# Social Interaction and Disability Pension Participation: Evidence from Plant Downsizing

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## Abstract

We estimate the magnitude of social interaction effects in disability pension participation in Norway. Specifically, we investigate how a worker's propensity to draw disability benefits is affected by a plausibly exogenous shock to the disability entry rate of similarly-aged workers in his neighborhood. The problem of omitted variable bias is addressed employing a novel instrumental variable (IV) strategy, using plant downsizing at neighbors' plants of employment as an instrument for the disability entry rate among one's employed neighbors. Our IV estimates suggest that a one percentage point increase in the participation rate of previously employed neighbors increased the subsequent 4-year entry rate of workers employed at the end of 1999 by 0.65 percentage points. Numerous robustness and specification tests appear to support the validity of the identifying assumption of our IV approach.

**Keywords:** disability, downsizing, layoffs, plant closings, social insurance, social interaction, welfare norms

**JEL classification:** H55, I12, I38, J63, J65

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## 1. Introduction

Between 1980 and 1999, the share of non-elderly adults receiving disability benefits in the United States increased 60 percent to 4.7 percent.[1] Across the OECD as a whole, disability participation rates increased 36 percent over the period, to 6.4 percent. The dramatic growth in disability participation rates has important implications for national productivity and the public financing of disability benefit programs.[2] In 1999, disability benefit payments comprised 1.4 percent of GDP in the U.S. and 2.5 percent of GDP across countries in the European Union. Thus, understanding the determinants of disability participation is becoming an increasingly important issue for policy makers.

Notably, the substantial growth in disability rolls has occurred despite any change in the prevalence of self-reported disabilities (e.g. Burkhauser et al. 2001; Cutler and Richardson 1997). On the other hand, convincing evidence exists that economic conditions affect disability participation. Black, Daniel and Sanders (2002) demonstrate that the coal boom and subsequent bust had a large impact on disability participation in coal-producing states. Moreover, Autor and Duggan (2003) show that both the demand for low-skilled workers and the disability insurance replacement rate affect the participation of high school dropouts. These studies strongly demonstrate that utilization of disability programs is not solely determined by health status.[3]

In this paper we empirically investigate the magnitude of social interaction effects in disability pension (DP) participation in Norway. Specifically, we investigate how a worker's propensity to draw DP is affected by a plausibly exogenous shock to the disability entry rate of similarly-aged workers in his neighborhood. A large and growing empirical literature suggests an important role for social interactions in many behavioral outcomes including teenage childbearing (Crane 1991), educational attainment (Sacerdote 2001; Hoxby 2000; Lalive and Cattaneo 2005 ), saving decisions (Duflo and Saez 2003), criminal activity (Case and Katz 1991; Glaeser, Sacerdote and Scheinkman 1996; Katz , Kling and Liebman 2001; Ludwig, Duncan and Hirschfield 2001; Kling, Ludwig and Katz 2005) and welfare participation among ethnic minorities (Bertrand, Luttmer and Mullainathan 2000; Aizer and Currie 2004) . If social

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[1] Statistics on disability program use and expenditures obtained from OECD (2003).
[2] Throughout this paper, we employ the colloquial expressions "on disability" and "disability participation" to refer to the utilization of disability pension benefits.
[3] See Rupp and Stapleton (1995) and Stapleton et al. (1998) for related studies on the impact of economic climate of DI application and receipt.

interaction effects exist in the context of disability insurance, it could help explain the wide variation in disability participation across geographic areas and over time. Moreover, knowing the magnitude of such effects is critically important for predicting the impact of policy, demographic changes and economic shocks on disability participation rates.

In the context of disability participation, social interaction effects could potentially operate through a number of mechanisms. For example, social norms against disability participation could reduce the desirability of participating by imposing a utility cost in the form of social stigma (Moffitt 1983; Lindbeck, Nyberg and Weibull 1999).[4] However, the magnitude of this stigma is expected to decline as the disability participation rate among one's peers increases, thereby increasing one's incentive to apply for disability. In this way social interaction effects give rise to a *social multiplier* that amplifies the effect of policy changes and economic shocks on aggregate participation rates (see e.g. Brock and Durlauf 2001; Glaeser and Scheinkman 2003). Any change that *directly* affects individuals' rate of disability use will have an additional *indirect* effect through the influence that one's participation has on others.

Identifying social interaction effects in observational data is complicated by problems of omitted variable bias.[5] Peers are likely similar in ways unobservable in data and are also likely subject to similar unobserved shocks. In this paper, the problem of omitted variable bias is addressed employing a novel instrumental variable (IV) strategy similar to the "partial population intervention" approach suggested by Moffitt (2001). Specifically, our strategy hinges on the empirical observation that plant downsizing events have a substantial effect on disability entry rates (Rege, Telle and Votruba 2005). We therefore use plant downsizing at neighbors' plants of employment as an instrument for the disability participation rate among one's previously employed neighbors. The intuition behind this approach is that, if social interaction effects exist, then neighborhoods disproportionately hit by plant downsizing should exhibit a relative increase in disability entry rates, even among workers who were not themselves directly affected by downsizing.

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[4] Social norms are only one possible channel through which social interaction effects might operate in DI participation. As described in section 2, two other possibilities are leisure complementarities and information exchanges.

[5] Manski (1993, 1995) catalogs the range of estimation problems in observational studies of social interaction effects, though our terminology varies somewhat from his. In particular, Manski refers to the *social interaction effects,* which we intend to estimate, as *endogenous effects*.

Social interaction effects estimated under this IV strategy will not suffer from omitted variable bias provided downsizing rates in neighbors' plants of employment are uncorrelated with unobservable determinants of DP participation. This identifying assumption is potentially problematic because layoffs concentrated within a particular neighborhood could reflect a decline in local economic opportunities. Alternatively, plant downsizing may be concentrated in neighborhoods populated by persons with higher propensities to utilize DP. The richness of our data, an 11-year panel dataset containing socio-economic information, employment data, and disability participation records for every person in Norway, makes it possible to conduct numerous robustness and specification tests of the validity of our identifying assumption.

Our analysis indicates that social interaction effects play an important role in DP participation. Our IV estimates suggest that a one percentage point increase in the participation rate of previously employed neighbors increased the subsequent 4-year entry rate of workers employed at the end of 1999 by 0.65 percentage points, an increase of approximately 10 percent. This has important policy implications. It suggests that if a policy or an economic shock has the direct effect of inducing $100x$ percent of the working population to enter DP, then, due to social interaction effects, the indirect effect will increase entry by an additional $0.65(1-x)x$ percentage points. Our results also suggest that social norms towards disability participation affect the magnitude of the social interaction effects. This lends empirical support to concerns about the potential development of "welfare cultures" arising from poorly designed disability insurance programs.

## 2. Social Interaction Effects

The logic of social interaction effects rests on notions of utility interdependence. That is, when one's peers engage in a particular behavior, it can potentially affect one's own utility from engaging in that behavior. In the context of disability participation, this interdependence could operate through at least three channels: social norms, information and leisure complementarities.

Disability participation is likely affected by social norms regarding "appropriate" participation behavior.[6] Coleman (1990) defines a social norm as a rule of behavior that is enforced by social sanctions, which can take the form of stigma. Social interaction effects arise if social norms are conditional in nature, that is, when the stigma associated with not adhering to a

[6] See Moffitt (1983), Besley and Coate (1992) and Lindbeck, Nyberg and Weibull (1999) for theoretical models of social norms and economic incentives in the welfare state.

norm is felt more strongly when one's peers adhere to the norm. For instance, a person with a marginal disability would likely feel a higher degree of social stigma from drawing disability benefits if surrounded by peers devoted to their work. Thus, as disability participation increases among one's peers, the incentive to apply for DP among non-recipients is expected to increase.

There exists some empirical evidence that suggests an important role of social norms in welfare utilization. Though not specific to disability programs, Moffitt (1983) finds evidence for a stigma related disutility of welfare participation. Horan and Austin (1974) document negative self-characterization and lack of self respect among welfare recipients. Moreover, Flaa and Pedersen (1999) document that 20% of welfare program recipients in Norway feel a loss of social approval.

