Parental Job Loss and Children's School Performance

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Abstract

Using Norwegian register data we estimate how children's school performance is affected by their parents' exposure to plant closure. In municipalities with mediocre performing labor markets, fathers' exposure leads to a substantial decline in children's grade point average, while mothers' exposure leads to improved school performance. This negative effect of paternal job loss appears largely unrelated to its effect on father's income and employment, shift in parental time towards child rearing activities, marital dissolution, and residential relocation. The disparate effects of job loss across fathers and mothers are, however, consistent with sociological literature suggesting that the mental distress experienced by displaced workers is generally more severe for men than women.

Keywords: educational outcomes, downsizing, job loss, layoffs, plant closure, school performance

JEL classification: I20, J63, J65

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1. Introduction

Job loss is an endemic feature of market economies as producers periodically re-optimize in response to changing market conditions. In the USA 8.1 million workers were displaced from jobs during the 2003-2005 period.[1] While such re-optimization can be crucial for long term economic performance, job loss can be detrimental to affected workers. Convincing evidence indicates that job loss increases the likelihood of future unemployment, welfare program participation and divorce, and negatively affects future earnings and health.[2] The detrimental effects of job loss potentially extend to children in the household, but little research has investigated such effects. The current paper utilizes a unique dataset to estimate the effect of parental job loss on children's school performance.

Parental job loss could affect a child's school performance through a number of possible mechanisms. To the extent that job loss reduces future family income, the reduction in financial resources could directly affect children's school performance (e.g. Becker and Thomes 1986, Duncan and Brooks-Gunn 1997, Blau 1999, Baum 2003). Parental job loss could also affect children's school performance if displacement affects parental time towards child rearing activities (Becker 1993). For example, paternal job loss may lead the father to assume a larger share of home production activities. If the father is less effective in taking care of the children than the mother, then this shift could have a negative effect on the children. Alternatively, job loss likely imposes stress on the affected parent (e.g. McKee-Ryan et al. 2005) from which it could be hard to shield the child (e.g. Ström 2002, Sleskova et al. 2006). Job loss could also trigger other disruptions to the child's environment, such as parental divorce or relocation, which impede a child's educational performance (e.g. Gruber 2004 and Astone and McLanahan 1994).

Estimating a causal relationship between parental job loss and child outcomes faces two main challenges: concerns of omitted variable bias and the scarcity of appropriate data. Omitted variable bias arises if a parent's job loss is correlated with unobservables that also affect child outcomes, such as the parent's productivity or the experience of an unobserved shock (e.g. sudden decline in parent's health). As described below, to circumvent the most obvious forms of omitted

[1] Bureau of Labor Statistics of the U.S. Department of Labor, News Release, August 17th 2006 (http://www.bls.gov/news.release/pdf/disp.pdf).

[2] See for example Jacobson, Lalonde and Sullivan (1993), Stevens (1997), Kletzer (1998), Dragano, Verde and Siegrist (2005), Huttunen, Møen and Salvanes (2006), Eliason and Storrie (2006), Sullivan and von Wachter (2006), Røed and Fevang (2007) and Rege, Telle and Votruba (2007, 2008).

variable bias, our empirical strategy utilizes job losses that are associated with plant closures.[3] Investigating the relationship between parental job loss and child outcomes is also constrained by data availability. The task requires data on parental labor force participation, linked to relevant outcomes for the children. Our analysis utilizes a comprehensive, longitudinal register database containing annual records for every person in Norway (the *FD-trygd*), in addition to a database containing the school grades of all graduating secondary students in Norway from 2003 to 2005. Importantly, the two databases contain personal identifiers allowing us to link each child's educational outcomes to the parents' records. This provides us with a unique opportunity to investigate the effect of parental job loss on a child's school performance.

Our analysis specifically investigates how children's graduation-year grade point average (GPA) is affected by their parents' exposure to plant closure. Our effect estimate is based on covariate-adjusted comparisons of GPA across children of workers originally employed in plants that either subsequently closed or remained stable over time. Such estimates are potentially biased if closing plants are concentrated in industries or geographic areas with children of low school performance or with schools of low quality. The richness of our register data allows us to include industry, municipality and school fixed effects to address these sources of bias. Moreover, we are able to conduct robustness tests for other types of unobserved differences across workers in closing and stable plants.

Our empirical results suggest that paternal job loss has a substantial negative effect on children's school performance in municipalities with mediocre performing job markets (defined by unemployment rates above 2.5 percent, constituting 70 percent of our sample). In these municipalities, paternal job loss is associated with a 0.10 point reduction in graduation-year GPA, a decrease of 14 percent of a standard deviation. In contrast, maternal job loss is associated with an (marginally significant) increase in GPA in municipalities with mediocre performing job markets. For both parents, we find no evidence that job loss affects children's school performance in "booming" municipalities.

Additional analyses fail to support a number of possible mechanisms for the negative effect of paternal job loss. Specifically, the GPA effect of paternal job loss appears largely unrelated to its effect on father's income and employment, a shift in parental time towards child

[3] Throughout, we use the term "plant" to refer to the establishment at which a worker is employed, which is distinct from the firm of employment (as firms can consist of multiple plants).

rearing activities, marital dissolution, and residential relocation. Instead, the disparate effects of plant closure across fathers and mothers appear to be consistent with sociological literature suggesting that men and women respond to job loss differently because of social norms and feelings of identity (Gershuny 1994, Jahoda 1982). According to this literature, the larger variety of non-employment-related roles, with which women identify, makes them more adaptable and equipped to handle job loss. In contrast, job loss can be detrimental for the man, because a large part of his identity is connected to his specific job. While speculative, these arguments are consistent with empirical studies documenting that the mental distress experienced by displaced workers is generally more severe for men than women (McKee-Ryan et al. 2005, Grzywacz and Dooley 2003, Waters and Moore 2002). If parents are unable to fully shield their children from the documented distress fathers experience in association with job loss, this could account for the negative effect of paternal job loss on children's GPA.

