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## Consequences of Parental Job Loss on the Family Environment and on Human Capital Formation: Evidence from Plant Closures

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DISCUSSION PAPER SERIES

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the Family Environment and on Human  
Capital Formation: Evidence from Plant  
Closures**

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## ABSTRACT

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# Consequences of Parental Job Loss on the Family Environment and on Human Capital Formation: Evidence from Plant Closures\*

We study the consequences of mothers' and fathers' job loss for parents, families, and children. Rich Swedish register data allow us to identify plant closures and account for non-random selection of workers to closing plants by using propensity score matching and controlling for pre-displacement outcomes. Our overall conclusion is positive: childhood health, educational and early adult outcomes are not adversely affected by parental job loss. Parents and families are however negatively affected in terms of parental health, labor market outcomes and separations. Limited effects on family disposable income suggest that generous unemployment insurance and a dual-earner norm shield families from financial distress, which together with universal health care and free education is likely to be protective for children.

**JEL Classification:** I12, J1

**Keywords:** parental unemployment, workplace closure, family environment, child health, human capital formation

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# 1 Introduction

We study the consequences of job loss for parents, families, and children. Firm startups and closures are an integral part of the process of economic growth and restructuring, generating overall gains. Workers who lose their jobs, however, pay a price, suffering long-term negative consequences on future employment, earnings, health, and marriage stability.<sup>1</sup> Because these factors are likely to affect the family environment in which children grow up and parental investments in child human capital, some of the burden of this restructuring process may be transmitted to the children of affected workers.<sup>2</sup> Understanding this transmission is important since childhood human capital development has consequences for childhood wellbeing and long-run socio-economic status (Cunha and Heckman, 2007; Almond and Currie, 2011).

While a number of studies show negative effects of *paternal* job loss on child health, schooling and labor market outcomes<sup>3</sup>, other studies find only limited or negligible effects (Bratberg et al., 2008; Hilger, 2016). Most studies tend to find negative effects on child health due to *maternal* job loss (e.g., Mörk et al., 2014; Bubonya Cobb-Clarke, 2017), yet some studies suggest positive effects of *maternal* job loss on educational outcomes (Rege et al., 2011; Schaller and Zerpa, 2019) and child health (Page et al., 2019). Our reading of the literature, summarized in detail in Appendix A Table A 1, is that the findings depend on the outcomes studied, which parent is exposed to job loss and the institutional context, such as access to unemployment insurance and other welfare institutions, and the extent to which maternal job loss implies withdrawal from the labor market.<sup>4</sup> Furthermore, the empirical methodology, i.e., how job loss is defined and the inability to sufficiently account for selection, can influence and possibly bias results (Page et al., 2009; Hilger, 2016).

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<sup>1</sup> Earlier evidence on negative effects of job loss includes Jacobsen et al. (1993), Eliason and Storrie (2006), Bratberg et al. (2008), Hilger (2016) on earnings and labor market outcomes; Sullivan and von Wachter (2009), Eliason and Storrie, (2009a,b), Eliason (2014), Browning and Heinesen (2012) on health outcomes; Schaller and Stevens, (2015) on health insurance coverage and health care utilization; and Eliason (2012), Huttunen and Kellokumpu (2016) on divorce.

<sup>2</sup> See, e.g., Francesconi and Heckman (2016) and Conger and Conger (2007) for reviews of the effects of parental investment and economic hardship on child human capital development.

<sup>3</sup> E.g., Lindo (2011), Schaller and Zerpa (2019), Bubonya Cobb-Clarke (2017), Rege et al. (2011), Stevens and Schaller (2011), Oreopoulos et al. (2008) and Page et al. (2019).

<sup>4</sup> Page et al., (2019) and Schaller and Zerpa, (2019) discuss how the labor supply response of mothers matter for child outcomes.

Mixed results, often based on small samples from different countries, a limited and different set of outcomes in each study, and a predominance of studies focusing on paternal job loss make it difficult to draw more general conclusions and assess why results diverge. This motivates us to analyze the consequences of both maternal and paternal job loss due to plant closures in 1995–2000 for factors that matter for the family environment, i.e., economic situation of parents and families, family separations and parental health, and children’s human capital formation, as measured by health, educational and early labor market outcomes. We do this in a unified framework and in a context with rich data availability, a dual-earner norm, and a well-developed welfare state.

We use population-wide Swedish register data, which has several advantages. A long data panel for the years 1987–2010 makes it possible to follow children’s human capital development in childhood and early adulthood and their family environments up to 8 years before and 10 years after a parent’s workplace closes. Population, tax and longitudinal labor market registers contain information on family links, earnings, unemployment, disposable income and social assistance receipts for parents and children, allowing us to assess the consequences for family financial resources and stability.<sup>5</sup> Registers of deaths and hospital discharges are used to analyze the consequences for the health of children and parents, the latter which may affect the home environment and parenting quality. These register-based measures are arguably more objective than the health outcomes available in surveys since self-evaluations and parental evaluations of child health may be affected by job loss.<sup>6</sup> Hospitalization discharges also capture relatively severe negative health conditions, which are likely to have long-run consequences for children (Currie, 2009). Education registers include both compulsory school GPA and information on high school completion, allowing us to study educational performance at different margins. Matched workplace-employee data are used to identify all workplace closures during the period 1995–2000, avoiding reporting errors and selection problems that are likely when relying on self-reported reasons for job loss.<sup>7</sup> We

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<sup>5</sup> Tax registers and labor market registers cover the population, ages 16–74.

<sup>6</sup> While Lindo (2011) and Liu and Zhao (2014) study outcomes that are easily measured (Lindo: birth weight; Liu and Zhao: height and weight for age), Bubonya et al. (2017), Schaller and Zerpa (2019) and Brand and Thomas (2014) focus on health measures that are more subjective, especially when reported by parents. Schaller and Zerpa also study health insurance coverage and health care utilization.

<sup>7</sup> Analyzing the causal effects of job loss, one would ideally like to observe workers who have experienced job loss as a result of an exogenous shock, but at the same time, one needs a sufficient number of children who have experienced parental job loss. As a compromise between these two goals, many earlier studies have focused on cases where a parent

can thus study a comparatively large population of families: our sample includes 141,533 children aged 2–18 suffering maternal or paternal job loss due to workplace closure.<sup>8</sup>

Following earlier Nordic studies analyzing the effects of plant closures (e.g., Browning et al., 2006; Eliason and Storrie, 2009 a, b), we use propensity score matching to account for the non-random selection of workers to closing workplaces. We match on a broad set of conditioning variables, including the pre-displacement health outcomes of both children and parents. Access to a long panel of data also allows us conduct placebo analyses comparing outcomes in the years preceding the job loss for children whose parents' workplaces close down at some future date to the outcomes of children whose parents' workplaces do not close down. This strategy makes it possible to assess the selection problems that arise when it is not possible to match on pre-displacement outcomes, as discussed in Hilger (2016).

The main contribution of the paper is to provide a comprehensive analysis of the consequences of parental job loss for family environments and human capital formation in childhood and early adulthood. We thus complement the earlier studies of the consequences of job loss for adults and children, which have typically focused on either adults or children and on either health, educational or labor market outcomes, and where a majority of the studies of consequences for children have focused on paternal job loss (see, e.g., Jacobsen et al., 1993; Eliason and Storrie, 2006, 2009a,b; Sullivan and von Wachter, 2009; Browning and Heinesen, 2012; and Huttunen and Kellokumpu, 2016 and papers cited in Appendix A Table A 1). More broadly, we contribute to the growing literature on how family environments and parents influence the human capital formation of children and young adults, reviewed in Francesconi and Heckman (2016). Our focus on the Nordic context is of particular relevance since, on the one hand, the financial consequences of job loss may be less severe due to generous unemployment insurance, universal health care, free education and less dependence on a single breadwinner income, but on the other hand, a strong dual-earner norm together with individual taxation and

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reports having suffered an involuntary job loss, resulting from either firm closure or dismissals, where the latter is likely endogenous to factors related to productivity and health.

<sup>8</sup> Most earlier studies from the US and Canada (see, e.g., Schaller and Zerpa, 2019, Brand and Thomas, 2014, Wigthman, 2012, Lindo, 2011, Coelli, 2011, Stevens and Schaller, 2011 and Page et al., 2009) rely on survey data, as do Bubonya et al. (2017) (Australian data), Peter (2016) (German data), Ruiz-Valenzuela (2015) (Spanish data), and Liu and Zhong (2014) (Chinese data). Because surveys are, by nature, limited to a small number of respondents, these studies have struggled with small sample sizes. An exception is Oreopoulos et al. (2009), who use Canadian register data.

high marginal tax rates may put greater stress on displaced mothers to find new employment.

Similar to earlier studies, including those in Sweden and other Nordic countries, we find that job displacements lead to lower future earnings and higher unemployment rates for both mothers and fathers. We find larger negative effects on household disposable income when fathers are displaced but more family separations when mothers experience job loss. Although our evidence points to weaker effects on financial resources than found in US studies, the effects are persistent for up to ten years. Our analysis of parental health outcomes shows increased mortality for displaced fathers and increased hospitalizations due to mental health problems and alcohol-related diagnoses for displaced mothers. Parental job loss thus negatively affects several important aspects of the childhood environment, with possible consequences for parenting quality, childhood resources and human capital formation.

Despite these negative effects on the family environment, our main finding is that the burden of job loss does not seem to spill over to child outcomes. Parental job loss due to workplace closures does not increase the likelihood of child hospitalization or mortality over a ten-year follow-up period. Instead, we find a small decline in hospitalization due to diagnoses related to mental illness, alcohol-related conditions, self-harm or exposure to abuse following paternal job loss. When studying educational and early adulthood outcomes, we find no effects of paternal job loss. Although we find small and statistically significant negative effects of maternal job loss on compulsory school GPA and high school completion and possibly small increases in the probability of receiving social assistance and being unemployed, the credibility of these results can be questioned. The estimates for GPA vary unsystematically with the timing of exposure to job loss, and for all of these outcomes, statistically significant pretreatment estimates of similar magnitude as the estimated effects indicate remaining negative selection in the treatment group compared to the matched control group. Even if we were to make a causal interpretation, the effects on long-term outcomes are estimated precisely enough to rule out large negative consequences for children following parental job loss.

Our findings are at odds with the earlier evidence on job loss on child health and schooling outcomes but in line with some of the previous findings in early adulthood.<sup>9</sup> In



spite of large sample sizes, we do not find negative effects of paternal job loss. Nor do we find positive effects of maternal job loss. These deviating findings may partly be driven by a better ability to account for non-random selection of families affected by job loss. It is also possible that welfare state institutions are able to cushion and insure against negative shocks to the family environment and, in particular, the effects of parental job loss by reducing the impact on disposable income and making investments in child human capital less sensitive to family financial and parenting resources.<sup>10</sup> A strong dual-earner norm also insures against the loss of one income and works against finding positive effects of maternal job loss.

The rest of the paper is organized as follows. First, we provide a short description of the Swedish institutional setting. Thereafter, we present the data and empirical strategy before turning to the results. Finally, we summarize and discuss our findings.

## **2 The Swedish setting**

The extent to which financial and psychological strain caused by parental job loss is passed on to children is likely to depend on institutional factors, such as whether the family is dependent on one income, incentives for female employment childcare arrangements, the organization of schools and health care, and the presence of unemployment insurance, active labor market programs and other forms of social assistance. This section will therefore present some institutional details about the Swedish setting that are of relevance for understanding the effects of parental job loss.

First, there is a strong dual income earner norm in Sweden. Individual taxation, high marginal tax rates, and earnings-related benefits for sick leave, parental leave and pensions provide strong economic incentives for both spouses to contribute to family income. Labor force participation is consequently high among both men and women. Lundin et al. (2008) show that even among mothers of pre-school aged children, 75–80 percent are employed. This implies that few families are dependent on just one breadwinner's income and that job loss is unlikely to cause women to drop out of the

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<sup>10</sup> Schaller and Stevens (2015) show that job loss in the US is associated with the loss of adult health care insurance coverage, which can potentially limit access to preventive care also for children.

labor force. Instead, women have incentives as strong as the incentives for men to regain employment.

Second, families have access to universal health care, childcare and free education, which implies that important inputs in the production of child human capital are not sensitive to family income or tied to parental employment. High-quality universal access childcare is subsidized to encourage labor force participation among parents. In the mid- and late 1990s, the time period when the job losses we study occurred, approximately 50 percent of 1–2-year-olds and 70 percent of 3–6-year-olds attended publicly subsidized childcare (Lundin et al., 2008). There are also universal and subsidized afterschool activities for school children in the lower grades. Free school meals are served to all children in compulsory school (ages 6–16) and high school (ages 17–19). University tuition is free, and subsidized student loans are available for all students. In addition, health care and prescription drugs are free of charge or heavily subsidized for children and heavily subsidized for adults.

Third, during the studied period, unemployed workers were typically covered by unemployment insurance benefits, with a replacement rate of 80 percent of lost earnings up to a ceiling. These generous replacement rates were combined with an active labor market policy, requiring benefit recipients to take part in labor market programs. Unemployed individuals with insufficient unemployment benefits or who did not qualify for unemployment benefits could apply for social assistance from the municipality if in need of financial support. Social assistance was means-tested at the household level and often conditioned on participation in activation programs.

### **3 Data**

The database used in the empirical analysis combines population-wide individual-level register data on Swedish residents from the following sources: the in-patient hospital discharge and causes-of-death registers provided by the National Board of Health and Welfare; the population, education, tax, and workplace registers<sup>11</sup> provided by Statistics

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<sup>11</sup> To follow firms and workplaces, Statistics Sweden has constructed a database on firm dynamics called ‘The database on dynamics of enterprises and establishments’, where changes have been carefully investigated to correctly categorize firm and workplace closures and separate true closures from mergers and other organizational changes. More specifically, workplaces are categorized as closed down if i) the workplace identifier disappears, and ii) at most 50 percent of the original workforce are found working in one establishment the following year, and iii) at most 50 percent of the workforce at the new establishment worked at the original workplace the previous year.

