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Plant Closure and Marital Dissolution

Abstract:
We estimate the effect of plant closure on divorce using a panel data set comprising more than 80,000 married couples in Norway. Plant closure substantially increases the likelihood of marital dissolution of workers in affected plants. The marriages of husbands originally employed in plants that closed between 1995 and 2000 were 11 percent more likely to be dissolved by 2003 than comparable marriages of husbands in stable plants. Additional analyses suggest that the effect of plant closure on divorce is not due to unexpected reduction in earnings. The results are, however, consistent with role theories, in which the husband's attractiveness declines if he fails to fulfill a traditional role as a breadwinner.

Keywords: marital dissolution, divorce, new information, shock, plant closure, plant downsizing, displacement

JEL classification: J12, J63, J65

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1. Introduction

Plant closure is an endemic feature of market economies, as producers adjust in response to changing market conditions. While such re-optimization can be crucial for long term economic performance, convincing evidence shows that plant downsizing can be detrimental to affected workers. Plant downsizing increases the likelihood of future unemployment and welfare program participation, in addition to having a negative effect on future earnings and health.[1] In the present empirical study we investigate how family life is affected by plant closure. In particular, we examine the effect of plant closure on marital dissolution.

Divorce rates have been rising since the 1960s in most Western countries. While divorce rates stabilized and tended to fall in the USA after 1980 (Stevenson and Wolfers 2007), they continue to rise in Western Europe (Council of Europe 2005). Recently, the percent of marriages ending in divorce has been just below 40 in the EU and around 50 in the USA (Eurostat 2007, Cherlin 2005). The causes of the rise in divorce rates are not well understood, but most scholars relate it to fundamental changes in the functioning of the labor market, and particularly, women's increased labor force participation (Easterlin 1980, Cherlin 1992, Stevenson and Wolfers 2007).

Exposure to plant closure can affect marital stability through several mechanisms. For example, plant closure could lower future family earnings (Jacobson, Lalonde and Sullivan 1993, Rege, Telle and Votruba 2005, Huttunen, Møen and Salvanes 2006),[2] reducing future expected consumption opportunities within marriage. Alternatively, plant closure could force the affected spouse into a different role in the family (for example away from a "masculine" role as a breadwinner), and thereby reduce his or her self-esteem and attractiveness as a spouse (Jahoda 1982, Vahtera and Kivimaki 1997, Waters and Moore 2002, McKee-Ryan et al. 2005). Our empirical analysis investigates the plausibility of these two mechanisms; reduced earnings and role theories.

We study the relationship between plant closure and divorce using a comprehensive, longitudinal register database containing annual records for every person in Norway. In our main analytic sample, we consider all couples being married in 1995 where the husband is closely attached to the labor marked, yielding more than 80,000 couples. The register data allows us to calculate employment counts by plant and year, identifying workers who in 1995 were employed in a plant that subsequently

[1] See for example Jacobson, Lalonde and Sullivan (1993), Stevens (1997), Dragano, Verde and Siegrist (2005), Rege, Telle and Votruba (2005) and Huttunen, Møen and Salvanes (2006).

[2] Economists often focus on the effect of earnings reductions on marital instability; see Weiss 1997.

closed or was stable. Our effect estimate of plant closure on marital dissolution is based on comparisons of covariate adjusted divorce rates across married workers originally employed in closing and stable plants. The crucial identifying assumption is that plant closure events are uncorrelated with unobserved individual determinants of marital dissolution. Importantly, if this assumption does not hold, we would expect workers in closing plants to have a higher propensity to divorce *even prior to the closure event*. The richness of our dataset allows us to test this, and to do additional specification checks testing for unobserved differences across workers in closing and stable plants.

Our empirical results suggest that husbands' exposure to plant closure has a substantial effect on marital dissolution. The marriages of husbands originally employed in plants closing between 1995 and 2000 were 11 percent more likely to be dissolved by 2003 than comparable marriages of husbands in stable plants. We do not observe a stronger association between future low earnings and plant closure among divorced workers than among workers who stayed married. This suggests that the effect of husband's plant closure on divorce is not due to an unexpected reduction in earnings. Interestingly, however, we find no significant effect of wives' exposure to plant closure on likelihood of divorce. Moreover, the effect of husbands' exposure to plant closure on divorce is larger among couples where the husband is "the main bread winner" with earnings exceeding 1.25 of the wife's earnings. These findings are consistent with role theories, in which the husband's self-esteem and attractiveness decline when he fails to fulfill the traditional "masculine" role as a breadwinner.

Using rich register data, this paper presents the first empirical investigation identifying a *casual link* between a spouse's job loss and divorce. The relationship between job loss and marital instability has been an important empirical research topic within the social sciences for a long time (see e.g. Jahoda, Lazarsfeld and Zeisel 1933, Liker and Elder 1983, Jensen and Smith 1990, Kraft 2001, Charles and Stephens 2004, Eliason 2005, Hansen 2005, Schøne and Hardoy 2007).[3] Due to data limitation, however, previous analyses may be plagued by omitted variable bias; workers experiencing a job loss are likely to hold unobservable characteristics (ineffective, easily bored, lazy, unfocused, non-cooperative, limited social skills, etc.) that impact both the likelihood of job loss and marital dissolution.[4] In this paper

[3] See Ström (2003) for a review of empirical research on relationships between unemployment and the family.

