results of the second stage of the IV regression models using this alternative IV, while the first stage estimates are reported in Table S1 in the *Online Supplement*. The results of this robustness check are very consistent with our previous results. We find a negative effect of parental separation on children's GPA in Model 1. This estimate seems, however, to be due to violations in the exclusion restriction using this alternative IV. Once we add a more extensive set of control variables to control for these violations, no

Table 6
2SLS estimates of the effects of parental separation on child GPA, using the proportion of male colleagues at the maternal workplace as an IV for parental separation, separation happened before age 6.

	(1) Full sample	(2) Full sample	(3) Male	(4) Male	(5) Female	(6) Female
Parental separation	−0.02	0.09 (0.15)	0.10 (0.14)	0.03 (0.20)	−0.44**	0.15 (0.22)
	(0.10)				(0.15)	
Female	0.34***	0.34***				
	(0.00)	(0.00)				
Birth order	−0.21***	−0.14***	−0.21***	−0.13***	−0.19***	−0.15***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Controls for maternal age, maternal age square, cohort of child (dummy variables), and parental countries of origin (dummy variables)	Yes	Yes	Yes	Yes	Yes	Yes
Controls for maternal level of education, field of study, workplace size, private/public workplace, interaction between workplace size and private/public workplace, and region	No	Yes	No	Yes	No	Yes
N	315,401	315,401	161,719	161,719	153,682	153,682

Note: Second stages of 2SLS IV regression models. Parental separation instrumented by ratio of opposite sex co-workers at the maternal workplace. Robust standard errors in parentheses.
* $p < .05$; ** $p < .01$; *** $p < .001$ (two-tailed tests).
Source: Sweden in Time - Activities and Relations (STAR) register database.

negative effect of parental separation on children's academic performance is found. This finding is also confirmed when we look separately at girls and boys. This robustness check therefore supports our main conclusion according to which parental separation has no negative effects on boys and girls in our sample of Swedish adolescents.

6. Discussion and conclusion

Using the proportion of male colleagues at the maternal workplace, measured at the time of birth, as an instrumental variable for parental separation, we found no negative effect of parental separation on the GPA scores of 15-year-olds in Sweden. The point estimates were virtually zero, and the result was robust to focusing on parental separations before age 6, to using the share of male colleagues in the maternal industry branch as an alternative instrument and was the same for boys and for girls. We have argued that our instrumental variable, the share of male colleagues at the maternal workplace, fulfills, if the assumptions hold, the requirements of a valid and relevant instrument, which enabled us to estimate the causal effects of parental separation.

Overviews of research on the causal effects of parental separation on various children's outcomes typically conclude that, on average, parental separation has a weak to moderate negative effect (Amato 2000, 2010; McLanahan et al., 2013; Härkönen et al., 2017; Raley and Sweeney 2020). This is what we expected based on our theoretical reasoning, even though our results aligned with many studies that found no effects (e.g., Aughinbaugh et al., 2005; Sanz-de-Galdeano and Vuri 2007). The latter finding was also

Table 7
2SLS estimates of the effects of parental separation on child GPA, using the proportion of male colleagues in the maternal industry branch as an IV for parental separation.

	(1) Full sample	(2) Full sample	(3) Male	(4) Male	(5) Female	(6) Female
Parental separation	−0.55***	0.03 (0.12)	−0.48***	−0.07	−0.62***	0.12 (0.18)
	(0.07)		(0.10)	(0.17)	(0.11)	
Female	0.34***	0.34***				
	(0.00)	(0.00)				
Birth order	−0.20***	−0.14***	−0.19***	−0.13***	−0.20***	−0.15***
	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.01)
Controls for maternal age, maternal age square, cohort of child (dummy variables), and parental countries of origin (dummy variables)	Yes	Yes	Yes	Yes	Yes	Yes
Controls for maternal level of education, field of study, workplace size, private/public workplace, interaction between workplace size and private/public workplace, and region	No	Yes	No	Yes	No	Yes
N	386,942	386,942	197,713	197,713	189,229	189,229

Note: Second stages of 2SLS IV regression models. Parental separation instrumented by ratio of opposite sex colleagues in the maternal industry branch. Robust standard errors in parentheses.
* $p < .05$; ** $p < .01$; *** $p < .001$ (two-tailed tests).
Source: Sweden in Time - Activities and Relations (STAR) register database.

reported by Björklund and Sundström (2006) in their family fixed-effects analysis of parental separation effects on educational attainment in Sweden. Our findings therefore generally concur with previous findings, which vary from no causal effects to weak to moderate ones. They agree with research underlining the heterogeneity in parental separation effects, which range from positive effects to negative ones, with most children experiencing no major effects (Amato and James 2010; Amato and Anthony 2014). Our results add to the latter findings.

Instrumental variable estimation of parental separation effects identifies the causal effect of parental separation in a subpopulation of children, namely, those whose parents' separation was triggered by the instrumental variable (here, the share of male colleagues at the maternal workplace). Above, we discussed at length the probable characteristics of the subpopulation to which our estimates generalize. The children in the subpopulation are of parents who separated because of a higher share of male coworkers at the mother's workplace and who would not have separated otherwise, and we argued that a reason for many of the separations was that the mother met a new partner at work (South et al., 2001; Svarer 2007) or at least engaged in a romantic affair at work. Such separations are likely to involve "good enough" partnerships (Amato, 2002) that would not have dissolved otherwise, but are also likely to include acrimony between the separating parents that can last beyond the separation and are more likely to involve (early) stepfamily formation, both of which predict poorer results for children (Amato 2000, 2010; Härkönen et al., 2017; Raley and Sweeney 2020).