In addition to the stigma associated with social norms against drawing disability, navigating the application process may also involve a cost in terms of time and frustration. Peers familiar with this process can be a valuable source of information for would-be applicants, reducing the utility cost of filing an application. This information transfer implies that the cost of applying for disability is lower when more of one's peers draw disability.

Alternatively, a person on disability will have more time available for leisure activities than one engaged in work. Thus, disability participation by one's peers can increase one's value of leisure, making it more attractive to draw disability pension. Similar to social norms and the information channel, this implies that a person's likelihood of applying and participating in a disability program increases when participation among his peers increases.

Independently of the channel through which social interaction effects operate, these effects give rise to a *social multiplier*, and possibly to multiple equilibria, that amplifies the effect of policy changes, demographic shifts and economic shocks on aggregate participation rates.[7] Any change that directly affects individuals' likelihood of drawing disability will have an additional indirect effect through the influence that one's participation has on others. For example, if an economic shock decreases the opportunity cost of drawing disability for a subset of workers, the subsequent increase in disability participation could reduce the stigma associated with drawing disability, thereby increasing participation rates even among those not directly affected by the shock. This self-reinforcing process continues until a new equilibrium is reached.

[7] For a formal analysis see e.g. Glaeser and Scheinkman (2003) or Brock and Durlauf (2001).

## 3. Disability Pension Program in Norway

The Norwegian Disability Pension (DP) program[8] serves a similar function as the combined disability programs of Social Security Disability Insurance (SSDI) and Supplemental Security Income (SSI) in the U.S. A basic and a supplementary pension provide a benefit that is increasing and concave in prior earnings similar to SSDI, and a special supplement ensures a minimum benefit amount similar to SSI. Even though the Norwegian and the U.S. program have similar benefits formula, increasing at a decreasing rate in past earnings, the Norwegian disability program is more generous with higher replacement rates, particularly for low income workers.

A second important difference between the Norwegian and U.S. program is that the Norwegian program allows workers to apply for DP while still employed. As a result, it is common for Norwegian workers to receive "sick money" prior to transitioning from employment onto disability without ever being unemployed. Sick money refers to temporary assistance (up to one year) provided to disabled workers, ensuring benefits equal to 100% of earnings up to some maximum level. After one year, workers can draw a somewhat smaller rehabilitation pension until returning to work or entering DP. Generally, a worker cannot be formally dismissed from his job for being on sick money. Therefore, unlike the U.S., it is not uncommon for disability entrants to enter directly from employment.

## 4. Empirical Strategy

The current section describes our strategy for estimating the impact of DP participation among a worker's peers on that worker's decision to enter DP. For the purpose of this paper, we analyze DP entry rates through 2003 of Norwegian workers age 45-63 in 1999.[9] For reasons that will become clear, we restrict our attention to workers who were full or part time employed in both 1994 and 1999. Therefore, our results are specific to older Norwegian workers with reasonably strong ties to the labor force.

Our hypothesis is that a worker's decision to enter DP is influenced by the DP participation of her or his peers. Defining "peer groups" from existing data sources is always somewhat arbitrary. Ideally, we would like to identify individuals that a given worker interacts with. Lacking

[8] See Rege, Telle and Votruba (2005) for a more detailed description of Norway's disability pension program.
[9] We always refer to the status at the end of a year, i.e. at 12/31/yyyy.

such data, peer groups are commonly defined by geographic proximity and/or by characteristics suggestive of "social proximity" (e.g. similar socio-economic or employment characteristics). In this paper, we define peer groups according to similarities in geography, age and employment history. Specifically, the peer group of each worker is assumed to consist of similarly-aged individuals residing in the worker's neighborhood in 1994 and, like the worker, employed full or part time in 1994.

In our dataset, Norway is divided into 14,211 geographically-defined neighborhoods. These neighborhoods are small in both geographic area and population. In average an individual lives in a neighborhood with 614 natives.[10] First, we might expect that workers would be more influenced by the behavior of other workers in their neighborhood than by non-workers. Thus, if social interactions influence DP participation, we would expect this influence to be observable across similarly-aged workers residing in the same neighborhood. Second, as we describe below, our empirical strategy relies on an instrument that is specifically applicable to workers.

In the following sections, we describe a conventional approach to estimating social interactions effects to highlight the omitted variable biases that likely plague such an approach. Following this we describe our instrumental variable approach for addressing this problem.

### 4.1. Baseline Approach

By way of example, we define the following linear probability model for the likelihood that a worker who is employed in 1999 draws DP by 2003:

(1) $$DP2003_i = \alpha_0 + \alpha_1 X_i + \alpha_2 N_i + \alpha_3 P_i + \phi PeerDP2000_i + \varepsilon_i$$

where

| | | |
|---|---|---|
| $DP2003_i$ | ~ | indicator that worker *i* draws DP in 2003panel |
| $PeerDP2000_i$ | ~ | participation rate among *i*'s peers in 2000 (defined as *i*'s employed neighbors in 1994) |

[10] Among workers in our sample the mean neighborhood native population size is 691 (see Table 1 Panel C ). The difference reflects our selection criteria which led to the exclusion of workers in some smaller neighborhoods.

| | | |
|---|---|---|
| $X_i$ | ~ | vector of 1999 characteristics of worker *i* |
| $N_i$ | ~ | vector of 1994 characteristics of *i*'s neighborhood and municipality |
| $P_i$ | ~ | vector of 1994 characteristics of *i*'s peer group |
| $\varepsilon_i$ | ~ | error term with mean zero |

The parameter of interest in equation (1) is $\phi$, which captures the impact of DP participation among *i*'s peers in 2000 on *i*'s propensity to draw DP by 2003.

Estimation of equation (1) will provide an unbiased estimate of $\phi$ provided that the unobservable determinants of the DP participation decision are independent of peers' participation rates, conditional on the included covariates. This independence assumption is difficult to defend because of omitted variables that are likely correlated across neighbors.[11] We categorize the potential sources of bias as follows:

*Individual-level unobservables:* Because individuals self-select into neighborhoods, it is likely that neighbors are similar in ways that yield higher DP participation rates in some neighborhoods and lower participation rates in others. For instance, neighbors could be similar in terms of their probability of becoming disabled or their distaste for work. Unless fully captured by the included covariates, an implausible assumption, within-neighborhood correlation of individual level determinants of disability is likely to result in an upward biased estimate of $\phi$ from equation (1).

*Economic Environment:* Neighbors are similar in terms of the economic environment in which they work or search for work. As a result, the opportunity cost of exiting the workforce could vary at the neighborhood-level, again yielding cross-neighbor correlations in DP use. Unless fully captured by the included covariates, neighborhood unobservables will lead to an upward biased estimate of $\phi$ from equation (1). Notably, this potential source of bias would exist even if individuals were randomly assigned to neighborhoods, which highlights the difficulty in generating plausible estimates of social interaction effects.

### 4.2 Instrumental Variable Approach

Based on the above discussion, the main challenge for generating an unbiased estimate of $\phi$ is addressing the potentially correlated unobservables within peer groups. Correlated unobservables could lead to differential rates of disability participation across peer groups even in the absence of social interaction effects. Our instrumental variable approach addresses this issue by identifying social interaction effects from the variance in peer DP participation rates resulting from plausibly exogenous shocks, experienced by a subset of workers in a peer group. We can then identify social interaction effects by looking at how the shocks affecting a worker's peers subsequently affect that worker's likelihood of entering DP. This strategy is similar in spirit to the "partial population intervention" approach suggested by Moffitt (2001).