[4] Charles and Stephens (2004) find that the likelihood of divorce rises after a spouse is being laid-off but does not change after a spousal displacement due to plant closings. This is also what we may expect to find in the presence of omitted variable bias. Omitted variable bias seems a minor issue in Eliason (2005), who investigates the effect of displacement due to establishment closures on marital dissolution using Swedish administrative data. He finds a positive (though often barely significant) effect of closure on the risk of divorce. However, he compares workers in establishments that close down fully with workers in establishments that possibly downsize substantially (p. 5-6). Moreover, he does not seem to exclude from his sample couples that married just ahead of or at the time of the closure, for whom the closure might have been fully anticipated at the time of marriage. These two issues appear likely to bias the estimated effect downwards.

we circumvent this omitted variable bias by focusing on job losses that are associated with plant closures.

This paper also adds to the literature investigating the effect of "new information" on marital instability (Becker, Landes and Michael 1977, Weiss and Willis 1997, Charles and Stephens 2004).[5] The main idea in this literature is that new information about a spouse that was unanticipated at the time of marriage, often labeled a "shock", can cause divorce by altering the spouses' initial belief of a positive expected benefit from the marriage (Becker, Landes and Michael's 1977). Becker, Landes and Michael (1977) and Weiss and Willis (1997) construct the shock-variable as the contrast between realized earnings and earnings estimated in a regression run on cross-sectional or panel data. Charles and Stephens (2004) apply job displacement and disability to measure shocks. The general result in these studies is that the shocks affect marital instability. To avoid biased results, the measures of shock should represent information that was unanticipated by the spouses at the time of marriage. It might, however, have been evident to the spouses at the time of marriage that the earnings level could not be sustained or that the health of a spouse would deteriorate, leading to omitted variable bias.[6] In the present paper we utilize plant closure events to capture unanticipated shocks.

The remainder of the paper is structured as follows. Section 2 discusses possible mechanisms through which plant closure can affect the likelihood of divorce. Section 3 presents the empirical strategy. Section 4 describes the dataset. Section 5 presents our results, specification and robustness checks, as well as discussions of the plausibility of different channels through which plant closure can cause divorce. Section 6 concludes.

2. Mechanisms

Work by Gary Becker (Becker 1973, 1974, 1991, Becker, Landes and Michael 1977) is the typical point of departure for studies in economics on causes of marital instability. The main idea is that a union is formed and maintained if both spouses expect utility of the marriage to exceed utility from available alternatives, like being single or marrying someone else. The quality of the match would vary considerably among married couples, depending on the pool of alternative spouses and the information available on possible spouses. In this model, important determinants of marital instability include the quality of the initial match, investment in marital-specific capital (e.g. children) and new

[5] See also Hoffman and Duncan (1995) and Böheim and Ermisch (2001).

[6] The bias may be enhanced by attenuation bias if there is measurement error in the shock variable.

information about the spouse's attractiveness as a partner. New and unanticipated information about a spouse, a "shock", can cause the spouses to reconsider the expected benefits of the marriage. If an unpleasant surprise makes a spouse alter the previous belief that the expected benefit of the marriage is positive, the couple will divorce.

Consistent with Becker's theory of marital instability, economists have typically focused on marital instability of unanticipated reductions in the pecuniary gains from marriage (see e.g. Weiss 1997). Future plant downsizing events can be hard to anticipate at the time of marriage, and it is well documented that plant downsizing reduces affected workers' future earnings (Jacobson, Lalonde and Sullivan 1993, Stevens 1997, Huttunen, Møen and Salvanes 2006, Rege, Telle and Votruba 2005). This suggests that unanticipated earnings reductions can be an important mechanism through which plant closure can affect marital instability.[7]

Not only pecuniary shocks can precipitate divorce, but so can any unexpected deterioration of a spouse's attractiveness as a mate, like mental or physical health. Convincing evidence suggest plant closure imposes health related stress on affected workers (e.g. Vahtera and Kivimaki 1997, Dragano, Verde and Siegrist 2005, and Rege, Telle and Votruba 2005). Thus, unanticipated deterioration in physical or mental health might be an additional mechanism through which plant closure can affect divorce. Plant closure may also increase marital instability through affecting the spouses' investment in marital specific capital. For example, a couple may delay having children as a consequence of plant closure.

In discussing effects of unemployment or job displacement on marital instability, sociologists often employ social exchange theories (Scanzoni 1979, Cook 1987), family stress theories (Hill 1949, Burr 1973, Aneshensel 1992) or role theories (Linton 1936, Nye and McLaughlin 1982). Similar to Becker's theoretical framework, social exchange theories and family stress theories imply that reductions in earnings can increase marital instability, and so could also e.g. poorer mental or physical health. Role theories, however, would emphasize the detrimental effects on marital well-being of a husband failing to live up to a traditional role of a breadwinner. Consequently, job displacement can lead to shifts of roles within the household. Male unemployment may put greater responsibility for

[7] Whether the overall effect on divorce of a reduction in the pecuniary gains from marriage is positive or negative is not obvious (Becker, Landes and Michael 1977, Charles and Stephens 2004). The shock may affect both the expected gain within the current marriage and the expected gain from dissolving the current union. For example, an unanticipated reduction in the husband's earnings will reduce the expected within-marriage utility of the spouses, which would raise the likelihood of marital dissolution. On the other hand, however, the expected gain from an outside opportunity, like becoming single or remarrying someone else is likely to decline if the husband experiences an earnings reduction. This tends to stabilize the current union. Still, most empirical studies in this field tend to find a negative rather than a positive effect of unanticipated reductions in earnings on marital dissolution, at least for the husband.

financial management on the wife, and the unemployed husband with a working wife may be under pressure to increase his responsibilities for household tasks (Gallie, Gershuny and Vogler 1994, Bittman et al. 2003). Such renegotiation of domestic roles could be breaking down traditional gender roles, possibly involving significant problems for male gender identity and increase conflicts over housework, roles and authority structures within the marriage (Liem and Liem 1990).