To date, we have limited empirical research on the implications of parental job loss for children. A notable exception is a recent paper by Kalil and Ziol-Guest (2008) documenting a significant adverse association between fathers' job loss and children's academic progress using the US Survey on Income and Program Participation. Consistent with our results, Kalil and Ziol-Guest (2006) find disparate effects of job loss across fathers and mothers. Other notable exceptions are Oreopoulos et al. (2005) and Bratberg et al. (2008) which study intergenerational income mobility using job loss associated with plant closure. Using Canadian data, Oreopoulos et al. (2005) find that children whose fathers were displaced have about 9 percent lower earnings than similar children whose fathers did not experience an employment shock. In a similar study using Norwegian data, Bratberg et al. (2008) find no effect of parental job loss on children's future earnings. The disparate effect across the Canadian and Norwegian study may be due to the generally high intergenerational earnings mobility in Scandinavian countries with generous welfare systems.

The remainder of the paper is laid out as follows. Section 2 discusses our empirical strategy and defines closing and stable plants. Section 3 describes our dataset and defines our measure of school performance. Section 4 presents our empirical results. Section 5 explores possible mechanisms. Section 6 concludes.

2. Empirical Strategy

Our dataset allows us to measure plant downsizing by looking at changes in employment levels by plant and year. We will refer to the *plant downsizing rate* (PDR) as the percentage change in employment from year *s* to year *t*. More precisely, the plant downsizing rate in worker *i*'s plant is given by

$$(1) \qquad PDR_{s,t}^{i} = \frac{FTE_{s}^{i} - FTE_{t}^{i}}{FTE_{s}^{i}},$$

where FTE_{s}^{i} and FTE_{t}^{i} are point-in-time plant employment counts in years *s* and *t*, denoting number of workers (full-time equivalents) in worker *i*'s plant at the end of each year, excluding worker *i* himself. In the following, we will refer to a plant reducing employment (from *s* to *t*) by more than 90 percent (i.e. $PDR_{s,t}^{i} > .90$) as a *closing plant*, and a plant with no reduction in employment (i.e. $PDR_{s,t}^{i} \leq 0$) as a *stable plant*.

Our register data reports employment counts in plants at the end of the year, whereas in Norway the school year starts in August and ends in June. For simplicity, however, we will refer to year x as the year a student starts the xth grade. We restrict our sample to graduating secondary students, 10th graders, whose fathers at the end of year 7 (i.e. middle of 7th grade) were employed in a plant that either closed during the next two years or was stable during this period.

Equation 2 defines the linear regression model that serves as our primary empirical specification throughout the analysis:

$$(2) \qquad G_i = \alpha + \eta W_i^{nb} + \eta^b W_i^b + \beta B_i + \gamma X_i + \delta C_i + u_i$$

where

- G_i ~ Measure of child *i*'s 10th grade educational outcome (grade point average)
- W^{nb} ~ Indicator that the father at the end of year 7 was employed in a plant that closed by the end of year 9 and that the municipality of residence was not booming (at least 2.5 percent unemployment)
- W^{b} ~ Indicator that the father at the end of year 7 was employed in a plant that closed by the end of year 9 and that the municipality of residence was booming (less than 2.5 percent unemployment)

B	~	Indicator that the municipality of residence was booming (less than 2.5 percent unemployment)
X	~	vector of characteristics of *i*'s father's plant (at the end of year 7); of *i*'s mother and father (at the end of year 7); and of *i*'s birth quarter, birth order and number of siblings.
C	~	vector of cohort dummies
u_i	~	error term with mean zero

As indicated, we allow for varying effects of plant closure across booming (less than 2.5 percent unemployment) and non-booming municipalities, expecting any detrimental effect of plant closure to be smaller when new job opportunities are abundant.[4] The parameter of interest is the estimated plant closure coefficient, η, which captures the incremental decrease in school performance from plant closure in a non-booming municipality relative to children whose father is working in stable plants. Estimation of Equation (2) will produce unbiased estimates of η provided that plant closure events are determined by exogenous economic shocks and are independent of unobservable determinants of children's school performance. This identifying assumption may be difficult to defend for several reasons. For example, plant closures may be associated with particular industries. If children of workers in these industries are more likely to perform poorly at school (and this is not captured by our observables), then our estimate of η will exaggerate a detrimental impact of parent's exposure to plant closure on the child's school performance. Similarly, the estimate of η will also be too large if plant closure events are concentrated in municipalities with children of low school performance or in areas with poor public schools. In our empirical analysis we address these potential sources of bias by including industry, municipality and school fixed effects.

Estimates of η could also be biased if workers with less parenting resources are concentrated in failing plants. In order to check for this potential source of bias we see how our estimate moves if we drop important covariates controlling for father and mother characteristics. It is well documented that parent's income and education are strong predictors of children's outcomes (e.g. Hill and Duncan 1987, Solon 1992, Haveman and Wolfe 1995). If our estimated effect does

[4] Modest changes in the unemployment rate cutoff used to define booming and non-booming municipalities had only small effects on our estimates in the expected direction.

not increase with the exclusion of these covariates, it suggests that workers with less parenting resources are not concentrated in failing plants.

It should be noted that, absent the sources of omitted variable bias identified above, our results potentially under-estimate the impact of plant closure on children's school performance since our plant closure measure is based on a worker's original plant of employment in year 7. Job mobility across downsizing and non-downsizing plants would therefore tend to attenuate our estimates.