Our strategy uses recent plant downsizing events to instrument for the participation rates of a worker's peers ($PeerDP2000_i$). This strategy hinges on two facts about disability participation. First, plant downsizing is a strong predictor of a worker's likelihood of entering disability.[12] Second, disability participation is "sticky," in the sense that participants rarely exit the system.[13] As a result, downsizing within peers' plants of employment is expected to increase the entry rate of peers onto DP, and this effect largely persists over time even in the absence of social interaction effects. Provided that downsizing at a neighbor's plant is independent of a worker's unobserved determinants of DP entry and unobserved neighborhood-level determinants, the variance in peer DP rates induced from recent downsizing in peers' plants can be used to obtain an unbiased estimate of social interaction effects.

The logic underlying our IV approach is fairly straightforward. The direct effect of plant downsizing on DP participation can be captured by inclusion of plant downsizing covariates. In the aggregate, peer groups disproportionately hit by plant downsizing will subsequently demonstrate an increase in DP participation relative to peer groups in which fewer peers experienced plant downsizing. If social interaction effects exist, we should observe a relative increase in DP entry

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[11] Manski (1993, 1995) provides a more complete and general analysis of the *reflection problem* in identifying social interaction effects. Our discussion of the identification issues is intended to address those issues that are relevant to the context of disability application and participation.

[12] See e.g. Black, Daniel and Sanders (2002), Autor and Duggan (2003) and Rege, Telle and Votruba (2005).

[13] Less than 1% per year (Annual Statistical Yearbook 2003, Norwegian National Insurance Administration).

among workers in disproportionately hit peer groups *independent* of a worker's own downsizing experience.

Operationally, we implement a two stage linear probability model.[14] The first stage equation predicts the DP participation rate among *i*'s peers at the end of 2000:[15]

$$(2) \qquad PeerDP2000_i = \alpha_0 + \beta_1 X_i + \beta_2 N_i + \beta_3 P_i + \beta_4 PeerPDR_i + \varepsilon_i$$

where $PeerPDR_i$ is a vector characterizing how individual *i*'s employed neighbors are affected by plant downsizing between 1994 and 1999. The second stage equation, modified from equation (1), predicts the likelihood that a worker who is employed in 1999 draws disability pension by 2003:

$$(3) \qquad DP2003_i = \alpha_0 + \alpha_1 X_i + \alpha_2 N_i + \alpha_3 P_i + \phi \widehat{PeerDP2000}_i + \varepsilon_i$$

where $\widehat{PeerDP2000}_i$ is the predicted value of the peer DP participation rate from estimation of the first-stage equation.

Under the identifying assumption that the plant downsizing experiences of a worker's peers are independent of the unobservable determinants of DP entry, IV estimates of $\phi$ will be unbiased. There are several reasons why this independence assumption may be problematic. For example, peers' plant downsizing experiences could be correlated with a worker's plant downsizing experiences, either in the past or going forward. We can address this concern through robustness tests, checking to see whether our IV estimate is sensitive to inclusion of covariates capturing a worker's past (1994-1999) or future (1999-2003) plant downsizing experiences. Alternatively, neighborhood plant downsizing may be correlated with a decline in economic opportunities or future job prospects even for individuals in non-downsizing plants. Again, we can test whether our IV estimate is sensitive to inclusion of variables meant to proxy for such things. Finally, plant downsizing may be concentrated in neighborhoods populated with persons having generally higher propensities to use DP. If so, we would expect the downsizing rates to be correlated with rates of

[14] Estimating IV-probit models produced similar marginal effect estimates.

[15] We use peers' DP rate in 2000 as our covariate of interest instead of the rate in 1999, as plant downsizing over 1994-1999 is a stronger predictor of peer DP use in 2000 than in 1999. We attribute this to the lengthy application approval process as well as the possibility that responses to downsizing events might not be immediate.

DP use in the neighborhood prior to the downsizing events. The richness of our data allows us to test this possibility as well.

### 4.3 Interpreting the Social Interaction Coefficient and Deriving the Social Multiplier

Even absent from any omitted variable bias, our IV approach will give us a different estimate of $\phi$ than the basic OLS Model. Provided that omitted variable bias is not an issue, the OLS Model presented in equation 1 identifies social interaction effects from variance in the peer participation rate ( $PeerDP2000_i$ ) that is due to either *recent or old shocks*. Variance in $PeerDP2000_i$ due to old shocks simply captures that the time needed to equilibrate from past shocks can vary across neighborhoods. This can give us a downward biased estimate of the social interaction coefficient. The intuition behind this is straightforward: Look at two peer groups A and B who are initially identical. Prior to 1994 both peer groups experience a permanent shock affecting DP entry. However, whereas A has equilibriated from this shock by 2000, B has not equilibrated until 2003. Thus, the entry rate between 1994 and 2000 ( $PeerDP2000_i$ ) is higher in A than in B, whereas the entry rate between 2000 and 2003 is lower in A than in B. In this way, the fact that the time needed to equilibrate from past shocks can vary across neighborhoods, gives us a downward biased estimate of the social interaction coefficient.

In addition to omitted variable bias, our IV approach deals with the issue that the time needed to equilibrate from past shocks can vary across neighborhoods by identifying variance in $PeerDP2000_i$ that is due to *recent* exogenous shocks. Hence, if omitted variable bias is not an issue, then we should expect a larger estimate of $\phi$ from our IV approach (equation 3) compared to the estimate from the OLS model (equation 1). This is because our IV approach assures that $\phi$ identifies social interaction effects from *recent* shocks and not from the fact that the time needed to equilibrate from past shocks can vary across neighborhoods.

Provided that our IV approach allows enough time between 1999 and 2003 for each neighborhood to equilibrate, our IV approach provides a very clean and policy relevant interpretation of the estimated social interaction coefficient $\phi$ . To see this, look at a peer group with $M$ employed workers. Assume that a governmental policy or economic shock has the direct effect of inducing 100$x$ percent of these workers to enter onto disability. Then, a share $\phi x$ of the remaining $M(1\text{-}x)$ employed workers will, due to social interaction effects, enter onto disability pension. Thus, the total effect of the shock is $Mx\left(1+ (1-x)\phi\right)$ workers exiting the workforce and entering onto disability.

Glaeser et al. (2003) defines the social multiplier as the estimated ratio of the peer group coefficient to the individual coefficient. In our framework this corresponds to $\left(1+ (1-x)\phi\right)$. Thus, for small shocks the social multiplier is simply $\left(1+\phi\right)$. Glaeser et al. (2003) estimate the social multiplier in three different areas: the impact of education on wages, the impact of demographics on crime and group membership among Dartmouth roommates. In all cases they find a significant social multipliers varying from 1.4 to 2.17 when using small social groups (floor in a dorm or dorm) or smaller geographical areas (county or PUMA) as peer groups. We will compare our estimates with these findings.

## 5. Dataset Description

We utilize a databases provided by Statistics Norway called *FD-trygd*. It is a rich longitudinal database containing records for every Norwegian from 1992 to 2003. The database contains 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 and neighborhood of residence.

In particular, the employment data in *FD-trygd* contains records for employment "events" since 1/1/1995. 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.[16] 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.[17]

[16] 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).
[17] 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.

*Plant Downsizing Variables:* Based on the employment records, we constructed plant-level employment counts at the end of year 1994, 1999 and 2003.[18] 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 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 measures of plant downsizing over two periods of time: from 1994 to 1999 and from 1999 to 2003. The measures, which we refer to as the plant downsizing rate (PDR), capture the percent decline in FTEs over the period. 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. Plants that grew over a given period were all recorded as PDR=0 for that period.

As our empirical strategy relies on the power of plant downsizing events to predict subsequent entry onto disability, we chose to focus on downsizing events in reasonably large plants. Specifically, the PDR variable was set to zero for workers employed in plants with fewer than 5 FTEs at the baseline point in time.