Role theories suggest that job displacement is likely to impose a smaller threat on the wife's than the husband's identity. Social norms and patterns have allowed women to develop and appreciate a greater range of non-employment-related roles. Women's greater tendency of experiences out of the labor force (rearing children) would provide them multiple sources of positive identity and more available social networks, possibly shielding them from the severity of the impact of unemployment (Gershuny 1994). Jahoda (1982, p. 53) puts it this way, "unemployment hits them [women] less hard than men psychologically speaking because an alternative is available to them in the return to the traditional role of housewife that provides some time structure, some sense of purpose, status and activity". Thus, the effect of plant closure on marital well-being is likely to differ with the sex of the exposed mate.[8] This is consistent with empirical studies documenting that displaced workers experience mental distress, and the distress is generally more severe among men than women (McKee-Ryan et al. 2005, Grzywacz and Dooley 2003, Waters and Moore 2002).

3. 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 between 1995 and 2000. More precisely, the plant downsizing rate in worker *i*'s plant is given by

$$PDR^i = \frac{x_{95}^i - x_{00}^i}{x_{95}^i}, \tag{1}$$

[8] In the typical framework of Becker, Landes and Michael (1977), an unexpected earnings reduction of one dollar should have the same effect (ceteris paribus) on marital instability regardless of whether the earnings decline is experienced by the wife or the husband. There are, however, several possible mechanisms that *would* result in an asymmetric effect across the spouses within this framework. For example, marital well-being might hardly be affected by the wife going from paid work to housework, since she may be similarly effective in producing marital well-being through earning money and through engaging in housework. Husbands, on the other hand, may in general be less able to maintain marital well-being if having to reallocate time from paid work to housework. This could be due to specialization, but also to social costs of disobeying social norms or not fulfilling traditional roles. Hence, by giving the notions of costs and benefits in the framework of Becker, Landes and Michael (1977) a wide definition, this framework seems able to endorse the main ideas of these sociological theories.

where x_{95}^{i} and x_{00}^{i} are point-in-time plant employment counts in 1995 and 2000, denoting number of workers (full-time equivalents) in worker *i*'s plant at the end of year, excluding worker *i* himself. In the following, we will refer to a plant reducing employment by more than 90 percent (i.e. *PDR*>. 90) as a *closing plant*, and a plant with no reduction in employment (i.e. $PDR \leq 0$) as a *stable plant*.

We restrict our sample to married couples in 1995, where the husband in 1995 was employed in a plant that either closed by 2000 (i.e. *PDR*>. 90) or was stable during this period (i.e. $PDR \leq 0$). We estimate the following linear probability model for the likelihood that a couple married in 1995 becomes divorced by 2003:

$$A_{i,03} = \alpha_0 + \eta W_i + \alpha_X X_i + u_i \quad (2)$$

where

$A_{i,03}$	~	indicator that the couple *i* is divorced by 2003
W_i	~	An indicator that the plant in which the husband is employed in 1995 is closing (i.e. *PDR*>. 90).
X_i	~	vector of 1995 characteristics of couple *i*, including socio-economic variables for both the couple and each of the spouses individually, indicators of spousal dependency, downsizing experience of the wife, etc.
u_i	~	Error term with mean zero

The parameter of interest in equation (2) is η, which captures the incremental increase in a couple's likelihood of divorce due to plant closure (of the husband's 1995 plant of employment), relative to couples in which the husband is working in a stable plant.

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 divorce. This identifying assumption will not hold if workers with higher unobserved propensities for divorce are more likely to work in plants that close, which may be the case for several reasons.

One possible reason could be that workers with higher unobserved propensities for divorce could self-select into (or out of) plants that subsequently close for some unobserved reason. For example, it might be that more stable partners can better foresee an upcoming closure and that they therefore tend to leave such plants before the closure occurs. If so, spouses remaining in closing plants are more

inclined to divorce for reasons unrelated to the upcoming closure event. Since we would not observe these reasons, we would get an upward bias in the estimated effect of plant closure on divorce. Alternatively, it could be that workers with particular characteristics detrimental to marital stability ("workaholics") are attracted to plants with higher risk of decline (recent start ups); or that plants with oscillating number of employees are over-represented by workers with lower ability to stay in long relationships. However, if such unobserved variables were important for our results, we would expect higher rates of divorce among workers in closing plants *even prior to the closure event*. In our empirical analysis we are able to test for this possibility.

Also, closing plants may be concentrated in disadvantaged neighborhoods or municipalities with poor labor marked conditions and high divorce propensities. Moreover, social interaction effects may result if a worker's likelihood of divorce increases when more of his neighbors are divorcing (see e.g. Moffitt 1983, Lindbeck, Nyberg, and Weibull, 1999, Bertrand, Luttmer, and Mullainathan 2000, Rege, Telle and Votruba 2007). If closing plants are concentrated in neighborhoods with high divorce rates, this could bias our estimate of η. In our empirical analysis, we address these potential sources of bias by including neighborhood fixed effects.