3. Dataset Description

Our empirical analysis utilizes two separate databases provided by Statistics Norway: an educational database and a register database called *FD-trygd*. The educational data includes school identifiers and grade outcomes for graduating secondary students (10^{th} graders) in Norway for 2003-2005. The *FD-trygd* data includes a rich longitudinal dataset containing records for every Norwegian from 1992 to 2003. The variables captured in this dataset include individual demographic information (sex, age, marital status, number of children), socio-economic data (years of education, income, wealth), current employment status (full time, part time, minor part time, self-employed), industry of employment (if employed), indicators of participation in any of Norway's welfare programs, and geographic identifiers for municipality of residence. Importantly, the *FD-trygd* data includes personal identifiers for one's parents, allowing us to link 10^{th} graders to their parents.

In addition, *FD-trygd* contains records for employment "events" since mid-1995. These events, captured by individual and date, include entry and exits into employment, changes in employment status (full time, part time, minor part time), and changes in plant and firm of employment. These employment events are constructed by data analysts at Statistics Norway from raw employment spell records submitted by employers, and verified against employee wage records (not available to us) to ensure the validity of each spell and to eliminate records pertaining to "secondary" employment spells.[5]

Based on the employment records, we constructed plant-level employment counts at the end of years 7 and 9. The counts were constructed as measures of full-time equivalents (FTEs), with

[5] If an individual was employed in multiple plants as a given time, primary employment was determined by employment status and recorded income from each source of employment.

part time and minor part time employment measured as 0.67 and 0.33 FTEs, respectively. Excluded from these counts were any persons identified in *FD-trygd* as self-employed or receiving assistance that should have precluded full time work (those receiving unemployment benefits, a rehabilitation pension or a disability pension). Plant-level FTEs were then used to construct the measure of plant downsizing as defined in equation (1).

Based on the educational records, we constructed a summary measure of each 10th grader's performance in the 11 graduating subjects.[6] Grades in individual subjects are awarded on a scale from 1 to 6, where six indicates excellence and 1 indicates very little competence. It is not obvious how individual marks should be aggregated into one summary measure (Hægeland et. al 2004). For example, a summary measure giving equal weight to mathematics and physical education may not be the most adequate. Consequently, we adopt a summary measure of grade point average (GPA) constructed by Hægeland et al. (2004) that puts weights on the different subjects in accordance with the number of teaching hours.

Our analytic sample consists of all native 10th graders graduating during 2003-2005. A number of exclusion criteria were applied to create our final sample of 10th graders. First, in Norway it is most common for children to start school the calendar year they turn six and graduate from 10th grade the calendar year they turn sixteen. In order to ensure that our estimate is identified from kids of standard school age, we limited our sample to those who graduated within one year of normal graduation age. Second, we excluded all children with unmarried parents at the end of year 7, to ensure that the effect of job loss is identified from families in which the father most likely lives in the same household as the child. Third, and important for our identification strategy, we restrict our sample to 10th graders whose father at the end of year 7 (i.e. middle of 7th grade) was employed full time in a plant that either closed during the next two years or was stable. Fourth, we excluded children of fathers with less than one year of tenure in his year 7 plant or where the father received assistance that should have precluded full-time employment. Since the personal income variable in *FD-trygd* includes both earnings and governmental assistance, this restriction ensures that personal income consistently captures annual earnings in year 7, though it potentially includes earnings from more than one employment source. Fifth, to ensure that our estimate is not driven by the closure of plants with persistently unstable employment levels or recent start-ups, we restrict

[6] This excludes the subject of *Nynorsk*, which is a more traditional way of reading and writing in Norwegian from which many students are exempt.

the sample to children where the father at the end of year 7 was employed in plants that were stable during year 7 and had existed for at least 3 years. Finally, we exclude all children with fathers working in the educational sector, since plant closure in this sector may affect the children directly. Applying these restrictions provided us with a sample of 10,344 tenth graders.

As described in the empirical strategy, the estimated effect of plant closure on children's school performance is captured through the inclusion of plant closure dummies for closures in booming and non-booming municipalities. During our period of study the Norwegian economy was thriving and several municipalities were booming with unusually low unemployment rates. In these municipalities we expect the effect of plant closure to be smaller since new job opportunities are abundant. We refer to a municipality with less than 2.5 percent unemployment as a "booming municipality". As a measure of unemployment we use the average unemployment rate in year 8 and 9, the time period through which we measure downsizing. About 30 percent of our sample of children live in a booming municipality (see Table 1).

The estimated plant closure coefficients capture the incremental decrease in school performance relative to children with fathers in stable plants. Based on characteristics at the end of year 7, a large number of covariates for the child, mother and father were included in all models:

- *Child Characteristics*
  - sex
  - number of siblings (0,1,2,3,4, ≥5) and birth order (1,2,3,4,5, ≥6): 21 categories (interacted)
  - birth quarter and age at graduation (15,16,17): 12 categories (interacted)
  - graduation year: 3 categories
- *Father Characteristics (end of year 7)*
  - age at birth of child (<20,20-25,25-30,30-35,35-40, 40-45,≥45): 7 categories
  - age at birth of his oldest child (<20,20-25,25-30,30-35,35-40, 40-45,≥45): 7 categories
  - number of children with other women than the mother of the child (half siblings): linear
  - years of education (<9, 9-12, 13-15, ≥16): 4 categories
  - years of tenure in plant (1-3,3-5,5-10, ≥10): 4 categories
  - plant size (10-25, 25-50, 50-100, 100-500, ≥500) : 5 categories

- personal income: linear and quadratic
- household wealth: linear and quadratic
- received sick money during year: indicator
- received social assistance: indicator

- *Mother's Characteristics (end of year 7)*
  - age at birth of child (<20,20-25,25-30,30-35,35-40, 40-45,≥45), 7 categories
  - age at birth of her oldest child (<20,20-25,25-30,30-35,35-40, 40-45,≥45), 7 categories
  - number of children with other men than the father of the child (half siblings): linear
  - years of education (<9, 9-12, 13-15, ≥16): 4 categories
  - employment status (not employed, unemployed, self-employed, employed full time, part time or minor part time): 6 categories
  - plant downsizing (≤0, 0-30%, 30-60%, 60-90%, >90%): 5 categories
  - personal income: linear and quadratic
  - received sick money during year: indicator
  - received social assistance: indicator
  - received disability pension: indicator
  - received rehabilitation pension: indicator