*Worker Sample and Characteristics:* Our analytic sample consists of native Norwegians age 45-63 employed either full time or part time in 1999. We chose to focus on older workers since these demonstrate the highest rates of DP entry. The upward age limit was imposed to ensure that none of our sample would be eligible for the normal retirement pension in 2003.[19] Excluded were any identified as self-employed or receiving assistance that should have precluded full time work (those receiving unemployment benefits, a rehabilitation pension or a disability pension), as well as any receiving social assistance. We excluded those employed in small plants (<5 FTEs) in 1999, for the purpose of controlling for the PDR of a worker's current plant going forward (over 1999-2003). For similar reasons, we limited the sample to those who were also employed in 1994, to allow us to control for the past PDR (1994-1999) in a worker's former plant. We limited our sample to those residing in a neighborhood in 1994 that contained at least

[18] For 1994 we used data for 01/01/1995 because 1994 data was not available.
[19] The age of eligibility for the normal retirement pension is 67.

10 workers age 40-61 to ensure that each person in our sample had a reasonable number of "peers" under our definition of peer groups (discussed above). Finally, we omitted 222 workers who had received a disability pension any time between 1994 and 1999. The resulting dataset consists of 379,596 workers residing in 10,351 different 1994 neighborhoods.[20]

Variables capturing individual socio-economic characteristics were constructed based on records for 1999. These variables include age, sex, education, marital status, number of children, personal income, other household income, net household wealth and an indicator for receipt of widow's pension. Employment-related variables, constructed from the employment database, include an indicator for part time status, tenure at current firm, plant size in 1999, and fourteen industry indicators.[21] The PDR of the worker's 1999 plant (1999-2003) was captured, as well as the past PDR (1994-1999) for the 1994 plant of employment. Personal income and household wealth in 1994 was also captured, allowing us to control for the effect of changes in the workers' economic standing.

Our outcome of interest is an indicator variable capturing whether the worker received either temporary or permanent DP at the end of 2003, with the one caveat. For workers who died or emigrated prior to 2003 and those drawing an early retirement pension[22] in 2003, the indicator was set to one if the worker had entered DP prior to the event occurring. In sum, 6.9 percent of our sample received DP in 2003 (or prior to the events described above). Summary statistics for the remaining individual-level variables are presented in Table 1 (panel A).

*Peer Groups and Characteristics:* As described in our empirical strategy, we define peer groups based on age, neighborhood of residence (in 1994) and employment status. Specifically, neighbors are included in a worker's peer group if they were age 40-61 and employed full time or part time in 1994. The upward age limit was imposed to ensure that peers were not eligible for the normal retirement pension in 2000. We defined peer groups based on 1994 neighborhoods of residence in case local downsizing events influenced worker mobility. If so,

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[20] Our regression models omit 12 observations with missing income and/or wealth variables.

[21] Coded based on major categories in the Classification of Economic Activities in the European Community (NACE), with certain categories combined due to small sample sizes (agriculture, hunting and forestry was combined with fishing; activities of households was combined with other community, social and personal service activities; extra-territorial organizations and bodies was combined with public administration and defense).

[22] In some firms, workers satisfying specific work history requirement can qualify for an early retirement pension at age 62.

defining peer groups based on 1999 neighborhood of residence could lead to estimation bias through neighborhood self-selection.

Similar socio-economic and employment variables as those described for the worker sample were constructed at the peer group level, using records for 1994. Summary statistics for these characteristics are presented in Table 1 (panel B). Continuous variables were converted to categorical variables to create the peer-level covariates used in our estimation models. For instance, the age and sex composition of a worker's peers was captured as the fraction of peers in 14 age-sex categories (three-year age intervals interacted with sex). Peers' income and wealth were each captured as the fraction of peers in 6 categories defined based on the $10^{th}$, $25^{th}$, $50^{th}$, $75^{th}$ and $90^{th}$ percentiles for the distribution of the relevant variable over the full sample of peers. Additional program participation variables were created for the fraction of peers on social assistance, receiving sick money at the end of 1994 or having received sick money at any time in 1994. Another difference between the peer-level and individual-level variables is the categorizations of industry, which are based on International Standard of Industrial Classification (SIC codes) in use in the earlier period. The percent of peers in 24 industry categories was captured, with categories defined at the two-digit SIC level.[23]

Peer level PDR variables were created based on the level of downsizing in each peer's plant over 1994-1999. Three peer level PDR variables were constructed capturing the fraction of peers in plants downsizing 5-25%, 25-65% and 65-100%.[24] For reasons described in our results section, the peer PDR variables were also captured to distinguish between downsizing plants in public-sector industries (social services and public administration) and those in private-sector industries.

Finally, the DP rate of each worker's peers was constructed as the fraction of peers on permanent or temporary DP in 2000. As in the worker sample, we included in this fraction any peers who received DP prior to dying, emigrating or drawing an early retirement pension in 2000. In sum, the mean participation rate among worker's peers was 8.5 percent in 2000.

[23] Again, some smaller categories were combined. The primary difference in the two methods of categorizing industries is a greater level of distinction in types of manufacturing for the peers than exists in the worker sample.
[24] The IV estimates presented later were not sensitive a more detailed classification of peer PDRs. We therefore use the less detailed classifications for parsimony.

*Other Municipal and Neighborhood Level Characteristics:* We created additional variables to capture characteristics of the 1994 municipality and neighborhood of residence thought to potentially influence DP entry behavior of the individual workers and their peers. These include total native population; fraction of immigrants; fraction of natives age <18, 18-40 and ≥61 years old; mean income and wealth; unemployment rate; and fraction employed full or part time.[25] Additional variables were constructed at the neighborhood level to capture characteristics of similarly-aged neighbors (40-61 in 1994) excluded from the peer group. These include fraction receiving permanent disability, fraction receiving temporary disability, fraction receiving rehabilitation pension, fraction unemployed and receiving day money, fraction unemployed and not receiving day money, fraction self-employed, and fraction employed minor part time. Summary statistics for these variables are presented in Table 1 (Panel C).

## 6. Empirical Results

### 6.1 Effect of Plant Downsizing on Individual and Peer DP Entry

As discussed in our empirical strategy, our IV strategy hinges on the fact that plant downsizing events over 1994-1999 influences the entry of 1994 workers onto DP. Table 2 depicts several results in this regard.

The two first columns in Table 2 present linear probability (OLS) estimates for the effect of the plant downsizing rate (PDR) on the probability a worker originally employed in the plant in 1994 receives disability benefit in 2000, excluding workers in small plants (<5 FTEs). Model 1 suggests that plant downsizing has a fairly large and significant effect on disability entry. For instance, we find that working in a plant that downsized between 65-100% between 1994 and 1999 increased the likelihood of DP participation in 2000 by 1.1 percentage points[26], a more than 10 percent increase relative to the mean entry rate. Model 2 allows the PDR effect to vary across public- and private-sector industries. These estimates indicate that the overall effect of plant downsizing on disability entry found in Model 1 is driven mostly from the impact of downsizing in private-sector industries. This finding is not surprising because the public sector rarely lays off

[25] The income, wealth and employment variables were calculated over natives age 22-67. For calculating the unemployment rate, the "employed" were counted as those working full time or part time, and the "unemployed" were counted as those neither working nor self-employed having received unemployment benefits or registered as "looking for work" in the past year.

[26] See Data Appendix A for results with more detailed PDR categories.

workers when downsizing, but rather relocates workers to other jobs within the municipality (Røed and Fevang, 2005).

Models 3 and 4 correspond to Models 1 and 2, estimated at the peer-group level (including peers in small 1994 plants) and weighted to reflect the count of peers over which the peer-level variables were constructed. In these models the dependent variable and the covariates are identical to those included in Models 1 and 2, but aggregated (as means) over all peers within the 1994 neighborhood. The pooled estimated effect of the PDR variables (see Model 3) deviate somewhat from the effects suggested by the individual-level estimates. Small and moderate downsizing events appear to have a somewhat smaller effect than suggested by the individual-level model, while large downsizing events appear to have a somewhat larger effect.