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 divorce since our plant closure measure is based on a worker's original plant of employment. Job mobility across closing and stable plants would therefore tend to attenuate our estimates.

4. Dataset Description

We utilize a register database provided by Statistics Norway called *FD-trygd*. It is a rich longitudinal database with records for every Norwegian resident from 1992 to 2005, containing individual demographic information (marital status, spouse identifier, sex, age, time of marriage[9], 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, indicators of participation on any of Norway's welfare programs, and geographic identifiers for county, municipality and neighborhood of residence.

[9] This variable is not in FD-trygd if the couple married before 1992. However, for preceding years, time of marriage is available in another database also managed by Statistics Norway; and the managers of this database kindly made this variable available to us. We used a unique personal identifier available in all public registers in Norway to merge this variable onto our dataset.

In particular, the database contains records for employment "events" since 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.[10] These employment records 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.[11]

Based on the employment records, we constructed plant-level employment counts at the end of year 1995 and 2000. The counts were constructed as measures of full-time equivalents (FTEs), with part time and minor part time employment measured as 0.67 and 0.33 FTEs, respectively. Excluded from these counts were any person identified in FD-trygd as self-employed or receiving assistance that should have precluded full time work (those receiving unemployment benefits, rehabilitation pensions or disability pensions). Plant-level FTEs were then used to construct the measure of plant downsizing from 1995 to 2000 as defined in Equation (1). The measure, which we refer to as the plant downsizing rate (PDR), captures the percent decline in FTEs over 1995-2000. For instance, plants that fully closed over a given period were recorded as having a PDR=1 for that period; plants with FTE counts declining by 50% were recorded as having PDR=0.5.

Our main analytic sample comprises couples of native Norwegians that were married in 1995. Moreover, we restrict the sample to couples where at least the husband was closely related to the labor marked in 1995. This means that he was full- or part-time employed with tenure of at least one year in the plant, and he did not receive assistance that should have precluded full time work (pension or unemployment benefit). To make sure that our results would not be driven by the effect of PDR on subjects eligible for (early) retirement pension, we do not allow the husband to be older than 55 years in 1995 (most employees are eligible for generous early retirement pension from the age of 62, and the eligibility requirements for unemployment benefits are also less restrictive for subjects above 60). We also restrict the sample to couples where none of the spouses received a welfare pension (e.g. elderly pension, disability pension, early retirement pension) or social assistance in 1995. This implies that earnings are an important source of income for the couples. As a precaution against the PDR variable being correlated with unobserved individual determinants of divorce, we exclude the couple if the husband works in a plant with less than 10 FTEs in 1995. Finally, if a couple gets married just ahead

[10] Throughout, we use the term "plant" to refer to the establishment where an employee works, which is distinct from the firm of employment (as firms can consist of multiple plants).

[11] If an individual was employed in multiple plants at a given time, primary employment was determined by employment status and recorded income (not available to us) from each source of employment.

of or along with a downsizing event, the event could not reasonably be assumed unanticipated. Hence, to assure that the couple is unlikely to have anticipated the downsizing event at the time of marriage, we exclude couples married after 1992. To facilitate interpretations of our results, we restrict the analysis to couples where the husbands work either in a stable or closing plant. The resulting dataset consists of 80,932 couples, living in 10,659 different geographically defined neighborhoods. Variables capturing couple and spouse socio-economic characteristics were constructed based on *FD-trygd* records for 1995. A large number of such variables are included in all models:

- age, for each spouse: 30 categories
- difference in age between spouses: linear
- years of education for each spouse: 4 categories (<9, 9-12, 13-15, ≥16)
- difference in years of education between spouses: linear
- number of children, for each spouse: 5 categories (0, 1, 2, 3, ≥4)
- age of youngest child below 18 in family: 8 categories (0-2,2-4,..,14-17)
- children of another bed, for each spouse: 2 categories (0, ≥1)
- year of marriage: 13 categories
- income, for each spouse: linear and quadratic
- income, sum of both spouses: quadratic
- difference between the husband's and the wife's proportion of the couple's income: linear
- net wealth, sum of both spouses: linear and quadratic
- earnings, for each spouse: linear and quadratic
- years of labor marked experience, for each spouse: 5 categories (≤ 10, 10-15, 15-20, 20-25, >25)
- difference in labor marked experience between spouses: linear
- received sick money in year, for each spouse: 2 categories
- hours worked, for each spouse: 4 categories (<10, 10-20, 20-30, >30 hours per week)
- industry of plant, for each spouse: 11 categories
- employed in public sector, for each spouse: 2 categories
- years of tenure in 1995-plant, for each spouse: 8 categories (<2, 2-3, 4-5, 6-7, 8-10, 11-15, >15, missing)
- number of FTEs in 1995-plant, for each spouse: 9 categories
- wife received unemployment benefit: 2 categories

- wife's PDR: linear and quadratic[12]
- spouses employed in same firm: 2 categories
- rate of FTEs in plant over FTEs in firm 1995, for each spouse: 9 categories
- mean age of employees in 1995-plant, for each spouse: 9 categories
- mean years of education of employees in 1995-plant, for each spouse: 9 categories
- mean income of employees in 1995-plant, for each spouse: 9 categories
- rate of employees in 1995-plant women, for each spouse: 9 categories
- rate of employees in 1995-plant currently married, for each spouse: 9 categories
- rate of employees in 1995-plant never married, for each spouse: 9 categories
- rate of employees in 1995-plant currently divorced, for each spouse: 9 categories
- rate of married male employees in 1995-plant whose wife is working, for each spouse: 9 categories