Sweden; and the Public Employment Service's register of job-seekers. The variables include individual demographic information (sex, age, country or region of origin, family links); socio-economic information (education level, earnings, total income and income from social assistance, unemployment spells); health (hospitalization, all causes and specific diagnoses, mortality); and workplace information (identifier, size, industry, county). Our data include information on all individuals aged 0–18 during the years 1987–2010 and information on their (biological) parents.

### 3.1 The sample

We sample children whose parents were employed at workplaces at risk of closing in 1995–2000. These years are chosen to allow a long follow-up period and for the observation of pretreatment outcomes. We define  $t$  as the base year when a workplace is potentially closed. For each base year, we include children who are at least two years old and at most 18 years old when the parents potentially experience a workplace closure. The sample hence includes cohorts born 1977–1998. We restrict our sample to children whose parents were employed and did not change workplace between  $t-2$  and  $t-3$ . To retain in the sample also ‘early leavers’, i.e., workers who leave the workplace just before the closure, we do not condition on working at the same workplace at  $t-1$ , the year directly before the potential closure. The reason is that early leavers are potentially a selected group. They may, on the one hand, be positively selected and have many options on the labor market and thus leave because they are able to find other employment in anticipation of the closure. On the other hand, early leavers may be negatively selected and be the first the employer wants to lay off if the workplace is downsized prior to closure. Finally, we exclude workplaces with fewer than ten employees because it is more likely that individual worker characteristics contribute to the closure of a small workplace.

A workplace is defined as closing in year  $t$  if a workplace existing in year  $t$  no longer exists in  $t+1$ . A child is considered treated, i.e., exposed to a parental workplace closure, if either parent worked at a workplace that was closed. As discussed above, a requirement for a worker to be included in the sample is to have worked at the workplace in  $t-2$  and  $t-3$ , but we do not put any restrictions on what happens in the following periods. Thus, we

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workplace the number of common workers in year 1 and 2 or number of employees year 2 is less than 50 percent and ii) the number of common workers in year 1 and 2 or number of employees year 1 is less than 50 percent.

compare the outcomes of children with displaced parents with the outcomes of children whose parents may or may not lose their job in the future. After appending all base years 1995–2000 and restricting the sample to children for whose parents we have information on the covariates used in the matching as well as information on the outcome variables, we are left with 56,509 children whose mothers experience job loss and 85,024 children whose fathers experience job loss.<sup>12</sup> For the children whose parents' workplace is not closed, we draw a random sample of 25 percent of the population.

The children and their parents are followed, for some outcomes, as far back as 8 years before the possible job displacement and up to 10 years after. To estimate placebo effects, we also sample individuals in the birth cohorts 1970–1977, who were exposed to parental job loss when they are 19–30 years old.

### **3.2 Definitions of outcome variables**

To investigate the effects of parental job loss on children's human capital development, we study child health, school outcomes and outcomes as young adults. To capture health, we first investigate to what extent children of displaced parents die prematurely (*mortality*). Death is arguably an extreme measure of health but is nevertheless an objective measure. Fortunately, very few young people die. However, this also means that we are less likely to capture any negative consequences focusing on mortality. Second, we study hospitalization and investigate whether a child has been hospitalized for any diagnosis (excluding pregnancy/child birth) (*hospitalization*).<sup>13</sup> This is a less dramatic and more common but still rather rare event. In our matched sample, only approximately 280 out of 1,000 children are hospitalized during the ten-year period following parental job loss. We also study cause specific health problems that could be a result of parental neglect or a stressful family environment, including (i) diagnoses related to conditions where hospitalization is avoidable if a child is given sufficient preventive care

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<sup>12</sup> 1.35 percent of the children have a displaced mother and 1.74 percent of the children have a displaced father.

<sup>13</sup> A concern is whether hospitalization captures poor health or whether it captures demand and availability of health care, and if these vary with social status. As health care for children is heavily subsidized or free of charge in Sweden, differences in financial resources should not affect the probability of being admitted. Moreover, earlier studies (see, e.g., Mörk et al., 2014) have shown that our hospitalization measures are strongly negatively correlated with family income. It is thus not the case that children with wealthy parents in general consume more health care.

(*avoidable*)<sup>14</sup> and (ii) diagnoses related to mental illness, alcohol-related conditions, self-harm or exposure to abuse (*mental and behavior*).<sup>15</sup>

To measure performance in compulsory school, we use the grade point average percentage rank in the national distribution in the final year (*GPA*) at age 16. We also investigate high school completion by age 20 (*high school*) and outcomes as young adults, more specifically, experience of any unemployment (*unemployed*) or living in a household receiving social assistance (*SA*) between ages 20–23.<sup>16</sup>

To explore possible pathways and mechanisms that operate through factors affecting the home environment and parenting quality, we analyze parental unemployment and earnings, family disposable income, dependence on social assistance and family separations and measures of parental health. Parental unemployment (*unemployed*) is measured as being registered as unemployed with the public unemployment service (PES) at least once during a calendar year. The measure of earnings combines annual earnings from employment and self-employment (*earnings*), and family disposable income includes all income sources of the household net of taxes and is adjusted for family size (*disposable income*).<sup>17</sup> Social assistance dependency is measured as a dummy taking the value one if the household receives any social assistance (*SA*) in a given year. The measure of family separation captures whether the biological parents are registered as living in separate households (*separated*). Parental health is measured using an indicator of parental mortality (*mortality*), whether the parent has been hospitalized (*hospitalization*), and hospitalization for diagnoses connected to excess alcohol consumption (*alcohol*) or mental health problems (*mental*).

### 3.3 Descriptive statistics

Table 1 compares child and parental characteristics measured two years before the potential workplace closure for parents at workplaces that close to the characteristics of

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<sup>14</sup> Avoidable conditions, sometimes referred to as ambulatory care-sensitive conditions, are conditions that should not be cause for hospitalization if properly cared for at an early stage. These conditions can be divided into three categories: conditions that can be prevented through vaccination; selected chronic conditions that can be managed by pharmaceuticals, patient education and lifestyle; and acute conditions for which hospitalization is commonly avoidable with antibiotics or other medical intervention. The frequency of avoidable conditions has been used as a measure of the quality of primary care. Billings et al. (1993), for example, study the association between socioeconomic status and hospitalization rates due to avoidable conditions among communities in the US. We use the definition of avoidable conditions for children suggested by the Public Health Information Development Unit in Australia (Page et al., 2007).

<sup>15</sup> See Table A2 for a detailed description of the diagnoses, including ICD codes, used to construct the health measures.

<sup>16</sup> An individual is defined as unemployed if he/she is registered as unemployed or participates in a labor market program at any occasion during the year. Data on unemployment are only available from 1992.

<sup>17</sup> Disposable income is calculated by Statistics Sweden and includes all types of income for all adults in the household.

children and parents at workplaces that continue to operate. Columns 3 and 4 provide the differences and p-values. Workplaces that close seem to be negatively selected in terms of both worker characteristics and the human capital of the workers' children. Children whose parents work at closing workplaces are somewhat younger and have lower GPA rank, and children whose mothers work at closing workplaces are more likely to be hospitalized already before the workplace closure. Workers at closing establishments are younger, have a lower education level, are less likely to be born in Sweden, have shorter tenure and are less likely to cohabit with their child's other biological parent. While mothers at closing workplaces have poorer health than mothers at surviving workplaces, there is no sign of such selection for fathers. We note that some workers are already registered as unemployed two years before the workplace is closed. Reasons could be that they are part-time unemployed or participating in a labor market program.

**Table 1 Summary statistics**

|                        | Surviving<br>workplace | Closing<br>workplace | Difference | (p-value) |
|------------------------|------------------------|----------------------|------------|-----------|
| Mother sample          |                        |                      |            |           |
| Child characteristics  |                        |                      |            |           |
| Boy                    | 0.49                   | 0.49                 | -0.00      | 0.00      |
| Age                    | 8.77                   | 8.55                 | 0.22       | 0.00      |
| Hospitalization        | 45.25                  | 46.29                | -1.04      | 0.25      |
| Mental and behavior    | 1.56                   | 1.82                 | -0.26      | 0.13      |
| Avoidable              | 6.29                   | 6.65                 | -0.37      | 0.28      |
| GPA rank at age 16     | 53.05                  | 50.16                | 2.89       | 0.00      |
| Mother characteristics |                        |                      |            |           |
| Age                    | 37.95                  | 37.49                | 0.46       | 0.00      |
| Compulsory education   | 0.12                   | 0.16                 | -0.04      | 0.00      |
| Secondary education    | 0.50                   | 0.53                 | -0.03      | 0.00      |
| University education   | 0.38                   | 0.31                 | 0.07       | 0.00      |
| Swedish born           | 0.90                   | 0.88                 | 0.02       | 0.00      |
| Separated              | 0.18                   | 0.22                 | -0.04      | 0.00      |
| Tenure                 | 4.94                   | 4.44                 | 0.50       | 0.00      |
| Unemployed             | 0.06                   | 0.09                 | -0.02      | 0.00      |
| Disposable income      | 366,377                | 362,523              | 3,854      | 0.00      |
| Income                 | 186,236                | 185,518              | 718        | 0.05      |
| Social assistance      | 0.04                   | 0.05                 | -0.01      | 0.00      |
| Hospitalization        | 50.79                  | 55.23                | -4.44      | 0.00      |
| Alcohol                | 0.56                   | 1.08                 | -0.52      | 0.00      |
| Mental                 | 2.26                   | 3.06                 | -0.80      | 0.00      |
| No obs.                | 1,004,172              | 56,509               |            |           |
| Father sample          |                        |                      |            |           |
| Child characteristics  |                        |                      |            |           |
| Boy                    | 0.49                   | 0.49                 | -0.00      | 0.93      |
| Age                    | 7.80                   | 7.69                 | 0.11       | 0.00      |
| Hospitalization        | 52.64                  | 52.34                | 0.31       | 0.70      |
| Mental and behavior    | 1.61                   | 1.54                 | 0.07       | 0.62      |
| Avoidable              | 8.77                   | 8.70                 | 0.07       | 0.84      |
| GPA rank at age 16     | 52.64                  | 50.38                | 2.27       | 0.00      |
| Father characteristics |                        |                      |            |           |
| Age                    | 39.20                  | 39.01                | 0.19       | 0.00      |
| Compulsory education   | 0.19                   | 0.20                 | -0.00      | 0.01      |
| Secondary education    | 0.48                   | 0.48                 | -0.01      | 0.00      |
| University education   | 0.33                   | 0.32                 | 0.01       | 0.00      |
| Swedish born           | 0.90                   | 0.89                 | 0.01       | 0.00      |
| Separated              | 0.16                   | 0.17                 | -0.01      | 0.00      |
| Tenure                 | 5.21                   | 4.64                 | 0.57       | 0.00      |
| Unemployed             | 0.06                   | 0.09                 | -0.03      | 0.00      |
| Disposable income      | 368,028                | 368,447              | -419       | 0.93      |
| Income                 | 304,597                | 301,808              | 2,789      | 0.00      |
| Social assistance      | 0.03                   | 0.04                 | -0.01      | 0.00      |
| Hospitalization        | 44.63                  | 43.95                | 0.68       | 0.35      |
| Alcohol                | 1.61                   | 1.55                 | 0.05       | 0.71      |
| Mental                 | 2.81                   | 2.67                 | 0.14       | 0.45      |
| No obs.                | 1,193,596              | 85,024               |            |           |

Notes: All variables measured in  $t - 2$ . Hospitalization, avoidable, mental and behavior, mental health problems, and alcohol-related problems are measured as persons per 1,000 hospitalized at least once during the year. Tenure is censored at 7 years; unemployment is measured as being registered at the PES as unemployed or in an active labor market program. GPA rank reported at 16 years old. GPA rank samples include 3,201 children with displaced mothers and 3,922 children with displaced fathers.

## 4 Empirical approach

The aim of this paper is to analyze whether there is a causal effect of parental job displacement on the family environment in which children grow up and on child human capital outcomes. However, workplace closures are not randomly allocated; in fact, the descriptive statistics presented above suggest that workers who experience job loss due to workplace closures are negatively selected. This section adopts the potential outcome framework proposed by Rubin (1974) to illustrate how we handle this methodological challenge.

We consider the binary treatment  $T$ , taking the value 1 if the parent's workplace is closed down and 0 otherwise. Let  $Y^0$  denote the potential outcome if  $T = 0$  and  $Y^1$  denote the potential outcome if  $T = 1$ . Our aim is to estimate the average treatment effect on the treated (ATET), i.e.,

$$\tau = E[Y^1 - Y^0 | T = 1] = E[Y^1 | T = 1] - E[Y^0 | T = 1] \quad (1)$$

Since the observed outcome for an individual is  $Y = TY^1 + (1 - T)Y^0$ , it is not possible to observe  $E[Y^0 | T = 1]$ . Let  $X$  be a vector of covariates not affected by the treatment. Under the assumptions of conditional mean independence and overlap<sup>18</sup>, the ATET is given by

$$E[Y^1 - Y^0 | T = 1, X] = E[Y^1 | T = 1, X] - E[Y^0 | T = 0, X] \quad (2)$$

However, matching on the potentially high-dimensional vector  $X$  is very demanding on data. We therefore follow Rosenbaum and Rubin (1983) and condition on the propensity score  $P(X) = P(T = 1 | X)$ , where  $0 < P(X) < 1$ , in which case the ATET is given by

$$\begin{aligned} E[Y^1 - Y^0 | T = 1, P(X)] = \\ E[Y^1 | T = 1, P(X)] - E[Y^0 | T = 0, P(X)] \end{aligned} \quad (3)$$

### 4.1 Implementation

When estimating the propensity score, it is important to condition on all confounders that are likely to affect both the probability of being exposed to a workplace closure and the

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<sup>18</sup> Conditional mean independence:  $Y^0 | T, X$  ; Overlap  $P(T = 1 | X) < 1$ .



outcome of interest. In our conditioning set, we include the following variables, measured at baseline, two and, for some variables, three years before the potential workplace closure: child sex and age; whether the biological parents live together; indicators for whether the child or the parents are hospitalized for any cause; parents' educational attainment, immigration status and time as residents in Sweden; household disposable income; household social assistance benefits; parental unemployment spells; worker earnings and tenure as well as the size and industry of the firm. Finally, we also control for the county and base year. Our conditioning set is thus similar to what has been used in earlier Swedish studies (see, e.g., Eliason and Storrie, 2009 a, b), with the addition of child characteristics. A complete and detailed list of the included covariates and functional forms can be found in Appendix B Table A 3.