Summary statistics for some of these variables are presented in Table 1. The first column presents means and standard deviations (in parenthesis) of our main analytic sample. About 6.8 percent of the 10^{th} graders had a father residing in a non-booming municipality and working in a plant in year 7 that closed during years 8 and 9. In the next two columns of the table we report the means and standard deviations for the sample of 10^{th} graders with fathers being employed in closing and stable plants. The GPA is slightly higher among 10^{th} graders with fathers in stable plants (4.15) compared to closing plants (4.11). The means of the other variables are similar across the two sub-samples. In particular, we see that the years of schooling of the fathers and the mothers is very similar in the two sub-samples, indicating that low-educated parents are not over-represented in failing plants. Taken together, children appear very similar on observables across stable and closing plants.

4. Empirical Results

4.1. Effect of Plant Closure on Children's School Performance

Table 2 presents OLS estimates for the effect of plant closure on children's school performance.[7] Standard errors in Table 2 (and subsequent tables) are corrected for heteroskedasticity and non-independence of residuals across children of fathers originally employed in the same plant.[8] Omitting industry, municipality and school fixed effects (see Model 1), we find that fathers' plant closure decreased children's GPA significantly in non-booming municipalities. In booming municipalities, there is no effect of plant closure. As discussed in Section 2, an important concern for our empirical strategy is that plant closures might be concentrated in industries or in geographic areas in which children for some other reason have poor school performance. If so, controlling for industry, geographic area and school fixed effects would be expected to reduce the magnitude of the estimated effect of plant closure. Inclusion of fixed effects for industry (see Model 2) has a modest impact on our estimate, with no significant differences across estimates in the two models. In fact, the magnitude of the estimated effect increases, inconsistent with the expected direction of omitted variable bias. Similarly, the estimated effect increases modestly when year-specific municipality fixed effects and school fixed effects are included (see Models 3 and 4).[9]

Even if father's plant closure is uncorrelated with unobserved determinants of grade outcomes, OLS estimates of η and η^b potentially misrepresent the average effect of father's plant closure if effects are heterogeneous along characteristics correlated with father's closure. To address this concern, Models 5 and 6 provide estimates of the "average treatment effects" using propensity matching methods described in Becker and Ichino (2002).[10] For computational reasons, estimation was performed separately for non-booming and booming municipalities and was unable to accommodate school fixed effects. The estimates are similar, though modestly larger in magnitude, to those in Model 3. They are also similar to OLS estimates obtained when separately

[7] Tobit estimation yields similar results (not reported).
[8] Using the "robust cluster(.)" option in Stata 9.2.
[9] Note that grades assigned on relative performance could explain why the estimate grows with inclusion of municipality and school fixed effects. If grades are assigned based on relative performance, the students unaffected by downsizing could see their grades increase if they attend school with students that were affected by downsizing.
[10] The average treatment effect estimates shown utilize the radius matching method discussed in Becker and Ichino (2002), implemented via the "attr" command developed for Stata® 8.0 using the default radius of 0.1. That is, each "treated" observation (i.e. fathers' plant closed) was matched to "control" observations within 10 percentage points in the estimated probability of father's plant closure. Reducing the size of the defined radius had minimal effect on the estimates.

estimated over the non-booming and booming municipalities (see Models 7 and 8). We are therefore comfortable interpreting the OLS results as estimates of the average effect associated with father's plant closure.

We also estimated quantile regression models to explore whether the effect of father's plant closure varied over the distribution of grade outcomes. These were implemented omitting municipality-year and school fixed effects, as the models failed to converge when the larger number of dummy covariates were included. Nonetheless, these estimates showed little evidence that the effect of father's plant closure varied over the distribution of grade outcomes. The estimated effects at the 5^{th}, 10^{th}, 25^{th}, 50^{th}, 75^{th}, 90^{th} and 95^{th} quantiles were similar in magnitude to those in Model 2.

We view the estimates including both industry and school fixed effects as our preferred estimate (Model 4). These results suggest that the grade point average is about 0.10 points lower among children of fathers originally employed in closing plants and residing in non-booming municipalities. This represents a 14 percent decline relative to the standard deviation of grade point average in our sample. Given the (approximately) normal distribution of GPAs, a decline of this magnitude for the median student is equivalent to a decline of over five percentage points in class rank. Thus, the average effect of plant closure is considerable in non-booming municipalities. For fathers residing in booming municipalities, about 30 percent of our sample, there is no effect of plant closure.

4.2. Robustness Tests

Our estimate is potentially biased if working parents of less academically skilled children or those with less parenting resources are concentrated in failing plants. It is well documented that parental education and household income are strong predictors of children's outcomes (e.g. Hill and Duncan 1987, Solon 1992, Haveman and Wolfe 1995), and we control for these characteristics in the estimates presented above. Nonetheless, our results remain potentially biased to the extent that unobserved variation in school performance or parenting resources persists conditional on these measured characteristics. To investigate this potential source of bias, Models 2-4 in Table 3 present estimates for the plant closure effect omitting covariates capturing parental education and household income and wealth. For comparison, Model 1 replicates the results of our preferred model (Model 4 in Table 2). Omitting these covariates has only a small effect on our estimate, in a

direction that is inconsistent with the hypothesis that exposure to plant closure is concentrated among children expected to perform at lower levels.

An alternative source of bias could arise if unobserved shocks affecting children's educational outcomes somehow influence plant closure. For instance, a negative health shock experienced by a key worker in a plant could negatively affect both his children and his plant's performance. Such scenarios would seem more plausible in smaller plants. In Model 5, we therefore restrict our sample to children of workers in larger plants. This restriction actually increases the magnitude of our estimate, suggesting that our original estimate is not biased by unobservable shocks spilling over from workers to their plants.