Table 1. Summary statistics

	Total		Husband PDR≤ 0		Husband PDR>.9	
	Fraction/Mean	St. dev.	Fraction/Mean	St. dev.	Fraction/Mean	St. dev.
Divorced by 2003	0.070	-	0.069	-	0.072	-
PDR husband above .9 (plant closure)	0.369	-	-	-	-	-
Age husband	43.27	6.87	43.07	6.90	43.61	6.79
Age wife	41.14	7.12	40.95	7.14	41.46	7.06
Income husband	327 373	310 262	336 313	314 052	312 057	303 051
Income wife	167 366	142 395	166 665	164 917	168 566	91 741
Years of education husband	13.25	2.86	13.19	2.86	13.34	2.84
Years of education wife	12.55	2.58	12.53	2.57	12.58	2.61
Years of working experience husband	22.35	5.87	22.21	5.91	22.59	5.78
Years of working experience wife	15.35	6.62	15.15	6.60	15.69	6.65
Tenure husband	8.32	6.01	8.10	5.90	8.71	6.18
Tenure wife [a]	5.69	5.12	5.57	5.05	5.88	5.24
Net wealth of household	288 619	9 266 563	295 282	9 626 528	277 202	8 615 093
FTE of husband's plant	192.46	382.03	190.42	430.42	195.97	280.29
FTE of wife's plant [b]	228.36	570.24	236.31	601.55	215.05	513.27
Years of education in husband's plant	12.76	1.47	12.73	1.45	12.81	1.50
Years of education in wife's plant [b]	12.85	1.56	12.82	1.55	12.90	1.57
Rate of female in husband's plant	0.295	0.236	0.283	0.230	0.317	0.244
Rate of female in wife's plant [b]	0.701	0.252	0.700	0.255	0.704	0.246
Rate of unmarried in husband's plant	0.277	0.134	0.291	0.136	0.253	0.128
Rate of unmarried in wife's plant [b]	0.246	0.155	0.248	0.155	0.242	0.154
Rate of married in husband's plant	0.610	0.133	0.598	0.131	0.630	0.132
Rate of married in wife's plant [b]	0.634	0.166	0.632	0.166	0.637	0.166
Rate of divorced in husband's plant	0.076	0.049	0.075	0.050	0.079	0.048
Rate of divorced in wife's plant [b]	0.077	0.063	0.077	0.064	0.077	0.062
#obs	80 962		51 123		29 839	

[a] Calculated over the subsample of 61,580 couples where the wife's tenure is not missing

[b] Calculated over the subsample of 63,860 couples where the variable is not missing for the wife

[12] PDR is set to zero if the spouse was not employed in 1995; and a dummy variable indicating that PDR is set to zero for this reason is also included.

Summary statistics for some of these variables are presented in Table 1. The first column reports means and the second standard deviations. About 7.0 percent of the couples got divorced from 1995 to 2003. In our main analytic sample, about 37 percent of the husbands worked in a plant in 1995 that downsized by more than 90 percent from 1995 to 2000. In the next four columns of the table we report the means and standard deviations for the sample of husbands employed in stable plants (PDR≤ 0) and in closing plants (PDR>0.9). Although not different in a statistical sense, the divorce rate by 2003 is slightly higher in closing plants (7.2 %) compared to stable plants (6.9 %). The means of all the variables are similar across the two sub-samples. Taken together, couples appear similar on observables across stable and closing plants.

5. Empirical Results

5.1. Main Regression Results

As described in the empirical section we estimate the effect of plant closure on the likelihood of divorce through the inclusion of a plant closure dummy. The estimated plant closure coefficient captures the incremental increase in a couple's likelihood of divorce due to plant closure (in the husband's 1995 plant of employment), relative to couples where the husband is working in a stable plant. Table 2 presents our main results. Models 1 and 2 are the logit and the OLS regressions without controlling for neighborhood fixed effects; while Model 3 includes 10,659 geographically defined neighborhood fixed effects in the OLS regression.[13] The estimated marginal effect is similar in magnitude (0.008) across all three models and suggests that plant closure significantly increases the likelihood of divorce.

Table 2. Main estimation results

Dependent variable: Divorced by 2003			
	Model 1	Model 2	Model 3
Husband PDR>.9	1.22e-01	8.19e-03	7.83e-03
	(3.11e-02)**	(2.02e-03)**	(2.10e-03)**
Neighborhood fixed effects			Included
Mean of marginal effects	7.80e-03		
R-squared		0.04	0.17
Mean divorce rate	0.07	0.07	0.07
Observations	80962	80962	80962

Notes: +, * and ** denote significance at the 10, 5 and 1 percent level. Robust standard errors in parentheses, corrected for non-independent residuals within husbands' plant. All regressions include covariates described in text and either 19 county fixed effects or 10659 neighborhood fixed effects.

[13] We were unable to run the logit model including all these neighborhood fixed effects.