The propensity score is estimated using a logistic regression model. We match on the nearest neighbor with replacement and use the Abadie and Imbens (2016) estimator to estimate robust standard errors. Figure A 1 in Appendix C shows the distributions of the propensity scores for displaced and non-displaced mothers and fathers. The figure shows that there is considerable overlap across the two groups, and we therefore conclude that the common support assumption is fulfilled. Figure A 2 in Appendix C shows the standardized difference in percent across covariates in the unmatched and matched samples. The matching reduces the bias in both the mothers' and fathers' samples. The standardized differences, an indicator suggested by Rosenbaum and Rubin (1985), are less than 1.5 percent for all covariates. This is far below the commonly suggested threshold of 20. We conclude that our matching is successful.

## 4.2 Econometric specifications

When analyzing effects on the worker's, i.e., the parent's, unemployment, earnings and family disposable income, we adopt an event study framework and estimate  $\tau_y$  for each year  $y$  both before (up to eight years) and after (up to ten years) the workplace closes down at time  $t$ . The ATET for each year  $y$  is

$$\tau_y = E(Y_y^1 - Y_y^0 | T = 1, P(X)) \quad y = \{t - 8, \dots, t, \dots, t + 10\} \quad (4)$$

The estimates for the years prior to the workplace closure serve as placebo tests to evaluate whether there are underlying differences between the treatment and the control

group. When analyzing the effects on mortality and separation, we instead estimate the cumulative effect up to year  $y$ .

When analyzing the effects on hospitalization for both parents and children, we generate a dummy variable taking the value one if the individual has been hospitalized at least once the first ten years following the workplace closure. Hence, the ATET is given by

$$\tau_{post} = E(Y_{post}^1 - Y_{post}^0 | T = 1, P(X)) \quad (5)$$

where  $Y_{post}^1$  and  $Y_{post}^0$  denote the potential outcomes for the aggregated variables. In addition, we generate a dummy variable taking the value one if the individual has been in that state at least once during the years  $y = t - 5, \dots, t - 3$ , that is, before the workplace closure in year  $t$ . The placebo effect is then given by

$$\tau_{pre} = E(Y_{pre}^1 - Y_{pre}^0 | T = 1, P(X)) \quad (6)$$

For outcomes observed only once, such as high school completion at age 20 and whether the child receives social assistance or unemployment benefits at some point at age 20–23, we consider cohorts that are treated at different ages in childhood.<sup>19</sup> For example, for high school completion at age 20, we can measure the outcome for children who were 6–18 years old when treated (the earliest cohort is born in 1990). Let  $age$  denote age at treatment. Then, the ATET on high school completion is given by

$$\tau_{post} = E(\sum_{age=5}^{age=18} Y_{age}^1 - \sum_{age=5}^{age=18} Y_{age}^0 | T = 1, P(X)) \quad (7)$$

When analyzing the effects on final compulsory school GPA, which is only observed once for each individual (at age 16), the ATET for each year  $y$  is estimated for different cohorts. Thus,  $\tau_{16}$  is the effect for children who experience parental job loss at age 16, while  $\tau_{15}$  is the effect for children who experience parental job loss at age 15. To estimate a placebo model, we focus on children who experienced parental job loss after the

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<sup>19</sup> Since the data cover the years 1987–2010, we can only study outcomes at age 20 for children exposed to a potential workplace closure at age 6 or older.

outcome of interest was realized; for example, for high school completion at age 20, the pretreatment effect is measured for individuals who were exposed to parental job-displacement at 23–30 years of age:

$$\tau_{pre} = E(\sum_{age=23}^{age=30} Y_{age}^1 - \sum_{age=23}^{age=30} Y_{age}^0 | T = 1, P(X)) \quad (8)$$

## 5 Results

We first present estimates of the effects of workplace closures on the family environment, i.e., effects on the displaced parent and on the family. It is likely that the effects of workplace closure on children occur via effects on the parents and the home environment. We investigate parental unemployment, earnings, disposable family income, family separations and parental mortality and hospitalizations. Then, we turn to the effects on the children and investigate the effects on mortality, hospitalization, GPA, the likelihood of having a high school diploma by age 23, and the likelihood of receiving social assistance or being unemployed at age 20–23.

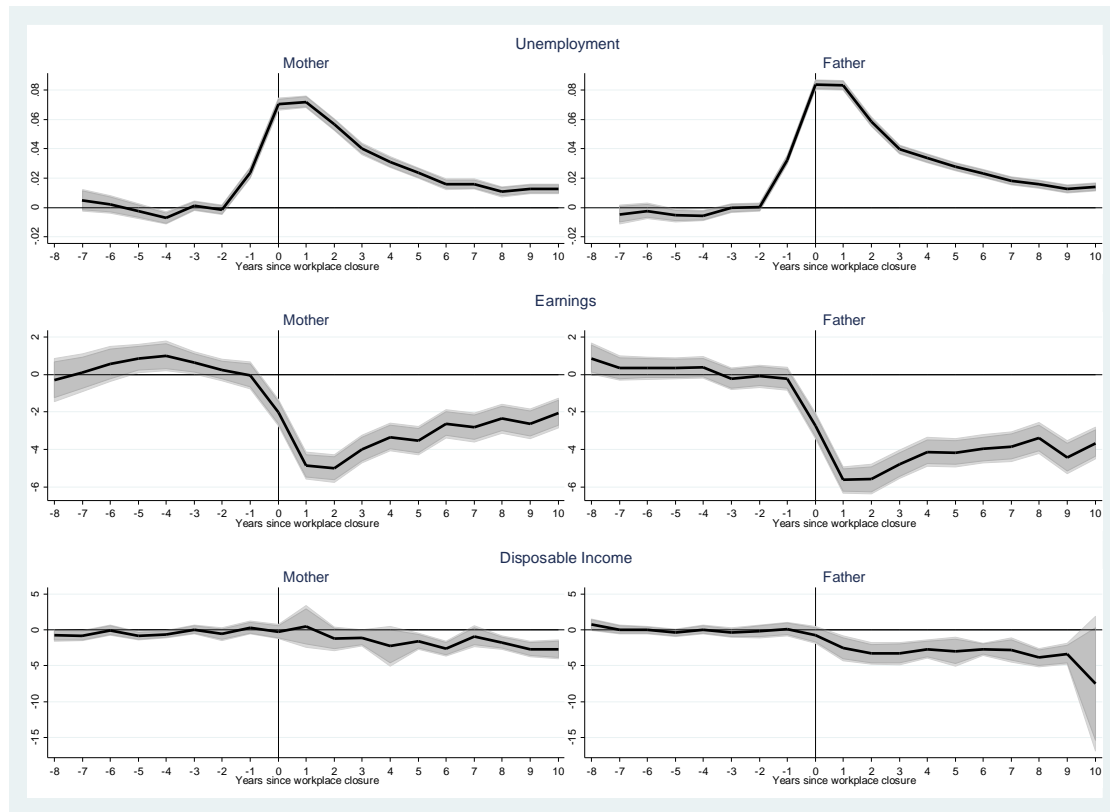
### 5.1 The effects of parental job loss on parental and family outcomes

Figure 1 shows the difference in the fraction employed (top panel), earnings (middle panel) and disposable income (bottom panel) between mothers (left) and fathers (right) who are exposed to a workplace closure and to parents in the matched control group, seven years prior to the exposure and up to ten years after. These estimates correspond to the ATET in equation (4). The dark gray area indicates the 90 percent confidence interval, and the light gray area indicates the 95 percent confidence interval.<sup>20</sup>

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<sup>20</sup> The estimated coefficients and number of observations for the results displayed in Figure 1–Figure 4 are available in the appendix D Table A 4–Table A 9.

**Figure 1 Parental outcomes: Unemployment (fraction), Earnings (percent) and Disposable income (percent) 8(7) years before and up to 10 years after closure**



Note: Estimated using propensity score matching (nearest neighbor with replacement). Standard errors take into account that the propensity score is estimated. The dark (light) gray area indicates the 90 % (95 %) confidence interval. Unemployment has only been observed in the data since 1992; therefore, the pre-period is only 7 years instead of 8.

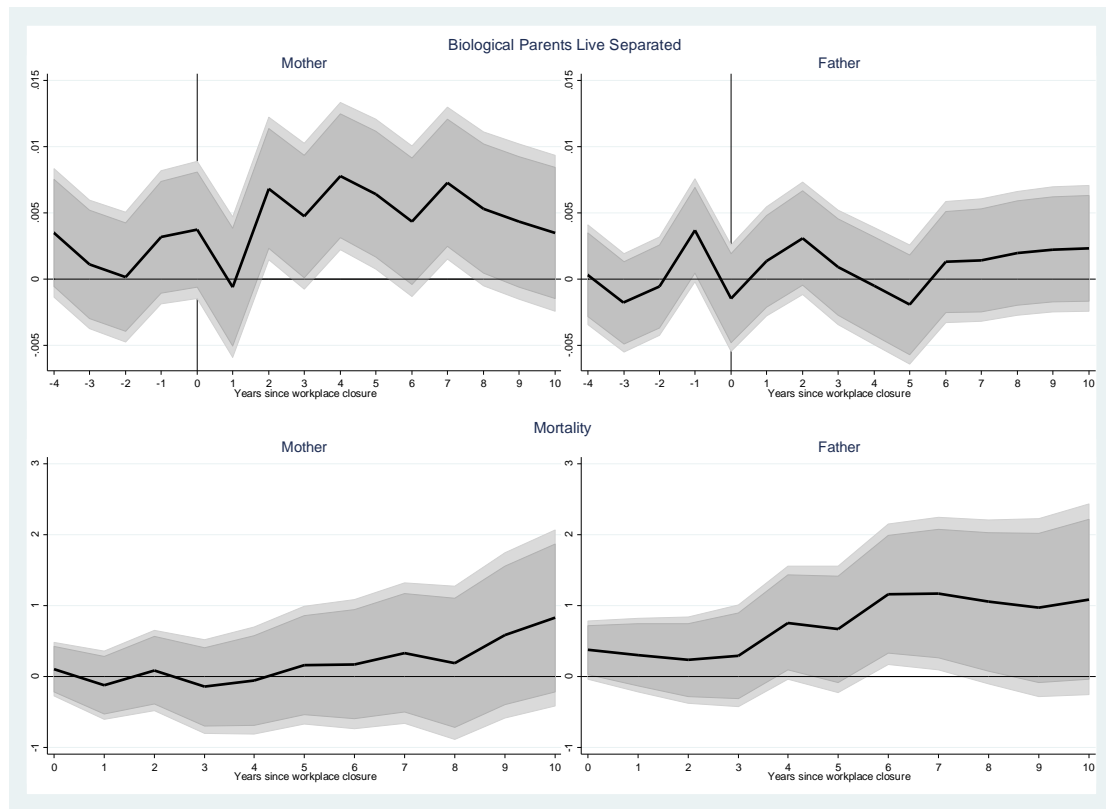
Starting with unemployment, it is clear from the figure that there are very small differences between the treatment and control groups two years or more prior to the workplace closure. However, once the workplace closes, unemployment increases sharply for both affected mothers and fathers. In the year of closure and the following year, the increase relative to the control workers is 7.2 percentage points for mothers and 8.4 percentage points for fathers, which implies an increased unemployment risk of 81 percent for mothers and 100 percent for fathers compared to the average levels of unemployment in these years for the control group. The increased unemployment risk diminishes gradually over time, but even after 10 years, there is an elevated risk of unemployment among parents who were displaced (1.3 percentage points or 15 percent for mothers and 1.4 percentage points or 17 percent for fathers). Earnings drop by 5–6 percent for both mothers and fathers once the workplace closes and then slowly recover. However, 10 years after the workplace closed, earnings are still approximately 4–5

percent lower for the displaced parents than for their controls. Disposable income in treated families shows a small but persistent decline compared to their matched controls. The decline is approximately 2–3 percent when mothers’ workplaces close and somewhat larger when fathers’ workplaces close, particularly in the years just after the workplace closure.

Figure 2 shows the effects of job loss on family separations (top panel) and parental mortality (bottom panel). The results suggest that family separations increase as mothers’ workplaces close. Two and three years after workplace closure, the share of separated families increases by between 0.5 and 1 percentage points compared to the control group. As 27 percent of the children in the control group did not live with both their biological parents two years after the job loss, this corresponds to an increase of 2–3 percent. After ten years, there is no statistically significant difference between families at closing and surviving workplaces. One interpretation of this result is that job loss affects the timing of separation in families that eventually would have split anyway.