Several unexpected patterns emerge when we allow the PDR coefficients to vary across private- and public-sector industries (see Model 4). First, the effect of downsizing in public sector industries now appears to have a *negative* impact on the peer DP rate in 2000. The estimated effect is significant and quite substantial for the fraction of peers in the smaller two downsizing categories. While the cause of this is unclear, it appears that the occurrence of small to moderate downsizing events in public sector plants within the local area are predictive of lower than expected DP entry rates. One plausible story is that local offices providing benefits to the poor or unemployed might shrink in response to better employment conditions. Similarly, offices providing services to the sick and disabled could shrink when the population utilizing such services declines.

Second, the effect of plant downsizings in private-sector industries grows substantially, some two to five times the magnitude suggested by the individual-level model. We offer a number of possible explanations for this. First, plant downsizings can indicate limited local employment opportunities that might influence DP entry even among those not directly affected. Second, our PDR variables capture downsizing events at one's 1994 plant. To the extent that workers who switch plants over the period are re-employed in similar plants as their neighbors, the peer level PDR could proxy for the direct effect of downsizing on workers who changed jobs. Third, the downsizing experience of peers in larger plants might be correlated with negative employment shocks experienced by peers in small plants. Fourth, the larger peer-level estimates potentially capture near-term social interaction effects, e.g. if workers are already being influenced by recent changes in their peers' DP rate. In short, the fact that the peer-level model suggests larger downsizing effects is not particularly surprising, though we admit being surprised by the magnitude of the differences.

Model 5 corresponds to the first stage in our IV approach,[27] and replicates Model 4 except for the omission of the PDR variables pertaining to public-sector industries. The estimated PDR coefficients for the private-sector industries are basically unchanged, suggesting we are safe in excluding the public-sector PDR covariates from our IV model.

## 6.2 Main Results: The Effect of Social Interaction on Disability Pension Entry

The first column in Table 3 reports the linear probability (OLS) estimate of the social interaction effect. This model suggests that a one percent increase in the 2000 peer DP rate predicts a 0.1 percentage point increase in the subsequent entry rate (to 2003) of workers employed at the end of 1999. Absent any omitted variable bias, we would expect this estimate to understate the social interaction effect induced by a recent shock. The intuition behind this is straightforward: past shocks have a smaller effect on entry rates because more time has been allowed for adjustment towards the new equilibrium.

Column 2 in Table 3 presents our baseline IV estimate. The social interaction effect estimated off of recent shocks grows substantially in magnitude as expected. Our IV estimate suggests that a one percentage point increase in the 2000 peer DP rate due to recent economic shocks increases the subsequent entry rate (1999-2003) of workers by 0.65 percentage points, an almost 10 percent increase relative to the baseline rate. IV probit estimates of the same model produced similar marginal effect estimates (see last column of Table 3). To put the magnitude of this estimate into context, this suggests that if a shock has the direct effect of inducing *x* percent of the working population to draw DP (and peer groups are hit symmetrically), then, due to social interactions, the indirect effect will increase entry by an additional $0.65(1-x)x$ percentage points. For small *x*, this corresponds to a social multiplier of 1.65, which is slightly lower than most of the estimates by Glaeser et al. (2003).

The reduced form estimates of our model, presented in column 3, suggest that the relationship between the individual PDR covariates and subsequent DP entry are closely proportional to their relationship with the peer DP rate in 2000. As such, the implied IV estimates suggested by the reduced form PDR coefficients, presented in column 4, are very similar and all within one standard error of our pooled IV estimate.

### 6.3 Robustness Analysis

The identifying assumption in our IV approach is that the plant downsizing experiences of a worker's peers occur independently of unobserved individual- and neighborhood-level determinants of DP participation. Table 4 reports the result of numerous robustness checks to test the validity of this assumption.

An important concern for our identifying assumption is that downsizing experiences could be correlated across peers. Our IV estimate could therefore be picking up delayed reactions[28] to the downsizing events in workers' own plants. If so, controlling for the plant downsizing rates (1994-1999) in workers' own plants would be expected to reduce the estimated social interaction coefficient. Comparing IV Model 1 (baseline model from Table 2) and 2 in Table 4 we can see that the inclusion of plant downsizing rates has a negligible effect on our IV estimate.

Peers' downsizing events could potentially influence subsequent entry onto disability through mechanisms having nothing to do with social interactions effects. In particular, local downsizing events could be indicative of declining local labor market opportunities, which could influence DP entry going forward. Models 3-5 include additional covariates through which declining labor market opportunities might be exhibited. In Model 3, we include covariates capturing the PDR of the worker's 1999 plant going forward (through 2003). In Model 4, we include covariates capturing the changes in worker's income and wealth variables since 1994. In Model 5, we include covariates capturing the unemployment rate in 1999 at both the neighborhood and municipal levels. The IV estimate is extremely robust to inclusion of each set of additional covariates.

As further robustness checks, we limit the sample in various ways that could affect the ability of the past PDR covariates to fully capture the past downsizing experience of the worker. In Model 6, we exclude workers whose 1994 plant had fewer than 5 FTEs, as the past PDR covariates were set to zero for such observations. Excluding these workers had negligible effect on our IV

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[27] But only approximately. Our true first stage model is estimated over workers still employed at the end of 1999, using the characteristics and PDRs of one's peers to predict the DP rate of one's peers in 2000. Thus, the coefficients will vary somewhat due to different implied weighting.

[28] After 1999 since the workers are still employed in 1999.

estimate. In Model 7, we restrict our sample to workers employed in the same plant in both 1994 and 1999. Doing so eliminates workers who might have experienced plant downsizing after switching jobs during the 1994-1999 period. Moreover, this restriction explicitly drops anyone who was directly affected by a downsizing event, in the sense that these workers were clearly retained at their original plant. Again, the effect on the IV estimate is extremely modest. Finally, Model 8 restricts our sample to workers still employed in their 1994 plant, and their 1994 plant was stable or growing over the 1994-1999 period. Specifically, we exclude workers in plants downsizing 5% or more. We regard this as a particularly strong test of robustness in the sense of conforming most closely to Moffitt's (2001) suggested approach: if social interaction effects exist, shocks affecting one's peers should affect the DP entry even of those workers experiencing no such shock. Instead of declining in magnitude, our IV estimate actually increases somewhat under this restriction, though the difference in statistically insignificant.[29]

### 6.4 Specification Tests

Another concern for our IV approach is that plant downsizing may be concentrated in neighborhoods populated by workers with higher propensities to draw disability pension. For example, working class neighborhoods are more likely to suffer from downsizing, and workers within such neighborhoods may be more likely to use disability insurance due to a higher incidence of disabling conditions and/or a lower opportunity cost associated with exiting the workforce. As a result, downsizing events in the past may proxy for an unobserved tendency of workers in certain neighborhoods to draw disability benefits. Tables 5 and 6 provide two specifications tests for this possibility.

Table 5 presents linear probability (OLS) estimates for the likelihood a worker in our sample received sick money in a given year, 1992-2002.[30] The use of sick money should capture some of a worker's propensity for using sickness-related benefits programs, like DP. Thus, if peers' downsizing experiences were correlated with individual's unobserved propensity for using DP, one would expect to observe this correlation in the context of sick money use before the downsizings occurred.

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[29] The larger estimate produced in Model 8 is potentially indicative of selection effects. Specifically, those retained in downsizing plants might be those with lower propensities for entering DP than those retained at non-downsizing plants. However, the imprecision of the estimates prevents us from rejecting the equivalence of the two estimates.

Instead, Table 5 provides no evidence that the PDR covariates are predictive of greater sick money use prior to 1994. Prior to 1996, coefficients are generally negative and consistently insignificant. Significant positive coefficients do emerge in 1996 and 1997, but do not persist. However, in the later years, some significant positive coefficients re-emerge, consistent with the influence of peer's downsizing events on worker's subsequent DP entry.