As discussed in Section 3, one concern for our empirical strategy is that plant closure events might be concentrated in disadvantaged geographic areas with poor labor market conditions and high divorce propensities. If so, including dummies for a number of geographically defined areas would be expected to reduce the estimated effect. The modest effect of including 10,659 neighborhood fixed effects (see Models 2 and 3) indicates that such geographic differences are not important. Nonetheless, we view the model including neighborhood fixed effects as the preferred one (Model 3). The result suggests that marriages of husbands originally employed in plants that closed between 1995 and 2000 were about .78 percentage points more likely to be dissolved by 2003 than comparable marriages of husbands in stable plants, an increase of about 11 percent.

5.2. Specification Tests

Our estimated effect of plant closure on divorce would be biased if, at the outset in 1995, workers in closing plants have a higher propensity to divorce for reasons not controlled for. If true, however, we would expect workers in closing plants to have a higher propensity to divorce *even prior to the closing event*. We test this in Models 2 and 3 reported in Table 3. For comparison, Model 1 repeats the results of our preferred model from Table 2. In Model 2 we check whether the rate of divorced employees in the husband's plant of employment in 1995 is correlated with the upcoming plant closure events.[14] If so, it would indicate that unobserved plant characteristics could be a problem. Similarly, in Model 3 we estimate the ”effect” of plant closures over 1996-2000 on the likelihood of divorce between 1995 and 1996. If unobserved plant characteristics were driving our main result, we would expect these preceding divorces (1995-1996) to be correlated with the later closure events (1996-2000).[15] The results of these two tests show an insignificant covariate-adjusted correlation between plant closures and preceding divorces. This suggests that our main result is not seriously biased by unobserved characteristics causing workers in closing plants to have a higher propensity to divorce.

[14] To reduce multicollinearity, we do not include the plants' rate of divorced employees as covariate in this model.

[15] To disable possible effects on divorces by 1996 from downsizing events over 1995-1996, we restrict the sample to employees in plants that were stable from 1995 to 1996. Note that the redefinition of the period over which the closure variable is defined and the restriction to stable plants in Model 3 is not what causes the insignificant result, as the regression in Model 5 is on the same sample and yields a significant effect of closure (1996-2000) on divorce by 2003.

Table 3. Specification tests

	Model 1	Model 2	Model 3	Model 4	Model 5
Dependent variable:	Divorced by 2003	Rate of divorced employees in husband's plant in 1995	Divorced by 1996	Divorced by 2003	Divorced by 2003
Husband PDR>.9	7.83e-03	7.96e-04	-2.95e-04	6.42e-03	9.32e-03
	(2.10e-03)**	(8.01e-04)	(1.69e-03)	(2.27e-03)**	(3.48e-03)**
Sample restrictions			Plant stable over 1995-1996		Plant stable over 1995-1996
Included PDR constructed over	1995-2000	1995-2000	1996-2000	1996-2000	1996-2000
R-squared	0.17	0.66	0.23	0.18	0.26
Observations	80962	80962	38813	70426	38813
Mean divorce rate	0.07	0.08	0.01	0.07	0.07

Notes: +, * and ** denote significance at the 10, 5 and 1 percent level. Robust standard errors in parentheses, corrected for non-independent residuals within husbands' plant. All regressions include covariates described in text (including neighborhood fixed effects).

A related concern could be that stable partners are able to self-select out of unstable plants prior to the closure. Since it appears more difficult to foresee plant closure "through" a stable period, however, we would expect the estimated effect to decline when restricting to plants stable over 1995 to 1996. The effect of plant closure over 1996 to 2000 on divorce by 2003 is estimated in Model 4, while in Model 5 we perform the same regression on the sub-sample of plants that were stable from 1995 to 1996. Comparing the results of Models 4 and 5 we see that restricting to stable plants does not reduce the estimated effect; to the contrary, the estimated effect increases somewhat. This suggests little reason for a concern that workers with high unobserved propensities to divorce are overrepresented in unstable plants.

5.3. Robustness

Table 4 presents several robustness checks. First, Models 2-5 investigate the robustness of our main result to variations in the definition of a closing plant. In Models 2 and 3, we can see that letting closing plants comprise plants downsizing more than 80 and more than 95 percent respectively, has a modest impact on the estimates. Model 4 shows that excluding fully closing plants (PDR=1) from the sample also has a fairly modest impact on the estimated effect. In Model 5 the sample is expanded to include workers in plants with PDR between 0 and 0.9, including an additional dummy capturing downsizing events from 90 to 0 percent. We can see that also intermediate downsizing events affect the likelihood of divorce.

In Models 6 and 7 we investigate whether the estimated effect varies when the sample is restricted to workers in plants with at least 20 and 50 FTE in 1995 (and not 10 as in our main analytic sample). We see that these restrictions only have fairly modest impacts on our estimate.

As described in our empirical strategy we define plant downsizing as the percentage change in employment between 1995 and 2000. This definition includes typical downsizing events where a proportion of the workers are laid-off, but it could also include "reorganizations" or merges. For example, a firm may shut down one of its plants to co-locate with one of its other plants. Alternatively, a plant is merged with a plant of another firm. Such reorganizations may be accomplished without laying off workers. Previous work has established that such reorganization can have serious detrimental effects on the well-being of affected workers (Røed and Fevang 2007). Here we investigate whether the effect on marital instability of such reorganizations differs from the effect of more typical downsizings. In Model 8 we explore this by splitting the plant closure variable in "typical closure" and "reorganization". How to make such a split in our data is clearly somewhat arbitrary. We redefine a plant closure as a "reorganization" if *(i)* more than 90 percent of the workers exit the plant during the same year, and *(ii)* among those exiting, at least 90 percent (and at least ten workers) were immediately rehired to the same next firm. The results of Model 8 indicate that the effect on marital instability is similar for "reorganization" and "typical closure".