The bottom panel of Figure 2 plots the cumulative excess parental deaths per 1,000 that is due to job loss for each year up to 10 years after the workplace closure. The risk of death increases relative to the control group both for mothers and fathers as their workplaces close, but the increase is only statistically significant for fathers. There is one additional death per thousand fathers 6–7 years after the workplace closure, which corresponds to a 10 percent increase.

**Figure 2 Effect of exposure to job loss the likelihood of biological parents being separated (share) and on parental mortality (number of deaths per 1,000)**



Note: Estimated using propensity score matching (nearest neighbor with replacement). Standard errors take into account that the propensity score is estimated. The dark (light) gray area indicates the 90 % (95 %) confidence interval.

Next, we study whether parents exposed to job loss are more likely to be admitted to the hospital after closure of the workplace.<sup>21</sup> The results in Table 2, corresponding to equation (5), show a statistically significant effect on hospitalization for conditions related to mental health and alcohol for mothers. Compared to the average likelihood of being admitted to the hospital, being exposed to a workplace closure increases the likelihood of being hospitalized for mental health problems by 10 percent and for alcohol-related conditions by 16 percent. The results for fathers are shown in the lower panel. We find no evidence of significant effects on hospitalization for fathers.

As a placebo model, we also show the differences in hospitalization between treated and untreated workers 3–8 years before workplace closure (equation (6)). As the estimates

<sup>21</sup> In Mörk et al. (2019), we also provide the results from an event study approach, where we compare yearly differences in hospitalization rates for treated and matched control sample eight years before up to ten years after the workplace closes. These results point in the same direction, but given that hospitalization is a relatively rare event, the point estimates vary much between years, and standard errors are large.

are small and statistically nonnsignificant, we conclude that there is no evidence that the results are driven by selection.

**Table 2 Effect of exposure to job loss on the probability of parental hospitalization**

|  | Hospitalization  | Mental health      | Alcohol           |
|--|------------------|--------------------|-------------------|
| <i>Mother at closing workplace</i>     |                  |                    |                   |
| Effect 0-10 years <i>after</i> closure | 1.154<br>(2.971) | 2.758**<br>(1.015) | 1.568*<br>(0.618) |
| # observations                         | 1,041,576        | 1,041,576          | 1,041,576         |
| # treated children                     | 55,474           | 55,474             | 55,474            |
| Mean of outcome variable               | 352              | 28                 | 10                |
| Effect 3-8 years <i>before</i> closure | 0.555<br>(2.782) | -0.0358<br>(0.584) | -0.430<br>(0.292) |
| # observations                         | 1,051,724        | 1,051,724          | 1,051,724         |
| # treated children                     | 55,878           | 55,878             | 55,878            |
| <i>Father at closing workplace</i>     |                  |                    |                   |
| Effect 0-10 years <i>after</i> closure | 2.961<br>(2.403) | 0.171<br>(0.843)   | -0.524<br>(0.655) |
| # observations                         | 1,237,751        | 1,237,751          | 1,237,751         |
| # treated children                     | 82,078           | 82,078             | 82,078            |
| Mean of outcome variable               | 326              | 28                 | 17                |
| Effect 3-8 years <i>before</i> closure | 0.470<br>(2.039) | 0.349<br>(0.503)   | 0.144<br>(0.366)  |
| # observations                         | 1,252,236        | 1,252,236          | 1,252,236         |
| # treated children                     | 83,063           | 83,063             | 83,063            |

Note: Standard errors in parentheses, \*\*  $p < 0.01$ , \*  $p < 0.05$  Estimated using propensity score matching. Standard errors take into account that the propensity score is estimated. Means are calculated using the matched sample.

To conclude, our results show that the family environments of children are adversely affected by parental job loss in a number of ways. The effects of job loss on the labor market outcomes of parents, situation of the family and parental health show effects that are in line with what has been found in the earlier literature for the Nordic countries. First, we find that parental unemployment rises sharply with job loss by some 7–9 percentage points. There is also a small increase in unemployment risk ten years after job loss. This is somewhat smaller than the 13 percent increase found in Eliason and Storrie (2006) for Swedish workers, including non-parents, but larger than the 5 percent increase reported for Norwegian parents in Rege et al. (2011). Our finding of a 2–6 percent decline in earnings in the years after workplace closure is similar to the effects found in Eliason

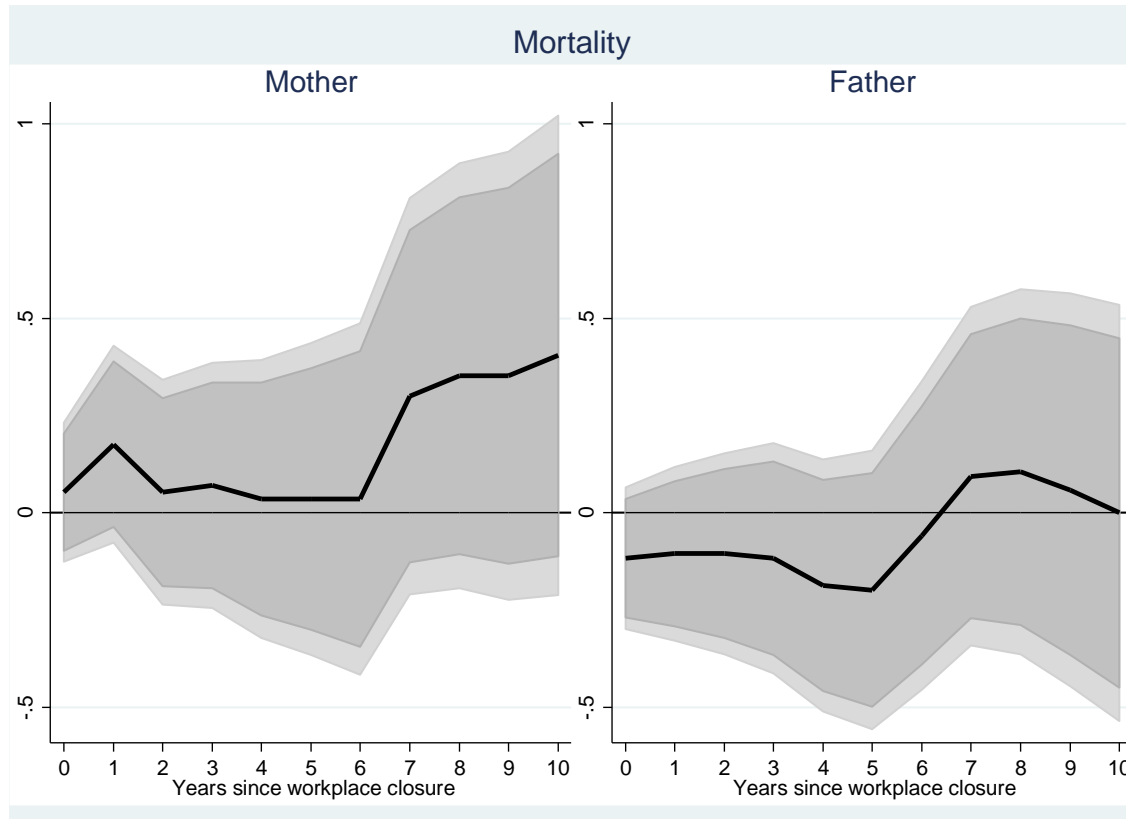
(2009, 2011) but smaller than the effects found for Norwegian parents in Rege et al. (2011) and Bratberg et al. (2008), who find a reduction of 5-10 percent, and in most studies from North America. The effects on disposable income are, however, modest, indicating that the Swedish safety net in the form of generous unemployment benefits succeeds in insuring families from large negative income shocks. Finally, we find a limited increase in family separations if mothers lose their job, but negative health effects for both mothers and fathers: for mothers in the form of increased hospitalizations for psychiatric and alcohol related conditions and for fathers in the form of increased mortality.

## **5.2 The effects of parental job loss on child outcomes**

Next, we turn to the children of the affected workers and show the effects on health, education and outcomes in early adulthood. Figure 3 shows how parental job loss due to workplace closure affects the cumulative difference in deaths per 1,000 children, up to 10 years after workplace closure. The graph to the left shows the effects of maternal job loss, and the graph to the right shows the effects of paternal job loss. For maternal job loss, there is an increase, although not statistically significant, in child deaths. The estimate for paternal job loss is zero.



**Figure 3 Effect of exposure to parental job loss on the cumulative number of deaths per 1,000 children**



Note: Estimated using propensity score matching. The matching method used is the nearest neighbor with replacement. Standard errors take into account that the propensity score is estimated. The dark gray area indicates the 90 % confidence interval, whereas the light gray area indicates the 95 % confidence interval.

The effects on hospitalization are presented in Table 3. We estimate equation (5) for overall hospitalizations, hospitalizations due to avoidable diagnoses and hospitalizations due to diagnoses related to mental illness, alcohol-related conditions, self-harm and exposure to abuse (mental and behavior).<sup>22</sup> The top panel shows the effect of maternal job loss, and the bottom panel shows the corresponding effects of paternal job loss.

The estimates of the difference in hospitalization during the first ten years after parental job loss between treated children and their matched controls are typically economically and statistically insignificant. For example, the estimate for experiencing maternal job loss indicates an increase in hospitalization rate of 1.8 more children per

<sup>22</sup> In Mörk et al. (2019), we also provide results from an event study approach, where we compare yearly differences in hospitalization rates for the treated and matched control sample eight years before and up to ten years after the workplace closes. These results point in the same direction, but given that hospitalization is a relatively rare event, the point estimates vary much between years, and the standard errors are large.

1,000, which corresponds to an increase of 0.6 percent compared to the mean of 278. The only statistically significant result is a decrease of 2.8 hospitalizations per 1,000 children for diagnoses related to mental and behavior in the ten years post paternal job loss, corresponding to a decline of 8.3 percent compared to the mean, which is approximately 33 hospitalizations per 1,000 children.

We also show placebo estimations of the difference in hospitalization between treated and matched control children 3–5 years *before* the workplace closure. These estimates for the pretreatment period are informative about whether the pretreatment trends in the treatment and control groups are similar. As is clear from the table, we cannot reject that the estimates for the pretreatment period are zero, rendering credibility to the estimated effects for the post-treatment period.

**Table 3 Effect of exposure to parental job loss on the probability of hospitalization 0–10 years after closure**

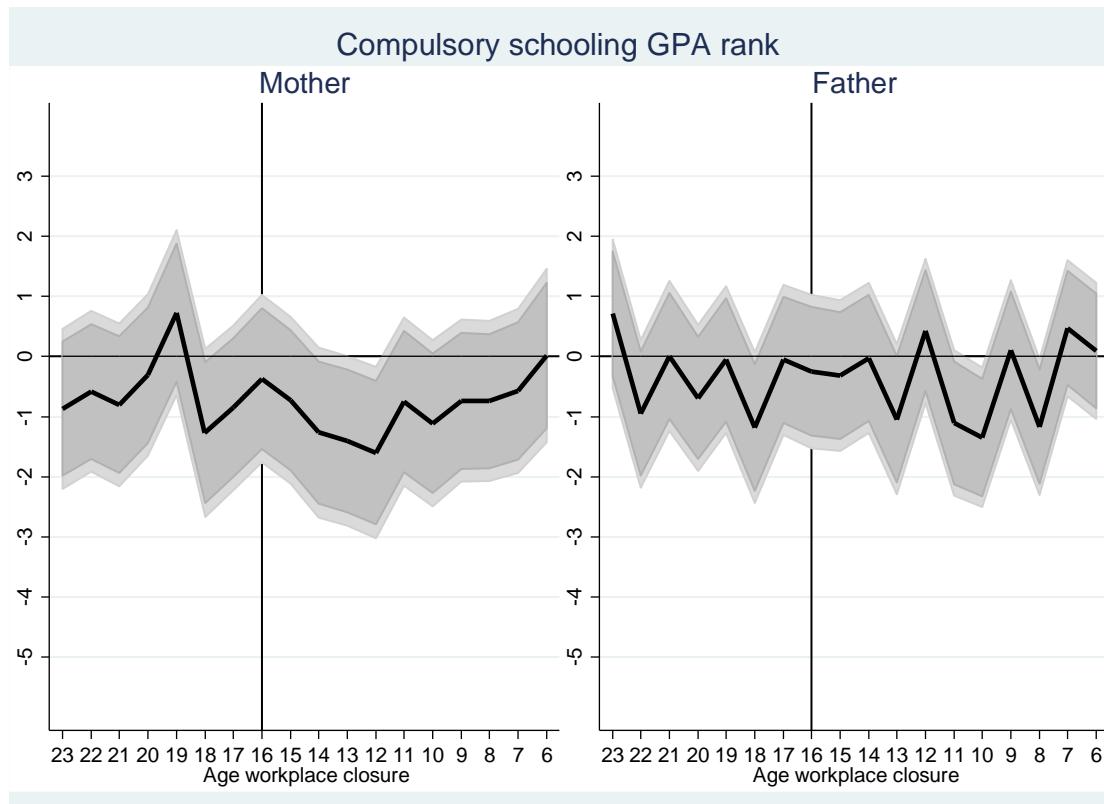
|  | Hospitalization    | Avoidable         | Mental and behavior |
|--|--------------------|-------------------|---------------------|
| <i>Mother at closing workplace</i>     |                    |                   |                     |
| Effect 0-10 years <i>after</i> closure | 1.796<br>(2.785)   | -0.345<br>(1.069) | 0.417<br>(1.171)    |
| # observations                         | 1,033,977          | 1,033,977         | 1,033,977           |
| # treated children                     | 55,114             | 55,114            | 55,114              |
| Mean of outcome variable               | 278                | 30                | 37                  |
| Effect 3-5 years <i>before</i> closure | 1.875<br>(2.171)   | 0.918<br>(0.977)  | 0.0987<br>(0.379)   |
| # observations                         | 960,923            | 960,923           | 960,923             |
| # treated children                     | 50,665             | 50,665            | 50,665              |
| <i>Father at closing workplace</i>     |                    |                   |                     |
| Effect 0-10 years <i>after</i> closure | -0.0665<br>(2.282) | 0.647<br>(0.893)  | -2.755**<br>(0.917) |
| # observations                         | 1,245,045          | 1,245,045         | 1,245,045           |
| # treated children                     | 82,750             | 82,750            | 82,750              |
| Mean of outcome variable               | 277                | 31                | 33                  |
| Effect 3-5 years <i>before</i> closure | 0.740<br>(1.902)   | 0.890<br>(0.880)  | 0.000<br>(0.338)    |
| # observations                         | 1,064,475          | 1,064,475         | 1,064,475           |
| # treated children                     | 70,264             | 70,264            | 70,264              |

Note: The dependent variable is an indicator taking the value zero if the child is not hospitalized during the whole time period and one if the child is hospitalized at least once during the period. Standard errors in parentheses, \*\*  $p < 0.01$ , \*  $p < 0.05$ . Estimated using propensity score matching. Standard errors take into account that the propensity score is estimated. Means are calculated using the matched sample.