5. Exploring Mechanisms

5.1. Effect of Fathers' Plant Closure

Tables 4 and 5 explore several mechanisms through which the closure of a father's plant could potentially affect his child's school performance.

Several analysts have documented a negative effect of plant closure on workers' future income (see e.g. Huttunen, Møen and Salvanes 2006, Eliason and Storrie 2006, Rege, Telle and Votruba 2008, Jacobson, Lalonde and Sullivan 1993). If household income affects a child's educational attainment, as suggested by some studies (e.g. Baum 2003, Blau 1999), this suggests a mechanism through which fathers' plant closure might reduce children's school performance. In Model 1 of Table 4, we estimate a modest (and only marginally significant) negative effect of father's plant closure on father's subsequent income in non-booming municipalities. This is likely the result of Norway's generous unemployment benefits the first year after a job loss, as our income variable also captures income from governmental transfers.

It has also been documented that workers exposed to plant closure are more likely to be unemployed in the future (see e.g. Eliason and Storrie 2006, Rege, Telle and Votruba 2008), a finding we replicate in two ways in our analytic sample. Model 2 indicates that the probability of full-time employment at the end of year 9 is significantly lower for fathers in closing plants. Moreover, Model 3 indicates that the probability of drawing unemployment benefits ("day money")[11] at some point between years 7 and 9 is significantly larger for fathers in closing plants

[11] All unemployed workers in our sample are entitled to day money following displacement provided they actively search for a new job.

residing in non-booming municipalities. These employment effects represent another plausible mechanism for the negative GPA effect of father's job loss, since spells of unemployment can be associated with stress and depression from which it may be hard to shelter the child. Alternatively, spells of unemployment may induce a shift in parental time towards child rearing activities.

Plant closure may also affect married workers' likelihood of divorcing (Rege, Telle and Votruba, 2007) and their likelihood of relocating to a different municipality. However, in our sample we find no evidence that fathers' plant closure in non-booming municipalities has either of these effects (see Models 4 and 5). Divorce and residential relocations therefore appear to be unlikely mechanisms for explaining the negative GPA effect.

We further explore the plausibility of these mechanisms in Table 5 by re-estimating our original model under different sample restrictions. In Model 2 our preferred specification is re-estimated excluding fathers with unusually small income growth over the period (less than 5 percent). This restriction excludes a larger fraction of fathers exposed to closure, so modest attenuation of the GPA effect estimate is expected. However, if the negative GPA effect of fathers' plant closure is due to fathers suffering negative income effects, estimates under the restricted sample should decline substantially. Comparing Model 2 to our original model (replicated in Model 1) the estimate does decline but only modestly, which fails to support the hypothesis that income declines are an important mechanism in the GPA effect.[12]

In Model 3 the sample is restricted to fathers employed full-time at the end of year 9, while Model 4 excludes fathers who received unemployment benefits over the period. Again, these restrictions attenuate the GPA effect estimates but only modestly. Thus, the employment implications of plant closure do not appear to be important mechanisms in explaining the GPA effect.

For completeness, Models 5 and 6 of Table 5 exclude cases where the parents divorced or the father moved to a new municipality by the end of year 9. Finding any difference here would be very surprising given the non-effect of fathers' plant closure on these outcomes and the small number of observations excluded under these sample restriction, and the estimates are virtually unchanged.

[12] This is in contrast to the Oreopoulo et al. (2006) finding that fathers' exposure to plant closure leads to a substantial decline in children's future income, and that the effect is driven almost entirely by changes in fathers' income.

The preceding analyses fail to support a number of possible mechanisms for the negative effect of fathers' exposure to plant closure on children's GPA. Specifically, the GPA effect of fathers' job loss appears largely unrelated to its effect on father's income and employment status, marital dissolution, and residential relocation. An alternative mechanism implied by Becker's (1993) economic model of the family is that father's plant closure induces a shift in the division of household production, in which the father assumes a larger share of the home production and the mother assumes a larger share of the market production. Such a shift in the household division of labor may affect the child. We investigate this hypothesis in the next section.

5.2 Shift in Household Division of Home and Market Production

Becker's (1993) economic model of the family emphasizes how parents seek to maximize the total utility of the family members, typically determined by leisure time, consumption and child outcomes, by effectively allocating their time between home and market production, in addition to leisure. To maximize the utility of the household, parents choose their optimal division of labor. If, for example, the father has better opportunities than the mother in market production, then the father will typically specialize in market production, whereas the mother specializes in home production. This division of labor is reinforced if the mother is better than the father in home production.

An important implication of Becker's model is that parental job loss may change the optimal division of labor in the household. If, for instance, job loss reduces a father's opportunities for market production, the household could find it optimal for the father to reduce his time spent in market production while the mother increases hers. The father may in turn increase his time spent in home production while the mother reduces hers. Such shifts in the household division of labor could potentially explain the negative effect of father's job loss on children's GPA, for example, if displaced fathers do not fully replace the mother's decreased time in home production or if mothers are more effective at child rearing than fathers.

In Table 6 we investigate such possibilities. In Model 1 we replicate our original GPA effect estimate. Consistently with a shift in the household division of labor, Model 2 estimates a significant positive effect of fathers' plant closure on the likelihood that mothers are full-time employed at the end of year 9. Thus, it is plausible that the negative GPA effects are linked to shifting divisions of labor in households affected by plant closure.