Table 6 reports OLS estimates for the "effect" of the peer PDR covariates on the *neighborhood* DP rate in years preceding 1995. These rates are calculated over all similarly-aged neighbors (40-61 in 1994) residing in the worker's 1994 neighborhood. If peers' downsizing experiences reflect a generally higher propensity to use DP in a worker's neighborhood, we would expect to find the peer PDR covariates positively correlated with prior rates of DP use in the neighborhood. Neighborhood DP rates in 1992 and 1993 are only weakly and inconsistently correlated with the peer PDR covariates. The fraction of peers experiencing small downsizing events is weakly negatively correlated with the neighborhood DP rate, while the fraction of peers in the other categories are weakly positively correlated. However, in 1994, we do find a significant positive correlation between the neighborhood DP rate and the fraction of peers experiencing the largest downsizing events. One plausible explanation for this finding is that some plants with substantial downsizing over 1994-1999 were already doing poorly, and perhaps laying off workers prior to 1994. Alternatively, workers could be reacting to expectations of future downsizing. This could induce the recent increase in the neighborhood DP rates that we observe.

A less favorable interpretation for our empirical strategy is that the finding reflects a systematic bias in our IV estimate: the fraction of peers in large downsizing plants reflects a higher propensity for DP use in one's neighborhood. However, if such a bias did exist, we would expect that the implied IV estimate generated off of the largest peer PDR category would most greatly suffer from this bias. The IV estimate generated off the smallest PDR category would suffer the least. However, recalling the results in Table 3, we found the implied IV estimates were very similar when based on the individual peer PDR instruments. Moreover, the implied IV estimate using the smallest PDR instrument was very similar to that using the largest PDR instrument. Taking together, it is difficult to conclude a systematic bias exists in terms of

[30] Models estimated for years 2001 and 2002 drop workers who had died, received an early retirement or received DP at the end of the prior calendar year since subsequent sick money use is virtually zero following such events.

higher unobserved propensities to use DP in neighborhoods harder hit by plant downsizing events.

### 6.5 The Role of Social Norms in Disability Pension Participation

In the context of disability participation, social interaction effects could operate through at least three different mechanisms: social norms, information and leisure complementarities. It is not within the scope of this paper to provide conclusive evidence separating these mechanisms. Our data does, however, allow us to provide some preliminary evidence on the role of social norms.

Table 7 reports IV estimates for different sub-samples of neighborhoods defined over characteristics intended to proxy for existing social norms towards DP participation in 1994. A person is presumably less likely to respond to the disability entry of his peers if residing in a neighborhood with stronger norms against DP participation. Thus, if social norms play a role in disability pension participation, we would expect weaker social interaction effects in neighborhoods with stronger social norms against living on welfare.

In the first two columns of Table 7 we compare neighborhoods with above median 1994 DP participation rates to neighborhoods with below median DP rates. The idea is that a neighborhoods' initial participation rate provides some information about the degree to which DP participation is stigmatized in this neighborhood. We find that the estimated social interaction coefficient is substantially larger in neighborhoods with higher 1994 DP rates. In columns 3 and 4, we compare neighborhoods with higher 1994 workforce participation to neighborhoods with lower workforce participation. Again, we find that the estimated social interaction coefficient is larger in neighborhoods with weaker commitment to the workforce.

During the 1980s and 1990s two coalitions comprised the political parties of influence in Norway, the coalition of socialists and the coalition of center/conservatives.[31] In columns 5 and 6 we use data from the national election in the autumn of 1993 and compare IV estimates across municipalities with more socialist or conservative/center voting patterns.[32] Our idea in doing so is that municipalities casting a larger share of votes for conservative/center parties are those with stronger social norms against welfare use. Data from polls can be taken to indicate such a

[31] Government was held by coalitions of the conservative/center parties in much of the 1980s, by a center coalition in the late 1990s, and by a conservative/center coalition in the early 2000s. From 1990 to 1997 the Labor Party held Government. Our results remain similar if the three center parties are excluded from the sample.

[32] Voting results are not available at the neighborhood level.

pattern. Statistics Norway performed two polls in 1992/3 asking respondents whether they were of the opinion that, in the future, welfare pension programs in Norway should be constricted, remain as they are, or be extended. In both polls, the respondents stating to vote conservative/center were more than twice as inclined as the socialist voters to be of the opinion that the programs should be constricted. Moreover, Flaa and Pedersen (1999) find that about 9 percent of the respondents stating to vote for the socialists thought that the government spent too much resources on welfare pension programs, while about 22 percent of the center/conservative voters were of the same opinion. Consistent with a social norm mechanism, we find that the estimated social interaction coefficient is substantially larger in more socialist municipalities.

## 7. Conclusion

In this paper we investigate the role of social interaction effects in disability pension participation in Norway. In particular, we investigate how an employed person's decision to utilize disability insurance is affected by his employed neighbors' disability entry. Our results lend empirical support to concerns about the potential development of "welfare cultures" arising from poorly designed disability insurance programs. Indeed, our IV estimates suggest that a one percentage point increase in the participation rate of previously employed neighbors increased the subsequent 4-year entry rate of workers employed at the end of 1999 by 0.65 percentage points. Moreover, our results suggest that social norms towards disability participation affect the magnitude of the social interaction effects.

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Table 1: Summary Statistics

Panel A: Worker Characteristics

| Characteristic | Fraction/Mean (s.d.) | Characteristic | Fraction/Mean (s.d.) | Characteristic | Fraction/Mean (s.d.) |
|---|---|---|---|---|---|
| DP status 2003[a] | .069 | Tenure | | 1999-2003 PDR[c] | |
| Age | 52.7 (4.71) | 1-3 yrs | .024 | 5-15% | .108 |
| Female | .423 | 3-5 yrs | .061 | 15-25% | .080 |
| Education (years) | | 5-8 yrs | .223 | 25-35% | .050 |
| ≤9 yrs | .133 | ≥8 yrs | .682 | 35-45% | .039 |
| 13-15 yrs | .318 | Plant size (FTEs) | | 45-55% | .028 |
| ≥16 yrs | .195 | 5-10 | .104 | 55-65% | .022 |
| Marital status | | 10-25 | .193 | 65-75% | .016 |
| Married | .728 | 25-50 | .185 | 75-85% | .019 |
| Widowed | .024 | 50-100 | .156 | 85-95% | .023 |
| Divorced | .137 | 100-500 | .229 | 95-100% | .122 |
| Children <18 y.o. | | ≥500 | .133 | 1994-1999 PDR[d] | |
| 1 | .269 | Industry | | 5-15% | .118 |
| 2 | .201 | agriculture, fishing | .004 | 15-25% | .076 |
| 3-4 | .073 | mining, oil | .022 | 25-35% | .045 |
| ≥5 | .002 | manufacturing | .176 | 35-45% | .033 |
| On widow's pension | .015 | electric, gas, water | .017 | 45-55% | .015 |
| Income/wealth[b] | | construction | .054 | 55-65% | .012 |
| Personal income | 316.0 (168.9) | wholesale/retail trade | .106 | 65-75% | .012 |
| Other HH income | 278.8 (580.6) | Hotels, restaurants | .009 | 75-85% | .019 |
| Net HH wealth | 318.5 (2759.2) | transport, communic. | .088 | 85-95% | .030 |
| Emp status: PT | .090 | financial intermed. | .040 | 95-100% | .148 |
| | | real estate, business | .067 | <5 FTEs (1994) | .042 |
| | | Public admin, defense | .112 | Income/wealth (1994)[b] | |
| | | education | .136 | Personal Income | 248.7 (119.4) |
| | | Health, social work | .143 | Other HH Income | 289.9 (3489.1) |
| | | other services | .026 | Net HH Wealth | 217.4 (6268.4) |

[a] Includes workers entering DP prior to death, emigrating, or drawing early retirement.
[b] In units of 1000 Norwegian *kroners*.
[c] Measures decline in plant employment (FTEs) for worker's 1999 plant of employment.
[d] Measures decline in plant employment (FTEs) for worker's 1994 plant of employment, set to zero for plants with fewer than 5 FTEs at baseline.

Table 1: Summary Statistics (cont.)