Table 5 addresses how long it takes from plant closure events occur till they materialize in marital dissolution. We see that plant closure events between 1995 and 2000 affect the likelihood of divorce already by 2000. The effect increases the most in the years up to 2003, and then tends to level off in 2004 and 2005. Thus, it appears that most of the overall effect is exhausted by 2003.

Table 4. Robustness checks

Dependent variable: Divorced by 2003								
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Husband PDR>.9	7.83e-03			6.55e-03	7.60e-03	7.04e-03	6.84e-03	
	(2.10e-03)**			(2.95e-03)*	(1.99e-03)**	(2.35e-03)**	(2.95e-03)*	
Husband PDR>.8		7.30e-03						
		(2.02e-03)**						
Husband PDR>.95			8.05e-03					
			(2.18e-03)**					
Husband PDR in <0,.9]					3.79e-03			
					(1.51e-03)*			
Husband PDR>.9 "typical closure"								7.21e-03
								(2.51e-03)**
Husband PDR>.9 "reorganization"								8.79e-03
								(2.84e-03)**
Sample redefinition		Obs. with husband PDR in [.9,.8> also included	Obs. with husband PDR in [.95,.9> excluded	Obs. with husband PDR=1 excluded	Obs. with husband PDR in <0,.9] also included	FTE ≥ 20 in husbands' 1995 plant	FTE ≥ 50 in husbands' 1995 plant	
R-squared	0.17	0.16	0.17	0.19	0.10	0.19	0.23	0.17
Mean divorce rate	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Observations	80962	84850	77960	65520	170554	64276	44007	80962

Notes: +, * and ** denote significance at the 10, 5 and 1 percent level. Robust standard errors in parentheses, corrected for non-independent residuals within husbands' plant. All regressions include covariates described in text (including neighborhood fixed effects).

Table 5. Impact over time on the likelihood of divorce of husbands being exposed to plant closure

Dependen variable: Divorced by given year						
	2000	2001	2002	2003	2004	2005
Husband PDR>.9	4.61e-03	5.81e-03	7.48e-03	7.83e-03	7.98e-03	7.96e-03
	(1.96e-03)*	(2.07e-03)**	(2.10e-03)**	(2.10e-03)**	(2.13e-03)**	(2.22e-03)**
R-squared	0.16	0.16	0.17	0.17	0.17	0.17
Mean divorce rate	0.06	0.07	0.07	0.07	0.07	0.08
Observations	80962	80962	80962	80962	79754	79072

Notes: +, * and ** denote significance at the 10, 5 and 1 percent level. Robust standard errors in parentheses, corrected for non-independent residuals within husbands' plant. All regressions include covariates described in text (including neigborhood fixed effects).

5.4. Discussion of Mechanisms: Reduced Earnings and Role Theories

As discussed in Section 2, there are many different mechanisms through which plant closure can affect the likelihood of divorce. The richness of our dataset allows us to empirically investigate the plausibility of two of these mechanisms; reduced earnings and role theories.

Economists have traditionally emphasized effects of changes in consumptions opportunities on marital instability (Weiss 1997). Within this tradition the interpretation of our main result would be that plant closure reduces expected earnings and thereby reduces consumption opportunities of the spouses, which affect marital instability. In Models 1-2 in Table 6 we report results documenting that plant closure events *do* reduce the future earnings of affected workers.[16] In Models 1 and 2 the dependent variable is earnings of the husband and the aggregate earnings of the spouses in 2003. In Model 1 we see that husbands originally employed in plants that closed between 1995 and 2000 have significantly lower earnings in 2003 than comparable husbands in stable plants. Moreover, Model 2 shows that this reduction in the husband's earnings is not replaced by the wife increasing her earnings: The estimated effect of plant closure on the sum of the spouses' earnings is very similar to the estimated effect on the husband's earnings.

Notably, Models 3 and 4 show that the estimated effect of plant closure on earnings is similar in magnitude for the sub-sample of divorced couples (Model 3) and for the sub-sample of couples still married in 2003 (Model 4). This indicates that the negative effect of closure on earnings is not mainly explained by a decline of earnings due to an actual divorce; for example if a divorce causes a spouse to leave the labor force. More importantly, this also suggests that the income reduction associated with plant closure is not a likely channel for the effect of plant closure on marital dissolution. If plant closure increases the likelihood of divorce by adversely affecting earnings, we would expect to

[16] For similar findings see e.g. Huttunen, Møen and Salvanes (2006) and Rege, Telle and Votruba (2005).

observe a stronger association between low earnings and plant closure among divorced workers than among workers who stayed married.