To further investigate this possibility, we sought to identify a sub-sample of mothers who, by virtue of their earnings history, appeared most able to increase their market production in response to fathers' plant closure. Specifically, the sample in Models 3 and 4 is restricted to children for whom mother's income in year 7 is less than 75 percent of their average income over her highest three income years preceding year 7.[13] As shown in Model 4, the effect of fathers' plant closure on mothers' likelihood of being full-time employed at the end of year 9 is more than twice as large for this subsample. However, the GPA effect is only slightly larger (see Model 3), suggesting the negative effect of fathers' plant closure is not concentrated in families where mothers responded by increasing employment.

Thus, these results fail to suggest that a shift in the household division of labor is an important mechanism through which fathers' plant closure affects children's GPA. In section 5.4 we will discuss how our results are consistent with identity and role theories from the field of sociology. First, however, we will investigate how children are affected by mother's plant closure.

5.3. Effect of Mothers' Plant Closure

In Tables 7 and 8 we explore the effect of plant closure experienced by the mothers. To do so, we constructed a dataset analogous to our main analytic sample except that the conditions applied to fathers (regarding labor market attachment etc., cf. Section 3) were instead applied to mothers (and v.v.). Due to the lower labor force participation of mothers, our sample size is substantially smaller for this dataset. All relevant models from Tables 4 and 5 were then replicated for this sample.

Although mothers' plant closure has qualitatively similar effects to fathers' plant closure in terms of subsequent income and employment (see Models 1-3, Table 7), some interesting differences emerge. In particular, plant closure in both non-booming and booming municipalities has a substantially larger negative effect on a mother's probability of full-time employment in year 9, despite a more modest effect on the receipt of unemployment benefits. Thus, it appears that mothers exposed to plant closure are less likely to actively search for a new job, especially in booming municipalities.

[13] For this purpose, we use historic "pension point" income records, which refers to income that counts towards eligibility and/or affects benefit size for various Norwegian pension programs. Also excluded are any mothers receiving a disability or rehabilitation pension, and those whose highest three years of pension point income (prior to year 7) were insufficient to accumulate "pension point" credits for having worked.

In Model 1 of Table 8, we find no evidence that mothers' plant closure has a negative effect on children's school performance. Instead, the estimated effect of mothers' exposure is positive and marginally significant in non-booming municipalities. We can see that Models 2, 3 and 4 fail to support a change in income or employment status as possible mechanisms for the positive effect of mothers' plant closure. In the next section we will argue that the disparate effects of plant closure across fathers and mothers are consistent with identity and role theories from the field of sociology.

5.4. Social Roles and Identity

According to theories of social roles and identity from the field of sociology, social norms and historical employment patterns allow women to develop and appreciate a greater range of non-employment-related roles (Gershuny 1994, Jahoda 1982), such as child rearing. The variety of roles with which women identify makes women more adaptable and equipped to handle job loss. In contrast, men's identity is to a larger degree associated with his specific work. This suggests that, despite new employment, job loss can be detrimental for the man because a large part of his identity was connected to his specific job. The job loss has reduced his options on the labor market and, especially in a municipality with a mediocre performing job market it is challenging to find a new job which will replace his identity loss. While speculative, these arguments are consistent with empirical studies documenting that the mental distress experienced by displaced workers is generally more severe for men than women (McKee-Ryan et al. 2005, Grzywacz and Dooley 2003, Waters and Moore 2002). If parents are unable to fully shield their children from the distress experienced by the displaced father, this could account for our negative effect of paternal job loss on children's GPA.

Evidence from time use surveys could also shed light on our findings. Several studies find that the time devoted by the husband to housework is hardly affected by job displacement, a result often taken to reflect persistence in the roles played by spouses (Gallie et al. 1994). Yeung et al. (2001) find that the role of providing teaching and homework assistance is predominantly occupied by the mother. If mothers adapt to job loss by shifting their energy towards this role, this could contribute to the positive effect of mothers' plant closure on children's GPA. This interpretation of our results is consistent with the positive effect of mothers' plant closure on children's school performance despite the larger (compared to fathers) negative effect on mothers' subsequent

employment, though it admittedly fails to explain why the positive GPA effect of mothers' plant closure only emerges in mediocre performing employment markets.

5. Conclusion

It is well documented that job loss may be detrimental to affected workers. Job loss has a negative effect on future earnings and health, and increases the likelihood of future unemployment, welfare program participation and divorce.[14] In this paper, we document that in municipalities with mediocre-performing job markets children are also affected by their parents' experience of job loss. In these "non-booming" municipalities, we find that fathers' exposure to plant closure has a negative effect on children's school performance, reducing graduation-year GPA by 14 percent of a standard deviation. This negative effect does not appear to be due to the effects of closure on fathers' income and employment, a shift in the household division of labor, or the consequence of parental divorce or relocation. In contrast, mothers' plant closure in non-booming municipalities has a positive effect on children's school performance, increasing graduation-year GPA by 11 percent of a standard deviation.

The distinct effects we observe for fathers' and mothers' exposure to plant closure in non-booming municipalities can be interpreted in light of identity and role theories from the field of sociology. These theories have emphasized how men and women respond to job loss differently because of social norms and feelings of identity. The larger variety of non-employment-related roles, with which women can positively identify, makes them more adaptable and equipped to handle job loss. If mothers adapt to job loss by shifting their energy towards their role of child rearing, this could contribute to the positive effect of mothers' plant closure on children's GPA.

In contrast, men's identity is to a larger degree associated with his specific job. Consequently, job loss can be detrimental for the man despite rapid reemployment. These arguments are consistent with empirical studies documenting that the mental distress experienced by displaced workers is generally more severe for men than women (McKee-Ryan et al. 2005, Grzywacz and Dooley 2003, Waters and Moore 2002). If parents are unable to fully shield their children from the distress fathers experience in association with job loss, this could account for the negative effect of fathers' exposure to plant closure on children's GPA.

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[14] See for example Jacobson, Lalonde and Sullivan (1993), Stevens (1997), Kletzer (1998), Dragano, Verde and Siegrist (2005), Huttunen, Møen and Salvanes (2006), Eliason and Storrie (2006), Sullivan and von Wachter (2006) and Rege, Telle and Votruba (2007, 2008).