Panel B: Peer Group Characteristics

| Characteristic | Fraction/Mean (s.d.) | Characteristic | Fraction/Mean (s.d.) | Characteristic | Fraction/Mean (s.d.) |
|---|---|---|---|---|---|
| DP status 2000[a] | .085 (.048) | Emp status: PT | .124 (.058) | Industry (cont.) | |
| Age | 48.8 (1.4) | Tenure | | retail trade | .062 (.039) |
| Female | .434 (.070) | 1-3 yrs | .163 (.065) | hotels, restaurants | .012 (.020) |
| Education (years) | | ≥3 yrs | .721 (.082) | transport, storage | .060 (.045) |
| ≤9 yrs | .166 (.092) | Plant size (FTEs) | | communication | .024 (.024) |
| 13-15 yrs | .284 (.081) | 5-10 | .092 (.052) | financial | .028 (.025) |
| ≥16 yrs | .168 (.101) | 10-25 | .159 (.074) | insurance | .010 (.014) |
| Marital status | | 25-50 | .145 (.069) | real estate, business | .048 (.041) |
| Married | .750 (.144) | 50-100 | .136 (.068) | public admin, defense | .096 (.063) |
| Widowed | .020 (.020) | 100-500 | .236 (.106) | sanitation | .007 (.012) |
| Divorced | .119 (.078) | ≥500 | .123 (.090) | social services | .292 (.100) |
| Children <18 y.o. | | Industry | | rec/cultural services | .013 (.018) |
| 1 | .203 (.076) | agriculture, fishing | .005 (.017) | personal services | .011 (.017) |
| 2 | .135 (.071) | mining, oil | .017 (.034) | 1994-1999 PDR[d] | |
| 3-4 | .048 (.044) | food, beverage[c] | .026 (.035) | 5-25% (public) | .078 (.059) |
| ≥5 | .001 (.006) | apparel, other[c] | .014 (.029) | 25-65% (public) | .038 (.040) |
| On widow's pension | .013 (.016) | wood products[c] | .013 (.039) | 65-100% (public) | .090 (.073) |
| On social assistance | .006 (.012) | paper, publishing[c] | .028 (.039) | 5-25% (private) | .100 (.065) |
| On sick money | .037 (.028) | chemical, plastics[c] | .018 (.040) | 25-65% (private) | .072 (.051) |
| Rec'd SM in year | .110 (.048) | basic metals[c] | .012 (.047) | 65-100% (private) | .118 (.059) |
| Income/wealth[b] | | fabricated metals[c] | .061 (.065) | | |
| Personal income | 241.4 (35.1) | electric, gas, water | .015 (.026) | | |
| Other HH income | 290.0 (603.7) | construction | .053 (.042) | | |
| Net HH wealth | 242.6 (997.6) | wholesale trade | .067 (.052) | | |

[a] Includes peers entering DP prior to death, emigrating, or drawing early retirement.
[b] In units of 1000 Norwegian *kroners*.
[c] Categories of manufacturing. Smallest three categories (manufacturing of apparel, mineral products and other) were combined into single category.
[d] Calculated separately by public- and private-sector industries.

Table 1: Summary Statistics (cont.)

Panel C: Neighborhood and Municipality Characteristics

| Characteristic | Fraction/Mean (s.d.) | Characteristic | Fraction/Mean (s.d.) | Characteristic | Fraction/Mean (s.d.) |
|---|---|---|---|---|---|
| Municipality (1994) | | Neighborhood (1994) | | Municipality (1999) | |
| Total population[a] | 75201 (114795) | Total population[a] | 691 (609) | Unemployment rate[b] | .098 (.039) |
| Fraction immigrant | .053 (.043) | Fraction immigrant | .048 (.056) | Unemp rate missing[b,d] | .006 |
| Fraction <18 y.o.[a] | .221 (.032) | Fraction <18 y.o.[a] | .225 (.066) | | |
| Fraction 18-40 y.o.[a] | .322 (.023) | Fraction 18-40 y.o.[a] | .319 (.053) | Neighborhood (1999) | |
| Fraction ≥61 y.o.[a] | .202 (.037) | Fraction ≥61 y.o.[a] | .189 (.093) | Unemployment rate[b] | .092 (.051) |
| Mean income[b] | 139.8 (23.2) | Mean income[b] | 146.9 (41.6) | Unemp rate missing[b,d] | .007 |
| Mean wealth[b] | 71.7 (45.5) | Mean wealth[b] | 67.6 (127.8) | | |
| Unemployment rate[b] | .140 (.044) | Unemployment rate[b] | .132 (.060) | | |
| Fract. emp'd FT/PT[c] | .586 (.078) | Fract. emp'd FT/PT[c] | .619 (.099) | | |
| Urban indicator | .843 | Fract. emp'd MPT[c] | .056 (.029) | | |
| | | Fract. self-emp'd[c] | .071 (.053) | | |
| | | Fract. perm. DP[c] | .106 (.059) | | |
| | | Fract. temp. DP[c] | .002 (.005) | | |
| | | Fract. rehab pension[c] | .022 (.017) | | |
| | | Fract. day money[c] | .049 (.030) | | |
| | | Fract. unemployed[c] | .013 (.013) | | |
| | | Peer group population | 119.2 (116.4) | | |

[a] Calculated over native Norwegians.
[b] Calculated over natives age 22-67, omitting those on early retirement.
[c] Calculated over natives age 40-61 in 1994.
[d] In 1999, unemployment rate set to missing if municipality/neighborhood no longer exists or fewer than 10 within area in labor force.
*Notes*: N=354015. Sample consists of workers, age 45-63 in 1999, employed FT or PT in 1994 and 1999. Also dropped were those in small 1999 plants (<5 FTEs), on social assistance in 1999, missing income/wealth variables in 1999, or having fewer than 10 persons in defined peer group (see text for definition).

Table 2: Effect of Plant Downsizing on Neighborhood Disability Pension Utilization

| | *Individual-Level Models* | | | *Peer-Level Models* | |
|---|---|---|---|---|---|
| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
| Dependent variable: 2000 DP utilization | | | | | |
| *PDR cats* | | | | | |
| 5-25% | .0047** | | .0028 | | |
| | (.0012) | | (.0058) | | |
| 25-65% | .0117** | | .0067 | | |
| | (.0016) | | (.0069) | | |
| 65-100% | .0111** | | .0231** | | |
| | (.0013) | | (.0053) | | |
| F-stat | 34.04 | | 6.63 | | |
| *p-value* | *<.0001* | | *.0002* | | |
| *PDR – public* | | | | | |
| 5-25% | | $.0033^{+}$ | | -.0222** | |
| | | (.0018) | | (.0084) | |
| 25-65% | | $.0047^{+}$ | | -.0263* | |
| | | (.0025) | | (.0110) | |
| 65-100% | | .0020 | | -.0045 | |
| | | (.0017) | | (.0068) | |
| F-stat | | 1.84 | | 3.60 | |
| *p-value* | | *.1368* | | *.0128* | |
| *PDR – private* | | | | | |
| 5-25% | | .0054** | | .0246** | .0247** |
| | | (.0016) | | (.0076) | (.0076) |
| 25-65% | | .0160** | | .0331** | .0324** |
| | | (.0020) | | (.0089) | (.0089) |
| 65-100% | | .0188** | | .0629** | .0634** |
| | | (.0020) | | (.0087) | (.0087) |
| F-stat | | 43.09 | | 19.11 | 19.30 |
| *p-value* | | *<.0001* | | *<.0001* | *<.0001* |
| mean | .0861 | .0861 | .0931 | .0931 | .0931 |
| N | 506623 | 506623 | 10351 | 10351 | 10351 |

*Notes:* $^{+}$, * and ** denote significance at the 10, 5 and 1 percent level. Robust standard error in parentheses. All estimates adjusted for individual and plant 1994 characteristics (described in text). F-stat refers to test of joint significance for the three PDR coefficients.
Models 1 and 2: Individual-level linear probability (OLS) results, estimated over sample of peers in 1994 plants with at least 5 FTEs. Standard errors corrected for non-independent residuals within plant.
Models 3-5: Peer-level OLS results, with observations weighted based on number of peers comprising peer group.