We turn to educational achievement and estimate the effect of parental job loss on final compulsory school grades (9th grade at age 16). We only observe children's compulsory school GPA rank when they graduate from compulsory school at age 16. Therefore, the time that has elapsed between treatment and observation of the outcome will be different for different cohorts, depending on how old the child was when the parent's workplace closed. Figure 4 shows the effects on GPA percentile rank in the 9<sup>th</sup> grade for children who were of different ages when the parents experienced a job loss, corresponding to equation (4). The estimate for "Age workplace closure 16" corresponds to the difference in GPA rank between treated children and their matched controls for when a parent workplace closes in the calendar year when the child turns 16, which is the graduation year, and the estimate for "Age workplace closure 15" corresponds to the effect for those treated one year before graduation. The placebo estimates for the "pre-period" measures the difference in GPA for treated and control children who were older than 16 at the time of parental job loss and thus had already graduated. Figure 4 shows the estimated effects for children exposed to parental workplace closure between ages 6 (i.e., 10 years before graduation) and 23 (7 years after graduation).

The estimates presented in Figure 4 vary across ages, and the confidence intervals are wide enough to include zero change for most ages. For children whose mother's workplace closed three to five years before they graduated from compulsory school, i.e., when they were 12–14 years old, there is a statistically significant negative effect of 1.5 percentile ranks, which corresponds to approximately 5 percent of a standard deviation. There are also significant negative point estimates for children who were 9–10 and 7 years old when exposed to paternal job loss. However, the instability of the estimates and the presence of statistically significant estimates for the children who had already graduated when their parent was displaced do not support a causal interpretation of these results.

**Figure 4 Effect of exposure to parental job loss on GPA rank percentile at age 16 for children graduating in the years after closure**



Note: Estimated using propensity score matching (nearest neighbor with replacement). Standard errors take into account that the propensity score is estimated. The dark (light) gray area indicates the 90 % (95 %) confidence interval.

The results, corresponding to the models specified in (7) and (8) for outcomes in young adulthood for children who were 5–18 years old when exposed to parental job loss, are presented in Table 4. The estimates in the first row show a small negative effect of mother’s job loss on high school completion by age 20 (0.6 percent). There is also an increase in the likelihood of living in a household that receives social assistance (6.3 percent) and an increase in unemployment (1.3 percent) at ages 20–23. Turning to the placebo estimates, which show effects for individuals whose parents experience job loss *after* the outcome was observed, when the individuals were 22 or older, we find that the former group is less likely to finish high school (1.9 percent) and more likely to receive social assistance (9.8 percent) and experience unemployment (2.1 percent). Hence, these individuals seem to be negatively selected with respect to labor market outcomes, suggesting that the estimated significant effects in the first panel are driven by selection. The estimated effects of father’s job loss on high school completion and unemployment

are small and statistically insignificant. There is a small positive effect on the probability of receiving social assistance, but as the placebo effect is also positive and of the same magnitude, we conclude that there is no causal effect of being exposed to paternal workplace closure on later outcomes.

**Table 4 Effect of exposure to parental job loss on long-term outcomes: High school diploma by age 20, social assistance and unemployment at age 20–23**

|   | High school<br>completion at age<br>20 | Social assistance<br>age 20–23 | Unemployed age<br>20–23 |
|---|--|--------------------------------|-------------------------|
| <i>Mother at closing workplace</i>      |  |                                |                         |
| Parent workplace closure<br>at age 6–18 | -0.00500**<br>(0.00249)                | 0.00476**<br>(0.00232)         | 0.00661*<br>(0.00360)   |
| # observations                          | 770,580                                | 781,081                        | 781,081                 |
| # treated children                      | 40,412                                 | 41,076                         | 41,076                  |
| Mean of outcome variable                | 0.829                                  | 0.117                          | 0.479                   |
| Parent workplace closure<br>at age >22  | -0.0104**<br>(0.00528)                 | 0.0187***<br>(0.00398)         | 0.0132***<br>(0.00496)  |
| # observations                          | 380,587                                | 414,787                        | 414,745                 |
| # treated children                      | 18,672                                 | 20,170                         | 20,169                  |
| Mean of outcome variable                | 0.544                                  | 0.190                          | 0.627                   |
| <i>Father at closing workplace</i>      |  |                                |                         |
| Parent workplace closure<br>at age 6–18 | -0.000566<br>(0.00215)                 | 0.00562***<br>(0.00203)        | 0.00471<br>(0.00315)    |
| # observations                          | 820,550                                | 833,509                        | 833,509                 |
| # treated children                      | 53,913                                 | 54,786                         | 54,786                  |
| Mean of outcome variable                | 0.834                                  | 0.117                          | 0.453                   |
| Parent workplace closure<br>at age >22  | -0.00121<br>(0.00323)                  | 0.00790**<br>(0.00366)         | 0.00204<br>(0.00456)    |
| # observations                          | 338,630                                | 368,065                        | 368,031                 |
| # treated children                      | 22,307                                 | 24,064                         | 24,062                  |
| Mean of outcome variable                | 0.560                                  | 0.634                          | 0.183                   |

Note: Standard errors in parentheses, \*\* p<0.01, \* p<0.05. Estimated using propensity score matching. Standard errors take into account that the propensity score is estimated. Means are calculated using the matched sample.

To conclude, parental job loss does not seem to have large negative consequences for children, although parents are hurt in a number of ways. First, we do not find any evidence of increased mortality or increased hospitalizations among the exposed children; hence, we do not confirm previous negative effects on health, found in, e.g., Schaller and Zerpa (2019) and Page et al. (2019). Instead, we find a small decline in hospitalization due to diagnoses related to mental illness, alcohol-related conditions, self-harm or exposure to

abuse (mental and behavior) following paternal job loss. This result is in line with earlier evidence in Angelini et al. (2018), who find that adolescents and young adults who are affected by paternal unemployment tend to become more conscientious and less neurotic. Page et al. (2017) instead find that a worse labor market for mothers *improves* health. Second, we do not find any convincing evidence of negative (or positive) effects on educational outcomes measured by GPA at 9th grade or high school completion, as implied by earlier evidence in Rege et al. (2011), Stevens and Schaller (2011) and Ruiz-Valenzuela (2015). When focusing on the effects on GPA for children who were 12–14 years at the time of parental job loss, our results are similar to the results presented in Rege et al. (2011). However, as is clear from Figure 4, for some of the cohorts graduating before parental job loss, there are significant estimates of similar magnitude, suggesting that the result is spurious or due to selection. Finally, when investigating more long-run outcomes, i.e., unemployment and social assistance as young adults, we do not find convincing evidence of significant negative effects of maternal and paternal job loss. These results are in line with the earlier evidence in Bratberg et al. (2008) and Hilger (2016) finding negligible or no effects on future earnings due to paternal job loss.

## 6 Conclusions

We study the consequences of maternal and paternal job loss for parents and for the family environment in which children grow up and for human capital development, as measured by childhood health, educational performance, unemployment and reliance on social assistance as young adults. Our overall conclusion is that Swedish children are not adversely affected by parental job loss. We draw this conclusion after studying a wide range of outcomes both during childhood and in early adulthood, following the children for as long as ten years after the job loss. Parental job loss does not lead to significant increases in child mortality, overall hospitalizations or cause-specific hospitalizations. Neither do we find convincing negative effects on educational outcomes and labor market outcomes as young adults.

This absence of effects on children is not due to parents and the family being unaffected by workplace closure. Similar to previous studies, we find that parents are more likely to be unemployed and have lower earnings for several years after job loss. We also find that job loss reduces family disposable income and provokes family

separation, although these effects are not very strong. In addition, parental health is negatively affected: fathers show increased mortality risk, and mothers are more likely to be hospitalized due to mental health problems and alcohol-related conditions.

How should we understand the absence of effects on children, given that parents and families seem to be negatively affected by workplace closures? A better ability to account for the non-random selection of families affected by job loss may be part of the explanation. It is also possible that the Nordic context, with a welfare state and a dual-earner norm, in part explains why adverse effects on parents and the family environment do not hurt children. First, the welfare state institutions of subsidized childcare, free tuition and health care insure families and children against the consequences of job loss and financial distress by making important human capital investments in children largely independent of parental employment and family resources. Second, the limited effects found on family disposable income suggest that generous unemployment insurance and social assistance partly shield families from financial distress. Third, the dual-earner norm may reduce families' reliance on a breadwinner's income and hence reduce the negative consequences of paternal job loss. The dual-earner norm may also be part of the explanation for why families are more severely hit by maternal job loss in terms of separations and increased reliance on social assistance. Furthermore, a need to regain employment likely limits mothers' ability and willingness to reallocate time towards parenting, reducing the scope for positive effects of maternal job loss on children's human capital accumulation.

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## Appendix A: Earlier studies

**Table A 1 Earlier studies**

| Study                             | Data  | Outcome   | Population   | Definition of job loss  | Model   | Results  |
|-----------------------------------|---|---|--|---|---|--|
| <b>Health</b>                     |   |   |  |   |   |  |
| Lindo (2011)                      | US, survey data: PSID.                                    | Birth weight (self-reported).   | Children born to mothers whose partner (the father) experienced job loss during pregnancy.<br><br>No. of treated children: 797 (paternal job loss).  | Involuntary job loss due to plant closure, lay-off or being fired (self-reported).  | Control for mother fixed effects, mother's age and year of birth, and child's sex and birth order fixed effects.<br><br>Placebo: No effects on children born two years before paternal job loss.          | Parents: Family income declines by 13 %.<br>Children: A decline in birth weight of 4-5 %. Suggestive evidence of larger effects at the bottom of the weight distribution.  |
| Liu and Zhao (2014)               | China, survey data: China Health and Nutrition Survey.    | Height-for-age and weight-for-age z-scores (self-reported)<br>z-score =(actual height(weight)-mean height(weight)/st. dev. height(weight).  | Children aged 0-18 with parents with working history in public institutions, state-owned enterprises, or collectives.<br><br>No. of treated children: 247 (paternal and maternal job loss).                        | Layoffs caused by restructuring of state-owned enterprises in connection with urban labor market reform (self-reported).  | Control for child-fixed effects as well as co-variables including lagged health.<br><br>Placebo: No effects of future job loss.   | Parents: Household income decreases (50 % of average household income) with paternal job loss but not with maternal job loss, in which case time spent caring for children increases.<br><br>Children: A decline in height- and weight-for-age with 0.33-0.37 standard deviations in case of paternal job loss. Smaller and insignificant effect of maternal job loss. The effect is driven by poor households.  |
| Mörk, Svaleryd and Sjögren (2014) | Sweden, register data.                                    | Hospitalization   | Children 3-18 years old, where the biological parent participates in the labor force.<br><br>No. of treated children: 1,603,459 (paternal and maternal unemployment).  | Being registered as openly unemployed or participating in a labor market program (register data).   | Control for child fixed effects as well as child age and gender, parental age, education level and immigrant background, parental health, family disposable income, intact family and local unemployment. | Children: Parental unemployment is associated with an immediate 1 % increase in hospitalization and a 5 % increase in the long run. Stronger effects for maternal unemployment.  |
| Schaller and Zepa (2019)          | US, survey data: Medical Expenditure Panel Survey (MEPS). | Health conditions (parental-reported): infectious illnesses, bronchitis, asthma, injuries, ADD, stress-related mental disorders (anxiety and depression).<br><br>Health insurance status.<br><br>Health care and prescription drug utilization expenditures (parental-reported, but with complementary information collected from a sample of medical providers). | Children 1-16 years old with at least one employed parent at first interview (when looking at mental health outcomes: children 6-16).<br><br>No. of treated children: 1,969/1,618 (paternal/maternal job loss).    | Involuntary job loss for the following reasons "job ended", "business dissolved or sold", "laid off" (self-reported).<br><br>Sensitivity: only job loss due to firm closures. | Control for child fixed effects co-variables and linear time trend.<br><br>Placebo: No effects of future job loss.  | Children: Both paternal and maternal job loss result in reductions in parent ratings of children's health and mental health.<br>Paternal job loss increases the incidence of anxiety and depression, and among low-SES families increases the incidence of injuries. Maternal job loss reduces the incidence of infectious illness among high-SES families. Paternal job loss implies a reduction in private insurance coverage counteracted by an increase in public health insurance coverage.<br>Health care visits:<br>Fathers: increase in mental health visits<br>Mothers: reductions in drug prescriptions. |
| Peter (2016)                      | Germany, survey data: Socio Economic Panel Study.         | Non-cognitive skills: Socio emotional behavior (5/6-year-olds), Locus of control (17-year-olds).  | Preschool sample: children aged five/six whose mother was 20 or older when giving birth.<br><br>Adolescent sample: Children aged 17 living with their parents, and whose mother was 20 or older when giving birth. | Involuntary job loss due to plant closures or dismissal by employer (self-reported).<br>Sensitivity: separate the two reasons for job loss.                                   | Regression-adjusted matching approach.  | Parents: Decreased life-satisfaction for preschool mothers and decreased household income for mothers with older children.<br><br>Children: Increased preschool children's socio-behavioral problems by 51 % of a standard deviation and decreased adolescents' locus of control by 26 % of a standard deviation (the latter only for dismissals).   |