In addition to acrimony and conflict after the factual separation event, we expected that pre-separation conflict contributes to any effect of parental separation for these children. Pre-separation conflict is usually seen as a confounder of parental separation, but divorce scholars have long discussed how (parental) separations should often be considered as a process in which conflict during the uncoupling phase is part of the separation effect (Morrison and Cherlin, 1995; Amato 2000; Sun and Li 2002; Demo and Fine 2010; Kim 2011; Härkönen et al., 2017). Infidelity leads to conflict during the separation phase, although it may be of limited duration during the pre-separation phase (but last beyond the separation event). Importantly, when this conflict is triggered by the instrumental variable, it becomes part of the estimated effect.

There are certainly limitations to our analysis. The IV estimation relies on very strong assumptions and our instrument is identifying a causal effect among a very specific sub-population for which the workplace sex ratio triggers the separation and for whom the monotonicity assumption holds. In addition, as explained above, the effect we identify refers to a population, which is ratherunlikely to be strongly affected by parental separation compared to our populations who experience parental separation for other reasons or in other contexts.

What may explain our finding of no effects of parental separation for our subpopulation of children, despite theoretical reasons to expect such an effect as well as findings of clear negative effects from other research with a similar design (Frimmel et al., 2016)? We mention four possible reasons. First, the outcome, grade point averages at completion of compulsory school, was measured at age 15, whereas the separations could occur at any time during childhood until then. In other words, most children had time to recover from any negative effects of their parents' separation. Second, the previous literature has argued that the effects of parental separation are most likely to be negative when it breaks up a well-functioning, low-conflict family (Dronkers 1999; Hanson 1999; Amato and James 2010). Even though the families in our subpopulation functioned well enough not to separate had the mother worked at a workplace with a different sex composition, it is probable that they had enough underlying problems to increase the chances of a workplace affair and a separation. Third, Frimmel et al. (2016) studied another country context (Austria) as well as other, more behavioral outcomes, which may be more sensitive to parental separation than school performance (Härkönen et al., 2017). Sweden is well known for its generous welfare state and low child poverty rates, which may limit the generalizability of our results to other contexts. However, earlier studies on the effects of parental separations (Jonsson and Gähler 1997; Björklund and Sundström 2006) have reported very similar estimates to those from other countries—and our estimates from regular regression models were also in line with these—and overviews of the literature have concluded that parental separation has similar effects across a range of countries and that any differences are not easy to systematize (Härkönen et al., 2017). This suggests that our results are not specific to the Swedish context. Fourth, we study cases in which the parents of the separated children may end up with new partners. The children may suffer from parental separation, but they could profit from the input in the parenting of the new partner. Within the cohorts included in our study, they may be affected by the 1990s recession in Sweden, which has led to a mismatch in the partner market (Engdahl et al., 2022). Swedish women may have married downward during this period and could possibly have found a more educated partner after the separation. In this case, the parental input from the partner could also have improved after the separation for the children and thereby cancelled out the negative effect of the parental separation.

Given that our estimates generalize to a particular subpopulation, do our results have broader implications for understanding parental separation effects? First, despite generalizing only to a specific subpopulation, our analysis contributes to the quest to understand the causal effects of parental separation. Second, as discussed earlier, because our subpopulation of separating parents would not have separated without being induced to separate by the share of opposite sex colleagues at the parental workplace, they probably had a "good enough" partnership (Amato, 200), in which conflicts and estrangement were not at a level where the union dissolution was almost unavoidable. Because such separations characterize a large fraction of current separations and divorces in countries where parental separation is common (Amato and Hohmann-Marriott 2007; Gähler and Palmtag 2015), the separating parents in our study are likely to share many relevant features of other separating parents, who dissolve their union for reasons other than finding a new partner at work.

Previous findings have shown that for a large share of children, parental separation does not have any discernible effects, either positive or negative (Amato and James 2010; Amato and Anthony 2014). Our findings are in line with these conclusions, suggesting that, on average, children whose parents dissolve a "good enough" union fare reasonably well, at least in terms of educational achievement in their adolescence. This contributes to the earlier literature, which has proposed that the effects of parental separation are likely to be negative when parents separate from a relatively well-functioning partnership (Amato et al., 1995; Dronkers 1999;

Hanson 1999; Booth and Amato 2001). These results have been largely correlational, and our results provide a causal estimate that questions these conclusions.

This study has contributed to research on the effects of parental separation by providing estimates that, within the subpopulation they generalize to, can be given a causal interpretation and by explicitly discussing both the type of causal effect that was estimated ("divorce-as-event" or "divorce-as-process") as well as the probable characteristics of the subpopulation and its relation to other separations. Future research can build on this work by considering other outcomes and contexts as well as focusing on other parts of the distribution of separations.

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CRediT authorship contribution statement

Michael Grätz: Conceptualization, Formal analysis, Writing – original draft, Writing – review & editing. **Juho Härkönen:** Conceptualization, Writing – original draft, Writing – review & editing.

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Appendix A. Supplementary data

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