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Table 1: Summary Statistics

variables	all	closing plants	stable plants
dependent variable			
10^{th} grade GPA	4.142	4.106	4.146
	(.762)	(.758)	(.762)
treatment variables (father's plant)			
plant closure in non-booming municipality	.0680	.6683	-
plant closure in booming municipality	.0337	.3317	-
non-booming municipality	.7017	.6683	.7055
child characteristics			
female	.5038	.5076	.5034
number of siblings	2.113	2.102	2.114
	(.854)	(.813)	(.859)
mother's characteristics			
age (when child was born)	28.20	28.21	28.20
	(4.51)	(4.49)	(4.51)
years of schooling (year 7)	13.18	13.18	13.17
	(2.40)	(2.30)	(2.40)
income(year 7)	187938	187898	187942
	(126691)	(121955)	(127222)
father's characteristics			
age (when child was born)	30.66	30.60	30.66
	(4.92)	(4.72)	(4.94)
years of schooling (year 7)	13.44	13.64	13.41
	(2.55)	(2.48)	(2.55)
income (year 7)	423479	412062	424771
	(310645)	(205918)	(320334)
tenure (year 7)	8.515	7.926	8.58
	(6.412)	(6.561)	(6.392)
# observations	10285	1046	9239

Note: Standard deviations are in parenthesis.

Table 2: Main results: Effect on children's 10th grade GPA of Plant Closure in Father's Plant

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Dependent variable: 10th grade GPA								
Plant closure in non-booming munic	-0.0853**	-0.0906**	-0.0944**	-0.1030**	-0.110**		-0.0937**	
	(0.0277)	(0.0262)	(0.0273)	(0.0274)	(0.032)		(0.0271)	
Plant closure in booming munic	0.0185	0.0042	0.0116	0.0078		0.040		0.0159
	(0.0367)	(0.0380)	(0.0431)	(0.0438)		(0.044)		(0.0458)
Included covars								
Industry FEs		X	X	X	X	X	X	X
Yearly munici FEs			X	X	X	X	X	X
School FEs				X				
Sample restriction								
Non-booming					X		X	
Booming						X		X
Mean	4.1419	4.1419	4.1419	4.1419			4.1495	4.1241
St. dev.	0.7620	0.7620	0.7620	0.7620			0.7609	0.7644
R-squared	0.25	0.26	0.34	0.40			0.34	0.38
N	10285	10285	10285	10285	5673	2108	7217	3068

Note: Models 1-4 and Models 7 and 8 are OLS estimates for the effect on 10th grade GPA of plant closure in father's plant of employment in year 7. Models 5 and 6 are propensity-matched estimates of the average treatment effect using the radius matching method discussed in Becker and Ichino (2002). * and ** denote significance at the 5 and 1 percent level. For OLS models, robust standard errors (in parenthesis) are corrected for non-independent residuals within plant. All estimates adjust for individual (child, mother and father) and plant characteristics (described in text).

Table 3: Robustness checks

	Model 1	Model 2	Model 3	Model 4	Model 5
Dependent variable: 10th grade GPA					
Plant closure in non-booming munic	-0.1030**	-0.0949**	-0.0886**	-0.0915**	-0.1639**
	(0.0274)	(0.0278)	(0.0286)	(0.0287)	(0.0429)
Plant closure in booming munic	0.0078	0.0245	0.0185	0.0122	0.0359
	(0.0438)	(0.0436)	(0.0455)	(0.0478)	(0.0583)
Sample redefinition					Exclude workers in plants with ≤50FTEs
Excluded covariates		Father's Education	Mother and father's education	Mother and father's education, income and wealth	
Mean	4.1419	4.1419	4.1419	4.1419	4.1789
St. dev.	0.7620	0.7620	0.7620	0.7620	0.7643
R-squared	0.40	0.38	0.36	0.34	0.47
N	10285	10285	10285	10285	5221

Note: OLS estimates for the effect on 10th grade GPA of plant closure in father's plant of employment in year 7. +, * and ** denote significance at the 10, 5 and 1 percent level. Robust standard errors in parenthesis, corrected for non-independent residuals within plant. All estimates adjust for individual (child, mother and father) and plant characteristics (described in text), as well as industry, year specific municipality and school fixed effects.

Table 4: Alternative Dependent Variables: Effect of Plant Closure in Father's Plant

	Model 1	Model 2	Model 3	Model 4	Model 5
Dependent variable:	Father's (log) income, year 9	Father full-time empl'd, at end of year 9	Father received DM[a] over years 7- 9	Divorced by the end of year 9	Relocated by the end of year 9
plant closure in non-booming munic	-10.2999+	-0.0379**	0.0576**	-0.0002	-0.0013
	(6.0113)	(0.0119)	(0.0122)	(0.0026)	(0.0035)
plant closure in booming munic	4.7327	-0.0172	0.0137	-0.0064*	-0.0046
	(11.0210)	(0.0134)	(0.0100)	(0.0030)	(0.0079)
Mean	462.4314	0.9599	0.0176	0.0037	0.0194
St. dev.	273.9815	0.1961	0.1315	0.0607	0.1381
R-squared	0.74	0.27	0.29	0.21	0.56
N	10258	10258	10285	10285	10285

Note: OLS estimates for the effect on specified dependent variable of plant closure in father's plant of employment in year 7. +, * and ** denote significance at the 10, 5 and 1 percent level. Robust standard errors in parenthesis, corrected for non-independent residuals within plant. All estimates adjust for individual (child, mother and father) and plant characteristics (described in text), as well as industry, year specific municipality and school fixed effects.

[a] DM = "day money," referring to the Norwegian unemployment benefit.