| Study   | Data  | Outcome  | Population   | Definition of job loss  | Model   | Results   |
|---|---|--|--|---|---|---|
|   |   |  | No. of treated children: 229/522 (preschool/adolescent sample, maternal job loss).   |   |   |   |
| Bubonya, Cobb-Clark and Wooden (2017)   | Australia, survey data: HILDA.                                      | Mental health (self-reported): experiencing anxiety and mood disturbances over a four-week period. | Children aged 15-20 living with at least one parent.<br><br>No. of treated children: 245/221 (paternal/maternal job loss).   | Involuntary job loss due to lay-off, retrenchment, redundancy, dismissal and firm closures (self-reported).<br><br>Sensitivity: unexpected job loss.  | Control for individual-specific fixed effects and co-variables.   | Parents: Mental health of women (but not men) declines following a spouse's job loss, but only if that job loss results in a sustained period of non-employment or if the couple experienced prior financial hardship or relationship strain.<br>Children: A negative effect of parental job loss on the mental health of adolescent girls, especially in case of maternal job loss.  |
| Page, M., Schaller, J. and Simon, D. (2019)   | USA, survey data: National Health Interview Survey (NHIS).          | Parent reports of child health and days of missed school because of illness.                       | Children ages 0–17 (or 5–17 for school-related outcomes) of the 34,000–40,000 families included in NHIS each year. 105,574–409,983 obs. depending on outcome.  | State-year-gender-specific predicted employment growth rates, using the base period share of total state employment in each industry, weighted by the base period share of men or women employed in a given state in each industry, summing across industries, by gender. | Exploit gender-specific variation across US states in the timing and severity of labor market shocks to estimate a difference-in differences model of health outcomes.                    | No association between general labor demand conditions and contemporaneous measures of children's health outcomes. Local unemployment rates are associated with small but significant increases in the incidence of injuries and severe emotional difficulties among children. Improvements in male labor market conditions are associated with decreases in injuries among children. Improvements in labor market conditions facing women are associated with declining parent-reported child health and increases in the likelihood that children experience severe emotional difficulties. |
| <b>Grades</b>   |   |  |  |   |   |   |
| Rege, Telle and Votruba (2011)  | Norway, register data.  | Grade point average of 10 <sup>th</sup> graders.   | Tenth graders (typically 16 years old) whose parents were employed in a plant three years before, which closed during the next two years or was stable and had at least one year of tenure and worked full time.<br><br>No. of treated children: 1,672 (paternal job loss) not mentioned in paper for maternal job loss. | Workers in plants with a plant downsizing rate of 90 % or more (register data).   | Control for industry, municipality and school fixed effects as well as covariates including past earnings.<br><br>Placebo: No effects of future plant closures.                           | Parents: A decline of 5.7/10.2 % in fathers'/mothers' earnings. Fathers/mothers are 2.7/3.9 pp. less likely to be fulltime employed and 4.6/5.1 pp. more likely to take up unemployment insurance the year after job loss. No immediate effect on divorce.<br>Children: Negative effect of paternal job loss (6 % of a standard dev).<br>Positive (non-significant) effect of maternal job loss.  |
| Stevens and Schaller (2011)   | US, survey data: Survey of Income and Program Participation (SIPP). | Grade retention the year after parental job loss.  | Children 5-19 whose fathers (or mothers in single households) experienced job loss.<br><br>No. of treated children: 2,170 (household head job loss).   | Involuntary job loss: fired or discharged, employer sold or bankrupt, slack work or business conditions (self-reported).<br><br>Sensitivity: only job loss due to employer sold or bankrupt, slack work or business conditions.   | Control for child fixed effects and time-varying and fixed family, school and child factors as well as regional unemployment.<br><br>Placebo: No effects of job loss in the current year. | Parents: Family income declines by 10 % and family earnings by 15 %. An increase in likelihood of divorce/relocation of 3/7.5 % in the short run.<br><br>Children: Increase in the probability of grade retention by 15 %. Larger effects in families with high pre-period income.  |
| Ruiz-Valenzuela (2015)  | Spain: survey data.   | Average grades during an academic year.  | Students aged 3-16 in Barcelona, in two-parent households.<br><br>No. of treated children: 54 (paternal and maternal job loss).  | Unemployed during the Great Recession (self-reported).  | Control for children-fixed effects as well as year by group fixed effects.<br><br>Placebo: No effect of future unemployment (only cross-section estimates).                               | Children: Father's job loss reduces grades by 13 % of a standard dev, especially for boys. No effects of maternal unemployment.   |
| <b>Long-run outcomes, including post-secondary schooling and subjective wellbeing</b> |   |  |  |   |   |   |
| Oreopoulos, Page and Stevens (2008)   | Canada, register data: Intergenerational Income Database (IID).     | Earnings, unemployment insurance and social assistance at age 25-32.                               | Boys 10-14 when fathers lost job. Fathers aged 30-50, with at least two-year tenure at the firm.<br><br>No. of treated children: 1,411 (paternal job loss).  | Job loss due to firm closures. (register data).   | Controlling for family income in the pre-displacement years, as well as region, industry and firm size fixed effects.   | Parents: Fathers' earnings are reduced by 30 % in the short run and 18 % after 8 years. Unemployment increases with 24 pp. in the short run. Family income is reduced by 10 %.  |

| Study                             | Data  | Outcome   | Population   | Definition of job loss   | Model   | Results  |
|-----------------------------------|---|---|--|--|---|--|
|                                   |   |   |  |  |   | Children: Earnings reduced by 9 % as adults. Effects concentrated in the bottom of the distribution. The likelihood of receiving unemployment insurance/social assistance increases by 4/1.5 pp.   |
| Bratberg, Nilsen and Vaage (2008) | Norway, register data   | Earnings at age 25-30 (15 years after paternal job loss).   | Children 12-15 when their father experienced job loss<br>Fathers with at least four years tenure at the firm.<br><br>No. of treated children: 2,486/720 (all displaced/plant closures, paternal job loss). | Job loss due to downsizing (at least 30 % of the labor stock) or plant closures (register data).   | Control for fathers' pre-displacement earnings and industry, as well as gender and cohort of the child.   | Parents: Fathers' earnings are reduced by 5-10 % (10-20 % for those on closing plants), and employment is reduced by 40 pp. initially and with 10-13 pp. after 7 years.<br><br>Children: No effects on earnings in the aggregate or anywhere in the earnings distribution.   |
| Page, Stevens and Lindo (2009)    | US, survey data: PSID.  | Education, income, earnings, unemployment, Aid to Families with Dependent Children (AFDC).  | Children aged 15 or younger when family head experienced job loss.<br><br>No. of treated children: 673/242 (all displaced/only job closures, household head job loss).                                     | Job loss due to layoffs or firm closures (self-reported), with focus on firm closures in most of the paper.  | Control for average family income 3-5 years before job loss (control for gender, age, business cycle).  | Parents: Earnings and family income are 20-30 % lower up to 6 years after job loss.<br><br>Children: When all job losses are included, future earnings drop by 10 % due to job loss, but only when firm closures are considered are earnings not affected. For children from poor families, negative effects on education, unemployment and AFDC. Larger effects for children who were young at parent job loss. |
| Coelli (2011)                     | Canada, survey data: Canadian Survey of Labour and Income Dynamics (SLID).  | Post-secondary enrollment at ages 16-19/29.   | Children whose main income earner experienced job loss when children were 16-18.<br><br>No. of treated children: 174 (household head job loss).  | Involuntary job loss due to permanent layoff (redundancy) or business failure (self-reported).<br><br>Sensitivity: separate between layoffs due to redundancy and business closures. | Control for after tax parental income at age 16, parental education, gender, distance to closest university and city, rural, time and province dummies.<br><br>Placebo: No effects on future job loss.  | Parents: Family income drops by 17 %. No evidence of increased stress (self-reported).<br><br>Children: Probability of enrollment lowered by 10 pp. Larger effect for children whose parents had higher pre-displacement income. If anything, larger effects for firm closures.  |
| Wightman (2012)                   | US, survey data: PSID.  | Post-secondary educational attainment at 21.  | Children where the household head experienced job loss.<br><br>No. of treated children: 1038/616 (layoffs/firm closures, household head job loss).   | Involuntary job loss due to layoffs or plant/firm closures (self-reported). Separate between the two causes for job loss.  | Control for gender, race, family structure, parental income and education, parental cognitive ability and non-cognitive attitudes at childbirth.<br><br>Sensitivity: use industry-specific demand as instrument for job loss.                                       | Children: parental job loss due to layoffs/firm closures reduces the probability of obtaining post-secondary education with 15/5 %.<br><br>IV estimates show larger negative effects.  |
| Brand and Thomas (2014)           | US, survey data: The National Longitudinal Survey of Youth (NLSY) and The National Longitudinal Survey's Child-Mother File (NLSCM). | High school completion at age 19, college attendance at age 21, college completion at age 25, depressive symptoms at ages 20-24, depressive symptoms at ages 25-29. | Children aged 0-17 to single (when displaced) mothers.<br><br>No. of treated children: 5,697 (maternal job loss).  | Involuntary job loss due to layoffs or plant closures (self-reported).   | Propensity score matching, on maternal cognitive and non-cognitive skill, delinquent activity, race, education, employment and family history (at child's birth/age 6/age 12).<br><br>Also investigates heterogeneous effects with respect to the propensity score. | Children: Maternal job loss leads to 4-6 pp. lower high school/college completion and 2.5 pp. more depressive symptoms at ages 25-29. Effects larger for mothers less likely to be displaced and in "better" times.<br>The negative effects are driven by children whose mothers were displaced when child was >5.   |
| Hilger (2016)                     | US, register data: Federal tax returns.   | College enrollment, college quality, early career earnings.   | Children aged 12-18 at paternal job loss.  | Uptake of unemployment insurance benefits.   | Difference-in-differences approach:<br>First difference: Children of laid off parents and children  | Parents: Reductions in household income.<br><br>Children: College enrollment declines by less than half of one percentage point. Marginally negative effects on  |

| Study                                  | Data   | Outcome   | Population  | Definition of job loss  | Model  | Results   |
|--|--|---|---|---|--|---|
|  |  |   | No. of treated children: Not clear from the paper.  | Sensitivity: involuntary job loss due to firm closures (register data).                           | whose parents remained at the firm.<br>Second difference: Those aged 19 before layoff and those aged 19 after layoff.  | college quality. No effects on early career earnings. Largest effects for middle incomes.   |
| Angelini, Bertoni and Corazzoni (2018) | Germany, survey data: German Socio-Economic Panel (SOEP).          | The “big five” personality traits at age 17–25. | Children aged 17–25.<br><br>No. treated children: 66 (paternal job loss).   | Self-reported unemployment any year between baseline survey and follow-up survey (self-reported). | Value-added model, conditioning on predetermined parental characteristics.   | Children: Paternal unemployment makes children significantly more conscientious and—to a smaller extent—less neurotic.  |
| Powdthavee and Vernoit (2013)          | Great Britain, survey data: British Household Panel Survey (BHPS). | Youth's self-reported happiness.                | Children 11–15 years.<br><br>No. treated children: 549/160 paternal/maternal unemployment.                                | Unemployment (self-reported).   | Longitudinal model of happiness using child fixed effects and mate effects.  | Children: Parental job loss when the child was relatively young has a positive influence on the child's overall happiness. However, this positive association became either strongly negative or statistically insignificant as the child grew older. |
| Nikolova and Nikolaev (2018)           | Germany, survey data: (SOEP).                                      | Life satisfaction at age 18–31.                 | Children 0–15.<br><br>No treated children: 66/ 149/124 in in age groups: 0–5/6–10/11–15. (maternal or paternal job loss). | Job loss due to plant closure (self-reported) and registered at the German Employment Office.     | Control for cohort fixed effects and the annual state unemployment rate faced as a child, averaged over the years 0–5, 6–10, and 11–15 to net out the long-term life satisfaction consequences of growing up in a recession. | Children: Parental job loss during early childhood (0–5 ages) and early adolescence (11–15) negatively affects adult life satisfaction, but that during middle childhood (6–10) does not seem to matter.  |

## Appendix B: Tables

**Table A 2 ICD-codes for different diagnoses**

| <i>Variable</i>                                | <i>Definition based on ICD10 codes</i>  |
|--|---|
| Hospitalization                                | = 1,000 if admitted to hospital that year   |
| Avoidable                                      | = 1,000 if admitted to hospital with diagnosis codes:<br>Asthma J45, J46<br>Diabetes E101–E108<br>E110–E118, E130–E138, E140–E148<br>Nutrition E40–E43, E550, E643<br>Anemia D501–509<br>hypertension i110,i119<br>Chronic obstructive lung disease J41, J42, J43, J44, J47; *J20<br>(main diagnosis together with) J41, J42, J43, J44, J47 (sub-diagnosis)<br>The following main diagnoses:<br>Diarrhea E86, K522, K528, K529<br>Epileptic cramps O15, G40, G41, R56<br>Infections H66, H67, J02, J03, J06, J312<br>Vaccine preventable:<br>B16, B26, B05, B06, A15–A19, A37, A36<br>Influenza and pneumonia j10, J11, J13, J14, j153, j154, j157 j159, j168, j181, j188<br>Tooth related K02–K06, A690, K08, K098, K099, K12, k13 |
| Mental and behavior                            | Hospitalization for self-harm<br>Hospitalization for mental health problems<br>Hospitalization for abuse by partner or parent<br>See definitions below  |
| Hospitalization for self-harm                  | =1,000 if admitted to hospital with Self-destructive behavior X60–X84, Y10–Y34  |
| Hospitalization for mental health problems     | =1,000 if admitted to hospital with mental health problems F00–F99  |
| Hospitalization for abuse by partner or parent | =1,000 if admitted to hospital: Y070 (partner/spouse), Y071 (parent), Abuse syndromes: T74  |
| Alcohol  | =1,000 if admitted to hospital at any time during the year with:<br>alcohol poisoning (T51, X45, X65, Y15),<br>alcohol use disorder (F10),<br>alcoholic liver disease or alcohol-induced pancreatitis (K70,K85, K86.0–1),<br>other alcohol-related diseases or conditions (E24.4, G31.2, G62.1, G72.1, I42.6, K29.2, 035.4)   |

Note: Unless otherwise indicated, admitted to hospital with main diagnosis or any of the first five sub-diagnoses.