In Models 5-7 we further explore the likelihood of the earnings mechanism. If we assume that the earnings mechanism is important, we would expect the estimated effect of closure on divorce to change if we control for earnings after 1995. The reason is that a negative effect on divorce of post-1995-earnings would be loaded onto the estimated effect of (post-1995) closure when post-1995-earnings are omitted. Thus, by including post-1995-earnings we would expect the estimated effect of closure to decline. To explore this empirically, we first re-estimate our preferred (Model 3 in Table 2) including controls for the earnings of the husband in 2000. In Model 5 we can see that this inclusion of future earnings barely moves the estimate. Since divorce can affect earnings, Model 5 may, however, have an endogeneity problem. Thus, in Model 6 and 7 we do a similar test by first re-estimating our preferred (Model 3 in Table 2) on the sub-sample of couples still married in 2000 (Model 6). Then, in Model 7 we use the same sample, and control for the earnings of the husband in 2000. We see that the estimated effect in Models 6 and 7 are virtually identical. Thus, adding information on the husband's future earnings has no impact on the estimate. This provides additional evidence that the reduction in earnings from plant closure is not an important reason why plant closure causes divorce.

Role theories would emphasize the husband's inability to fulfill a traditional role as a breadwinner when explaining an effect of plant closure on marital dissolution. If this is true, we should see a larger effect of husbands' exposure to plant closure on likelihood of divorce among couples in which the husband is the main bread winner. We explore this hypothesis in Model 8 by restricting the sample to couples where the husband is the main breadwinner, with earnings exceeding 1.25 of the wife's earnings. Comparing with our main analytic sample (Model 3 in Table 2), we see that the effect of closure on divorce is larger when we restrict the sample to couples where the husband is the main breadwinner. This is consistent with role theories.[17]

Model 9 provides additional evidence supporting role theories as an important mechanism for the effect of plant closure on divorce. Here we report results based on a dataset constructed like our main analytic sample, except that the conditions put on the husband (regarding labor market attachment etc.,

[17] Clearly, we are not arguing that these findings could not also have been explained within the framework of Becker, Landes and Michael (1977); see footnote 8.

cf. Section 4) is now put on the wife (and v.v.). Notably, we do not find a significant effect of wives' exposure to plant closure on marital dissolution.[18]

Table 6. Estimates of alternative dependent variables

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Dependent variable:	Husband's earnings 2003	Sum of earnings of spouses 2003	Sum of earnings of spouses 2003	Sum of earnings of spouses 2003	Divorced by 2003	Divorced by 2003	Divorced by 2003	Divorced by 2003	Divorced by 2003
Husband PDR>.9	-2.12e+04	-2.21e+04	-2.24e+04	-1.90e+04	7.69e-03	3.57e-03	3.55e-03	1.14e-02	
	(2.74e+03)**	(2.90e+03)**	(3.00e+03)**	(1.06e+04)+	(2.10e-03)**	(1.05e-03)**	(1.05e-03)**	(2.35e-03)**	
Wife PDR>.9									-4.09e-03
									(2.74e-03)
Sample redefinition			Couples still married in 2003	Couples divorced in 2003		Couples still married in 2000	Couples still married in 2000	Husband's earnings>1.25 *wife's earnings	Wives closely attached to labor market
Additional covariates					Earnings of husband in 2000 (third-order polynomial)		Earnings of husband in 2000 (third-order polynomial)		
R-squared	0.46	0.50	0.50	0.83	0.17	0.15	0.15	0.19	0.20
Observations	80962	80962	75271	5691	80962	76287	76287	65142	64023
Mean of dependent variable	445840.80	680085.07	677433.10	715160.94	0.07	0.01	0.01	0.07	0.07

Notes: +, * and ** denote significance at the 10, 5 and 1 percent level. Robust standard errors in parentheses, corrected for non-independent residuals within plant of spouse closely attached to labor market. All regressions include covariates described in text (including neigborhood fixed effects).

6. Conclusion

In this paper we estimate the impact of plant closure on divorce using a panel data set comprising more than 80,000 married couples in Norway. Our results suggest that plant closure in the husband's plant of employment significantly increases the likelihood of divorce. The marriages of husbands originally employed in plants that close down from 1995 to 2000 were 11 percent more likely to be dissolved by 2003 than comparable marriages of husbands in stable plants. The dataset enables us to perform a number of robustness and specification tests, which all support the reliability of this result.

Economists have traditionally focused on marital instability of unanticipated reductions in the pecuniary gains from marriage (see e.g. Weiss 1997). In contrast to this, we find that the effect of plant closure on marital dissolution does not appear to be driven by an adverse effect on expected future earnings. Plant closure is associated with substantial reductions in workers' future earnings. However, we do not observe a stronger association between future low earnings and plant closure among

[18] Some previous studies find an effect on marital instability of the wife being affected by earnings reduction or job displacement (e.g. Charles and Stephens 2004, Hansen 2005), while others do not (e.g. Becker, Landes and Michael 1977, Jensen and Smith 1990).

divorced workers than among workers who stayed married. This suggests that the effect of husband's plant closure on divorce is not due to an unexpected reduction in earnings.[19]

Role theories from the field of sociology have emphasized how job displacement can lead to shifts of roles within the household, and consequently may have differing effects across sexes. For the husband, displacement can constitute serious social distress if he fails to fulfill a traditional role as the main breadwinner. For the wife, however, weaker attachment to the labor market may lower the tension resulting from having to deal with both the job and social norms related to keeping the house and being a caring mother. Consistent with such role theories, we find no significant effect of wives' exposure to plant closure on the likelihood of divorce. Moreover, the effect of husbands' exposure to plant closure on divorce is larger among couples in which the husband is the main bread winner.

[19] Charles and Stephens (2004) also argue that an earnings mechanism may not be important in explaining the effect of job displacement on divorce. They conclude that "a partner's noneconomic suitability as a mate due to a job loss may be more important than financial losses in precipitating divorce" (p. 489).

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