Table 5: Sample Restrictions: Effect on children's 10th grade GPA of Plant Closure in Father's Plant

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Dependent variable: 10th grade GPA						
Plant closure in non-booming munic	-0.1030**	-0.0830*	-0.0986**	-0.1000**	-0.1035**	-0.1033**
	(0.0274)	(0.0347)	(0.0284)	(0.0288)	(0.0274)	(0.0277)
Plant closure in booming munic	0.0078	-0.0073	0.0125	0.0154	0.0082	0.0111
	(0.0438)	(0.0509)	(0.0459)	(0.0446)	(0.0439)	(0.0447)
Sample restrictions		father's income increased at least 5 percent by the end of year 9	father full time empl'd at the end of year 9	father rec'd no DM[a] over the years 7-9	father and mother still married by the end of year 9	father did not move to new municipality by the end of year 9
Mean	4.1419	4.1564	4.1463	4.1450	4.1423	4.1459
St. dev.	0.7620	0.7585	0.7601	0.7615	0.7620	0.7598
R-squared	0.40	0.43	0.40	0.40	0.40	0.40
N	10285	7133	9847	10104	10247	10085

Note: OLS estimates for the effect on 10th grade GPA of plant closure in father's plant of employment in year 7. +, * and ** denote significance at the 10, 5 and 1 percent level. Robust standard errors in parenthesis, corrected for non-independent residuals within plant. All estimates adjust for individual (child, mother and father) and plant characteristics (described in text), as well as industry, year specific municipality and school fixed effects.

[a] DM = "day money," referring to the Norwegian unemployment benefit.

Table 6: Effects on Mother of Plant Closure in Father's Plant

	Model 1	Model 2	Model 3	Model 4
Dependent variable:	10th grade GPA	Mother full-time empl'd at end year 9	10th grade GPA	Mother full-time empl'd at end year 9
Plant closure in non-booming munic	-0.1030**	0.0357*	-0.1132*	0.0878*
	(0.0274)	(0.0162)	(0.0569)	(0.0356)
Plant closure in booming munic	0.0078	-0.0038	0.0294	0.0005
	(0.0438)	(0.0231)	(0.0811)	(0.0532)
Sample restrictions			Mothers with higher earning potential [a]	Mothers with higher earning potential [a]
Mean	4.1419	0.4714	4.1494	0.2355
St. dev.	0.7620	0.4992	0.7596	0.4244
R-squared	0.40	0.55	0.54	0.51
N	10285	10285	3376	3376

Note: OLS estimates for the effect on 10th grade GPA of plant closure in father's plant of employment in year 7. +, * and ** denote significance at the 10, 5 and 1 percent level. Robust standard errors in parenthesis, corrected for non-independent residuals within plant. All estimates adjust for individual (child, mother and father) and plant characteristics (described in text), as well as industry, year specific municipality and school fixed effects.

[a] See definition in text in section 5.2.

Table 7: Alternative Dependent Variables: Effect on children's 10th grade GPA of Plant Closure in Mother's Plant

	Model 1	Model 2	Model 3	Model 4	Model 5
Dependent variable:	Mother's income, year 9	Mother full-time empl'd at end of year 9	Mother received DM[a] over years 7- 9	Divorced by the end of year 9	Relocated by the end of year 9
plant closure in non-booming munic	-14.6285*	-0.0721*	0.0332*	-0.0063+	0.0010
	(7.1047)	(0.0299)	(0.0141)	(0.0035)	(0.0100)
plant closure in booming munic	-4.9627	-0.0689+	-0.0063	-0.0050	-0.0076
	(6.6113)	(0.0369)	(0.0108)	(0.0048)	(0.0089)
Mean	310.5198	0.8930	0.0153	0.0036	0.0171
St. dev.	126.7386	0.3091	0.1229	0.0600	0.1298
R-squared	0.85	0.42	0.56	0.29	0.74
N	4430	4430	4436	4436	4436

Note: OLS estimates for the effect on specified dependent variable of plant closure in mother's plant of employment in year 7. +, * and ** denote significance at the 10, 5 and 1 percent level. Robust standard errors in parenthesis, corrected for non-independent residuals within plant. All estimates adjust for individual (child, mother and father) and plant characteristics (described in text), as well as industry, year specific municipality and school fixed effects.

[a] DM = "day money," referring to the Norwegian unemployment benefit.

Table 8: Sample Restrictions: Effect of Plant Closure in Mother's Plant

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Dependent variable: 10th grade GPA						
Plant closure in non-booming munic	0.1007+	0.0686	0.1050+	0.0914+	0.0982+	0.0979+
	(0.0538)	(0.0632)	(0.0548)	(0.0545)	(0.0539)	(0.0539)
Plant closure in booming munic	-0.0166	-0.0142	-0.0037	-0.0139	-0.0138	-0.0045
	(0.0825)	(0.0884)	(0.0905)	(0.0842)	(0.0827)	(0.0820)
Sample restrictions		Mother's income increased at least 5 percent by the end of year 9	Mother full time empl'd at the end of year 9	Mother rec'd no DM[a] over years 7-9	Father and mother still married by the end of year 9	Mother did not move to new municipality by the end of year 9
Mean	4.1942	4.2179	4.2040	4.1980	4.1953	4.1985
St. dev.	0.7462	0.7387	0.7387	0.7445	0.7453	0.7437
R-squared	0.52	0.56	0.54	0.52	0.52	0.52
N	4436	3371	3956	4368	4420	4360

Note: OLS estimates for the effect on 10th grade GPA of plant closure in mother's plant of employment in year 7. +, * and ** denote significance at the 10, 5 and 1 percent level. Robust standard errors in parenthesis, corrected for non-independent residuals within plant. All estimates adjust for individual (child, mother and father) and plant characteristics (described in text), ,as well as industry, year specific municipality and school fixed effects.

[a] DM = "day money," referring to the Norwegian unemployment benefit.