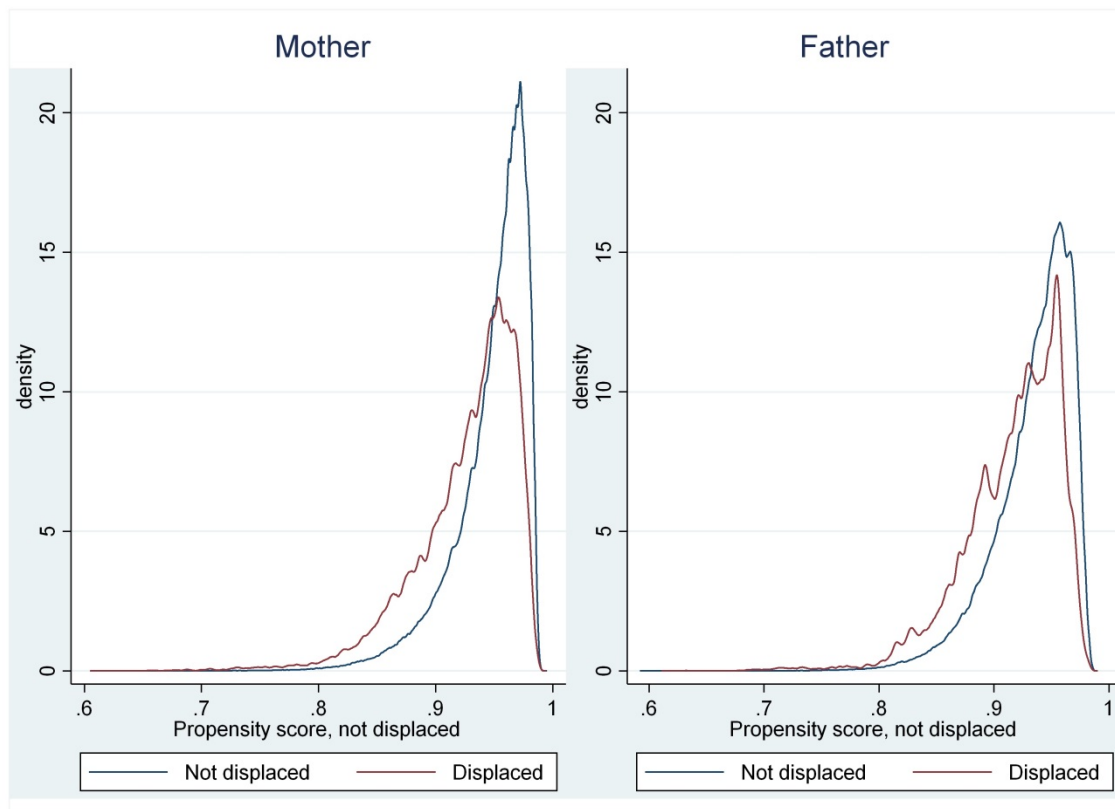
**Table A 3 Overview of covariates used to estimate the propensity score**

| <i>Variable</i>  | <i>Definition</i>  |
|--|--|
| Age (child, worker)  | Years of age   |
| Age^2 (child, worker)  | Years of age, squared  |
| Female (child)   | =1 if girl   |
| Hospitalization t-2 and t-3 (worker), t-2 or t-3 (other parent) and t-2 (child)                            | =1,000 if admitted to a hospital that year   |
| Hospitalization for diagnoses indicating mental health problems t-2 or t-3 (worker)                        | =1,000 if admitted to a hospital with a diagnosis code indicating mental health problems according to Table A2   |
| Hospitalization for diagnoses indicating alcohol abuse t-2 or t-3 (worker)                                 | =1,000 if admitted to a hospital with a diagnosis code indicating alcohol-related disease according to Table A2  |
| Hospitalization for diagnoses indicating alcohol abuse or mental health problems t-2 or t-3 (other parent) | =1,000 if admitted to a hospital with a diagnosis code indicating alcohol-related disease or mental health problems according to Table A2  |
| Mental and behavior (child)  | =1,000 if admitted to a hospital with a diagnosis code indicating mental health problems, self-destructive behavior, alcohol-related conditions, i.e., disease or abuse according to Table A2  |
| Separated (child)  | Dummy indicating that the biological parents do not live together  |
| Years in Sweden (worker, other parent)   | Dummy indicating time living in Sweden (8)<br>0: born in Sweden<br>1: time in Sweden < 6 years<br>2: 5 < time in Sweden < 11<br>3: 10 < time in Sweden < 16<br>4: 15 < time in Sweden < 21<br>5: 20 < time in Sweden < 31<br>6: 30 < time in Sweden < 41<br>7: time in Sweden > 40 |
| Unemployed in t-2 and t-3 (worker) and in t-2 (other parent)   | Dummy indicating whether the individual is registered at the PES   |
| Unemployed long (worker, other parent)   | Dummy indicating whether the individual has been registered at the PES more than 180 days  |
| Income from employment (worker)  | Income from employment or self-employment, deflated with CPI to 2014 prices  |
| Household disposable income (worker, other parent)   | Log household disposable income in 100 s SEK, deflated with CPI to 2014 prices   |
| Income from social assistance (worker, other parent)   | Log social assistance in 100 s SEK, deflated with CPI to 2014 year prices in the individual's household  |
| Swe * social assistance (worker, other parent)   | Interaction variable between born in Sweden and income from social assistance in the individual's household  |
| Education (worker, other parent)   | Dummy variables for years of schooling (3)<br>1: years of school < 10<br>2: 9 < years of school < 13<br>3: years of school > 12  |
| Tenure (worker)  | Dummy variables for number of years employed at the current workplace. Categories: 2, 3, 4 and 5 or more years.  |
| Size of workplace (worker)   | Number of workers at workplace   |
| Size of workplace ^2 (worker)  | Number of workers at workplace, squared  |
| Small workplace (worker)   | Dummy variable indicating whether the workplace has fewer than 50 workers  |
| Medium-sized workplace (worker)  | Dummy variable indicating whether the workplace has more than 49 but fewer than 250 workers  |
| Industry sector (worker)   | Dummy variables for industry sector, SNI code (9)  |

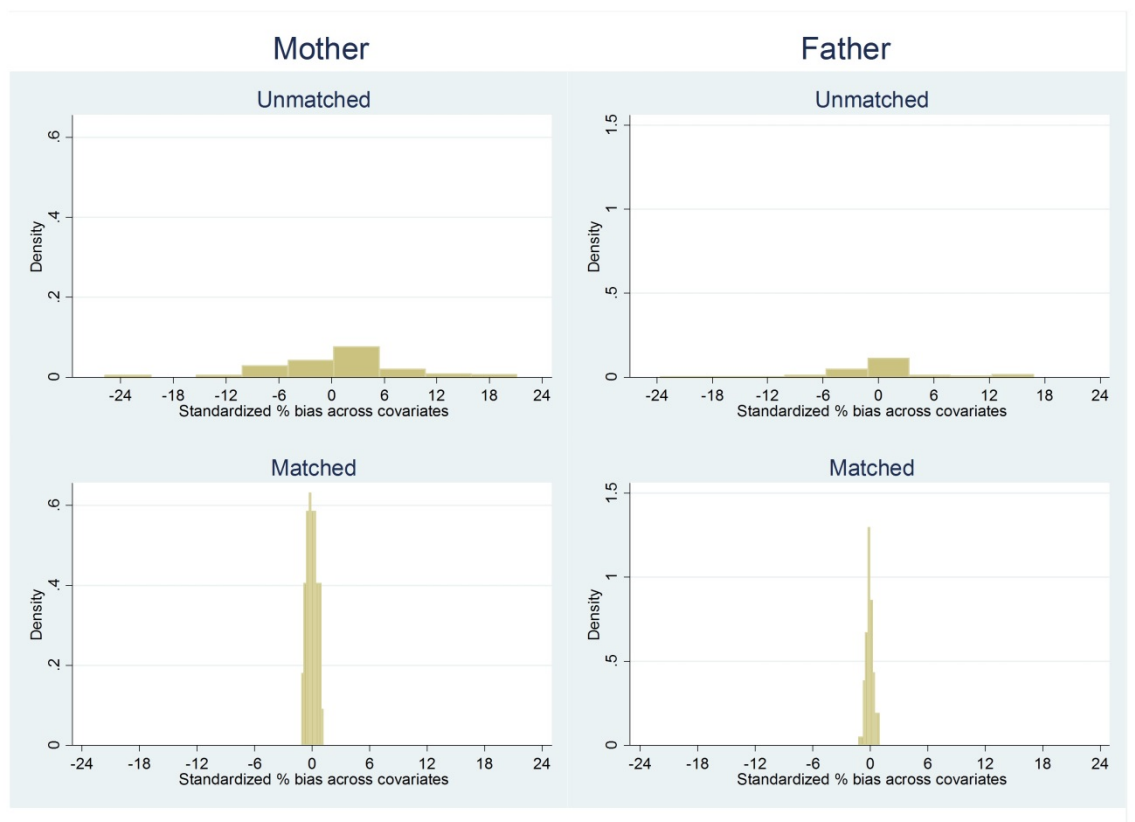
|                 |   |
|-----------------|---|
| County (worker) | Dummy variables for county (25)           |
| Sample year     | Dummy variables for sample year 1995-2000 |

## Appendix C: Common support and balancing of covariates

Figure A 1 Distribution of propensity score for displaced and non-displaced workers.



**Figure A 2 Standardized percent bias across covariates, unmatched and matched samples**



## Appendix D

**Table A 4 Mother's outcomes: Unemployment (fraction), earnings and disposable income in SEK 8(7) years before and up to 10 years after closure. Corresponds to Figure 1 mother**

| Per<br>iod | Estimate<br>Unemployment | Std.<br>Error | # Obs     | Estimate<br>Earnings | Std.<br>Error | Estimate<br>Disposable Income | Std.<br>Error | # Obs     |
|------------|--------------------------|---------------|-----------|----------------------|---------------|-------------------------------|---------------|-----------|
| -8         |                          |               |           | -372.8               | 743.1         | -2,514                        | 1,29          | 538,827   |
| -7         | 0.00488                  | 0.00380       | 361,977   | 117.5                | 662.8         | -2,612*                       | 1,224         | 714,67    |
| -6         | 0.00205                  | 0.00308       | 541,985   | 760.3                | 643.3         | -133.9                        | 1,196         | 888,217   |
| -5         | -0.00246                 | 0.00261       | 717,275   | 1,229*               | 546.1         | -2,926**                      | 1,021         | 1,062,772 |
| -4         | -0.00718**               | 0.00212       | 890,222   | 1,511*               | 621.1         | -2,152*                       | 961.2         | 1,063,759 |
| -3         | 0.00125                  | 0.00169       | 1,064,385 | 1,084*               | 519.8         | 212.9                         | 1,145         | 1,064,385 |
| -2         | -0.00166                 | 0.00171       | 1,064,385 | 442.6                | 543.3         | -2,092                        | 1,621         | 1,064,385 |
| -1         | 0.0237**                 | 0.00189       | 1,062,484 | -94.38               | 682.7         | 1,236                         | 1,699         | 1,062,484 |
| 0          | 0.0705**                 | 0.00205       | 1,060,579 | -4,017**             | 700.7         | -971.2                        | 1,921         | 1,060,579 |
| 1          | 0.0720**                 | 0.00207       | 1,059,007 | -10,002**            | 749.6         | 1,995                         | 6,028         | 1,059,007 |
| 2          | 0.0565**                 | 0.00199       | 1,057,753 | -10,754**            | 798.7         | -5,118                        | 3,543         | 1,057,753 |
| 3          | 0.0400**                 | 0.00192       | 1,056,556 | -8,906**             | 844.2         | -4,638                        | 2,487         | 1,056,556 |
| 4          | 0.0310**                 | 0.00185       | 1,055,454 | -7,760**             | 877.5         | -10,101                       | 6,298         | 1,055,454 |
| 5          | 0.0235**                 | 0.00179       | 1,054,264 | -8,464**             | 918.9         | -7,147**                      | 2,679         | 1,054,264 |
| 6          | 0.0159**                 | 0.00177       | 1,053,024 | -6,494**             | 950.4         | -12,274**                     | 2,441         | 1,053,024 |
| 7          | 0.0160**                 | 0.00171       | 1,051,739 | -7,195**             | 1,003         | -4,362                        | 3,562         | 1,051,739 |
| 8          | 0.0106**                 | 0.00169       | 1,050,280 | -6,206**             | 1,032         | -8,780**                      | 2,386         | 1,050,280 |
| 9          | 0.0128**                 | 0.00167       | 1,048,736 | -7,109**             | 1,095         | -13,707**                     | 2,859         | 1,048,736 |
| 10         | 0.0126**                 | 0.00169       | 1,047,166 | -5,673**             | 1,114         | -14,493**                     | 3,619         | 1,047,166 |

*Note:* Estimated using propensity score matching. The matching method used is the nearest neighbor with replacement. Standard errors in parentheses take into account that the propensity score is estimated. Statistical significance: \* denotes  $p < 0.05$  and \*\* denotes  $p < 0.01$ . Unemployment has only been observed in the data since 1992; therefore, the pre-period is only 7 years instead of 8.

**Table A 5 Father's outcomes: Unemployment (fraction), earnings and disposable income in SEK 8(7) years before and up to 10 years after closure. Corresponds to Figure 1 father**

| Period | Estimate     | Std.<br>Error | # Obs     | Estimate  | Std.<br>Error | Estimate          | Std.<br>Error | # Obs     |
|--------|--------------|---------------|-----------|-----------|---------------|-------------------|---------------|-----------|
|        | Unemployment |               |           | Earnings  |               | Disposable income |               |           |
| -8     |              |               |           | 2,094*    | 1,057         | 2,411             | 1,355         | 634,613   |
| -7     | -0.00459     | 0.00328       | 423,889   | 846.6     | 837.3         | 167.7             | 989.2         | 850,769   |
| -6     | -0.00230     | 0.00260       | 642,831   | 863.8     | 773.0         | -33.42            | 894.6         | 1,065,608 |
| -5     | -0.00546*    | 0.00215       | 858,292   | 865.5     | 754.0         | -1,333            | 906.1         | 1,279,784 |
| -4     | -0.00550**   | 0.00175       | 1,071,644 | 1,031     | 804.4         | 219.5             | 1,039         | 1,282,797 |
| -3     | -0.000374    | 0.00145       | 1,285,125 | -668.2    | 856.8         | -1,36             | 1,165         | 1,285,125 |
| -2     | 0.000164     | 0.00141       | 1,285,125 | -281.6    | 917.4         | -657.0            | 1,658         | 1,285,125 |
| -1     | 0.0326**     | 0.00153       | 1,280,815 | -713.0    | 966.7         | 505.1             | 1,79          | 1,280,815 |
| 0      | 0.0839**     | 0.00167       | 1,277,001 | -8,790**  | 1,112         | -2,785            | 2,374         | 1,277,001 |
| 1      | 0.0833**     | 0.00165       | 1,273,769 | -18,410** | 1,177         | -10,382**         | 3,518         | 1,273,769 |
| 2      | 0.0585**     | 0.00156       | 1,271,194 | -18,892** | 1,36          | -13,811**         | 3,256         | 1,271,194 |
| 3      | 0.0396**     | 0.00150       | 1,268,811 | -16,612** | 1,326         | -14,453**         | 3,531         | 1,268,811 |
| 4      | 0.0336**     | 0.00148       | 1,266,196 | -14,593** | 1,376         | -12,037**         | 2,979         | 1,266,196 |
| 5      | 0.0279**     | 0.00145       | 1,263,830 | -15,025** | 1,376         | -14,057**         | 4,781         | 1,263,830 |
| 6      | 0.0234**     | 0.00144       | 1,261,751 | -14,460** | 1,396         | -12,706**         | 2,061         | 1,261,751 |
| 7      | 0.0182**     | 0.00141       | 1,258,891 | -14,182** | 1,499         | -13,784**         | 4,278         | 1,258,892 |
| 8      | 0.0159**     | 0.00139       | 1,255,787 | -12,633** | 1,553         | -19,691**         | 3,31          | 1,255,788 |
| 9      | 0.0126**     | 0.00138       | 1,252,455 | -16,701** | 1,678         | -17,558**         | 3,92          | 1,252,457 |
| 10     | 0.0139**     | 0.00139       | 1,248,925 | -13,961** | 1,646         | -40,994           | 26,065        | 1,248,927 |

*Note:* Estimated using propensity score matching. The matching method used is the nearest neighbor with replacement. Standard errors in parentheses take into account that the propensity score is estimated. Statistical significance: \* denotes  $p < 0.05$  and \*\* denotes  $p < 0.01$ . Unemployment has only been observed in the data since 1992; therefore, the pre-period is only 7 years instead of 8.

**Table A 6 Effect of exposure to job loss on the likelihood of biological parents being separated (share) four years before and up to 10 years after closure and parental mortality (number of deaths per 1 000 between closure and year t). Corresponds to Figure 2 mother**

|    | Estimate<br>Separated | Std. Error | # Obs.    | Estimate<br>Mortality | Std. Error | # Obs.    |
|----|-----------------------|------------|-----------|-----------------------|------------|-----------|
| -4 | 0.00348               | (0.00246)  | 1,063,026 |                       |            |           |
| -3 | 0.00111               | (0.00248)  | 1,064,385 |                       |            |           |
| -2 | 0.000159              | (0.00249)  | 1,064,385 |                       |            |           |
| -1 | 0.00317               | (0.00256)  | 1,059,665 |                       |            |           |
| 0  | 0.00372               | (0.00264)  | 1,054,933 | 0.106                 | (0.194)    | 1,064,385 |
| 1  | -0.000625             | (0.00271)  | 1,050,716 | -0.123                | (0.245)    | 1,064,385 |
| 2  | 0.00683*              | (0.00275)  | 1,046,925 | 0.0881                | (0.289)    | 1,064,385 |
| 3  | 0.00473               | (0.00281)  | 1,043,311 | -0.141                | (0.336)    | 1,064,385 |
| 4  | 0.00778**             | (0.00284)  | 1,039,987 | -0.0529               | (0.384)    | 1,064,385 |
| 5  | 0.00641*              | (0.00287)  | 1,036,791 | 0.159                 | (0.424)    | 1,064,385 |
| 6  | 0.00436               | (0.00290)  | 1,033,938 | 0.176                 | (0.466)    | 1,064,385 |
| 7  | 0.00726*              | (0.00292)  | 1,029,754 | 0.335                 | (0.506)    | 1,064,385 |
| 8  | 0.00531               | (0.00296)  | 1,024,873 | 0.194                 | (0.552)    | 1,064,385 |
| 9  | 0.00433               | (0.00299)  | 1,019,509 | 0.582                 | (0.596)    | 1,064,385 |
| 10 | 0.00347               | (0.00300)  | 1,014,022 | 0.828                 | (0.632)    | 1,064,385 |

*Note:* Estimated using propensity score matching. The matching method used is the nearest neighbor with replacement. Standard errors in parentheses take into account that the propensity score is estimated. Statistical significance: \* denotes  $p < 0.05$  and \*\* denotes  $p < 0.01$ .

**Table A 7 Effect of exposure to job loss on the likelihood of biological parents being separated (share) four years before and up to 10 years after closure and parental mortality (number of deaths per 1 000 between closure and year t). Corresponds to Figure 2 father**

| Period | Estimate<br>Separated | Std. Error | # Obs.    | Estimate<br>Mortality | Std. Error | # Obs.    |
|--------|-----------------------|------------|-----------|-----------------------|------------|-----------|
| -4     | 0.000317              | (0.00192)  | 1,281,768 |                       |            |           |
| -3     | -0.00179              | (0.00189)  | 1,285,125 |                       |            |           |
| -2     | -0.000550             | (0.00190)  | 1,285,125 |                       |            |           |
| -1     | 0.00368               | (0.00197)  | 1,279,548 |                       |            |           |
| 0      | -0.00145              | (0.00204)  | 1,274,724 | 0.374                 | (0.207)    | 1,285,125 |
| 1      | 0.00134               | (0.00211)  | 1,270,376 | 0.304                 | (0.266)    | 1,285,125 |
| 2      | 0.00309               | (0.00216)  | 1,266,639 | 0.234                 | (0.311)    | 1,285,125 |
| 3      | 0.000882              | (0.00221)  | 1,263,065 | 0.293                 | (0.366)    | 1,285,125 |
| 4      | -0.000526             | (0.00226)  | 1,259,141 | 0.761                 | (0.407)    | 1,285,125 |
| 5      | -0.00193              | (0.00229)  | 1,255,420 | 0.667                 | (0.455)    | 1,285,125 |
| 6      | 0.00129               | (0.00233)  | 1,251,987 | 1.158*                | (0.505)    | 1,285,125 |
| 7      | 0.00141               | (0.00236)  | 1,247,691 | 1.170*                | (0.548)    | 1,285,125 |
| 8      | 0.00195               | (0.00239)  | 1,243,020 | 1.053                 | (0.591)    | 1,285,125 |
| 9      | 0.00224               | (0.00242)  | 1,237,955 | 0.971                 | (0.639)    | 1,285,125 |
| 10     | 0.00231               | (0.00243)  | 1,232,566 | 1.088                 | (0.686)    | 1,285,125 |

*Note:* Estimated using propensity score matching. The matching method used is the nearest neighbor with replacement. Standard errors in parentheses take into account that the propensity score is estimated. Statistical significance: \* denotes  $p < 0.05$  and \*\* denotes  $p < 0.01$ .

**Table A 8 Effect of exposure to parental job loss on the cumulative number of deaths per 1,000 children from the year of closure and up to 10 years after. Corresponds to Figure 3**

| Period | Estimate<br>Mother | Std. Error | # Obs.    | Estimate<br>Father | Std. Error | # Obs.    |
|--------|--------------------|------------|-----------|--------------------|------------|-----------|
| 0      | 0.0529             | (0.0912)   | 1,064,756 | -0.117             | (0.0928)   | 1,285,125 |
| 1      | 0.176              | (0.129)    | 1,064,756 | -0.105             | (0.114)    | 1,285,125 |
| 2      | 0.0529             | (0.147)    | 1,064,756 | -0.105             | (0.132)    | 1,285,125 |
| 3      | 0.0705             | (0.161)    | 1,064,756 | -0.117             | (0.151)    | 1,285,125 |
| 4      | 0.0352             | (0.182)    | 1,064,756 | -0.187             | (0.165)    | 1,285,125 |
| 5      | 0.0352             | (0.205)    | 1,064,756 | -0.199             | (0.183)    | 1,285,125 |
| 6      | 0.0352             | (0.231)    | 1,064,756 | -0.0585            | (0.202)    | 1,285,125 |
| 7      | 0.300              | (0.260)    | 1,064,756 | 0.0936             | (0.222)    | 1,285,125 |
| 8      | 0.352              | (0.279)    | 1,064,756 | 0.105              | (0.240)    | 1,285,125 |
| 9      | 0.352              | (0.294)    | 1,064,756 | 0.0585             | (0.258)    | 1,285,125 |
| 10     | 0.405              | (0.314)    | 1,064,756 | 0                  | (0.273)    | 1,285,125 |

*Note:* Estimated using propensity score matching. The matching method used is the nearest neighbor with replacement. Standard errors in parentheses take into account that the propensity score is estimated. Statistical significance: \* denotes  $p < 0.05$  and \*\* denotes  $p < 0.01$ .



**Table A 9 Grades, yearly estimates. Corresponds to Figure 4**

| Period | Estimate<br>Mother | Std. Error | # Obs. | Estimate<br>Father | Std. Error | # Obs. |
|--------|--------------------|------------|--------|--------------------|------------|--------|
| -8     | -0.0175            | (0.760)    | 77,675 | -0.978             | (0.687)    | 70,784 |
| -7     | -0.868             | (0.679)    | 77,699 | 0.710              | (0.630)    | 69,854 |
| -6     | -0.581             | (0.682)    | 76,148 | -0.953             | (0.627)    | 69,661 |
| -5     | -0.802             | (0.690)    | 75,008 | 0.00600            | (0.636)    | 69,597 |
| -4     | -0.308             | (0.685)    | 73,399 | -0.691             | (0.618)    | 69,075 |
| -3     | 0.731              | (0.698)    | 71,701 | -0.0514            | (0.624)    | 68,45  |
| -2     | -1.268             | (0.713)    | 71,179 | -1.180             | (0.639)    | 68,358 |
| -1     | -0.850             | (0.699)    | 70,186 | -0.0556            | (0.636)    | 68,081 |
| 0      | -0.370             | (0.711)    | 69,432 | -0.249             | (0.651)    | 68,619 |
| 1      | -0.729             | (0.710)    | 68,783 | -0.316             | (0.640)    | 69,46  |
| 2      | -1.265             | (0.720)    | 68,396 | -0.0256            | (0.638)    | 69,898 |
| 3      | -1.404             | (0.721)    | 67,796 | -1.044             | (0.638)    | 71,593 |
| 4      | -1.599*            | (0.725)    | 69,087 | 0.431              | (0.612)    | 74,113 |
| 5      | -0.749             | (0.714)    | 70,118 | -1.105             | (0.618)    | 76,775 |
| 6      | -1.112             | (0.705)    | 71,064 | -1.344*            | (0.594)    | 80,06  |
| 7      | -0.736             | (0.689)    | 72,271 | 0.108              | (0.593)    | 82,857 |
| 8      | -0.744             | (0.679)    | 72,273 | -1.167*            | (0.578)    | 84,798 |
| 9      | -0.572             | (0.696)    | 69,433 | 0.474              | (0.578)    | 85,695 |
| 10     | 0.0150             | (0.734)    | 62,858 | 0.0958             | (0.579)    | 84,443 |

*Note:* Estimated using propensity score matching. The matching method used is the nearest neighbor with replacement. Standard errors in parentheses take into account that the propensity score is estimated. Statistical significance: \* denotes  $p < 0.05$  and \*\* denotes  $p < 0.01$ .