Table 3: Main Results: The Effect of Social Interaction on Disability Pension Entry

| | OLS model | IV model | Reduced form | RF: Implied IV estimate | IV Probit |
|---|---|---|---|---|---|
| Dependent variable: 2003 DP utilization | | | | | |
| Peer 2000 DP utilization | .0897** | .6518** | | | 4.9613** |
| | (.0116) | (.1600) | | | (1.190) |
| | | | | | [.6176] |
| *1st stage PDR coefficients* | | | | | |
| 5-25% | | .0222** | .0137+ | .6171 | .0222** |
| | | (.0077) | (.0083) | | (.0077) |
| 25-65% | | .0293** | .0180+ | .6143 | .0293** |
| | | (.0089) | (.0100) | | (.0089) |
| 65-100% | | .0622** | .0408** | .6559 | .0622** |
| | | (.0087) | (.0098) | | (.0087) |
| F-stat | | 17.96 | 6.12 | | 17.96 |
| *p-value* | | *<.0001* | *.0004* | | *<.0001* |
| mean | .0688 | .0688 | 0688 | 0688 | 0688 |
| N | 379596 | 379596 | 379596 | 379596 | 379596 |

*Notes:* +, * and ** denote significance at the 10, 5 and 1 percent level. Robust standard error in parenthesis, corrected for non-independent residuals within neighborhood. All estimates adjusted for neighborhood, municipality and peer characteristics in 1994, and worker characteristics in 1999 (described in text). F-stat refers to test of joint significance for the three PDR coefficients. Mean marginal effect implied from IV Probit model presented in brackets.

Table 4: Robustness Checks

| | IV 1 | IV 2 | IV 3 | IV 4 | IV 5 | IV 6 | IV 7 | IV 8 |
|---|---|---|---|---|---|---|---|---|
| Dependent variable: 2003 DP utilization | | | | | | | | |
| Peer 2000 DP utilization | .6518** | .6219** | .6187** | .6234** | .6376** | .6287** | .6577** | .7314** |
| | (.1600) | (.1596) | (.1597) | (.1598) | (.1610) | (.1643) | (.2043) | (.2681) |
| *1st stage coefficients:* | | | | | | | | |
| PDR 5-25% | .0222** | .0222** | .0222** | .0222** | .0233** | .0232** | .0252** | .0233** |
| | (.0077) | (.0076) | (.0076) | (.0076) | (.0076) | (.0076) | (.0079) | (.0081) |
| PDR 25-65% | .0293** | .0293** | .0293** | .0292** | .0306** | .0301** | .0277** | .0264** |
| | (.0089) | (.0088) | (.0088) | (.0088) | (.0089) | (.0089) | (.0090) | (.0098) |
| PDR 65-100% | .0622** | .0620** | .0620** | .0619** | .0613** | .0614** | .0604** | .0563** |
| | (.0087) | (.0086) | (.0086) | (.0086) | (.0086) | (.0087) | (.0088) | (.0092) |
| F-stat | 17.96 | 18.09 | 18.09 | 18.09 | 18.00 | 17.86 | 16.60 | 13.23 |
| *p-value* | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 | <.0001 |
| *added covariates* | | | | | | | | |
| PDRs (94-99)[a] | | X | X | X | X | X | X | X |
| PDRs (99-03)[b] | | | X | X | X | X | X | X |
| Δ inc./wealth (94-99)[c] | | | | X | X | X | X | X |
| nbhd/munic unemp rate (99)[d] | | | | | X | X | X | X |
| *sub-samples* | | | | | | | | |
| ≥5 FT workers in plant (94) | | | | | | X | | |
| employed same plant 94-99 | | | | | | | X | X |
| stable/growing plant 94-99[e] | | | | | | | | X |
| Mean | .0688 | .0688 | .0688 | .0688 | .0688 | .0689 | .0711 | .0704 |
| N | 379596 | 379596 | 379596 | 379593 | 379593 | 363742 | 233359 | 147046 |

*Table 4 Notes:* ** denotes significance at the 1 percent level. Robust standard error in parenthesis, corrected for non-independent residuals within neighborhood. All estimates adjusted for neighborhood, municipality and peer characteristics in 1994, and worker characteristics in 1999 (described in text). F-stat refers to test of joint significance for the three PDR coefficients.

[a] Individual PDR covariates added for worker's 1994 plant (ten-percentile categories), entered separately for public- and private-sector industries. Also added were indictors for public-sector industry, part-time status and employment in small (<5 FTEs) plant in 1994.

[b] Individual PDR covariates added for worker's 1999 plant (ten-percentile categories), entered separately for public- and private-sector industries.

[c] Entered as third-order terms for change in personal income, change in other household income and change in household wealth. Two observations missing 1994 income/wealth variables were omitted.

[d] Entered as second-order terms, set to zero for neighborhoods/municipalities either missing of containing fewer than 10 persons in labor force in 1999, with indicators for such neighborhoods/municipalities.

[e] Employed throughout 1994-1999 period in plant downsizing less than 5%.

Table 5: Specification Test, Sick Money Utilization

| Dependent variable: Received SM in year | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *PDR categories* | | | | | | | | | | | |
| 5-25% | .0065 | -.0014 | -.0076 | -.0020 | .0282* | .0099 | .0095 | -.0076 | .0069 | .0138 | .0214 |
| | (.0109) | (.0111) | (.0104) | (.0111) | (.0116) | (.0120) | (.0118) | (.0128) | (.0139) | (.0144) | (.0146) |
| 25-65% | -.0074 | -.0009 | .0029 | -.0193 | .0139 | .0412** | -.0080 | .0273+ | .0110 | .0422** | .0387* |
| | (.0122) | (.0120) | (.0124) | (.0134) | (.0130) | (.0140) | (.0139) | (.0150) | (.0157) | (.0163) | (.0166) |
| 65-100% | -.0028 | -.0160 | -.0029 | .0032 | .0347** | .0251* | .0059 | .01880 | .0297+ | .0147 | -.0036 |
| | (.0122) | (.0122) | (.0120) | (.0126) | (.0131) | (.0138) | (.0142) | (.0142) | (.0157) | (.0166) | (.0168) |
| F-stat | 0.34 | 0.61 | 0.24 | 0.82 | 3.46 | 3.33 | .48 | 1.90 | 1.20 | 2.27 | 2.47 |
| *p-value* | *.7944* | *.6076* | *.8694* | *.4823* | *.0157* | *.0186* | *.6965* | *.1280* | *.3068* | *.0778* | *.0598* |
| Mean | .1162 | .1166 | .1211 | .1337 | .1449 | .1614 | .1662 | .1893 | .2364 | .2286 | .2286 |
| N | 379596 | 379596 | 379596 | 379596 | 379596 | 379596 | 379596 | 379596 | 379596 | 355820 | 342128 |

*Notes:* +, * and ** denote significance at the 10, 5 and 1 percent level. Robust standard error in parenthesis, corrected for non-independent residuals within neighborhood. All estimates adjusted for neighborhood, municipality and peer characteristics in 1994, and worker characteristics in 1999 (described in text). F-stat refers to test of joint significance for the three PDR coefficients. Results for 2001 and 2002 omit workers having died, emigrated or drawing early retirement (AFP) at end of previous calendar year.

Table 6: Specification Test, Neighborhood Disability Participation prior to 1995

| Dependent variable:<br>Neighbood DP rate in year | 1992 | 1993 | 1994 |
|---|---|---|---|
| *PDR categories* | | | |
| 5-25% | -.0133$^{+}$ | -.0118 | -.0140$^{+}$ |
| | (.0072) | (.0075) | (.0079) |
| 25-65% | .0077 | .0109 | .0137 |
| | (.0082) | (.0085) | (.0091) |
| 65-100% | .0132 | .0158$^{+}$ | .0205* |
| | (.0080) | (.0084) | (.0088) |
| F-stat | 3.09 | 3.23 | 4.56 |
| *p-value* | *.0261* | *.0216* | *.0034* |
| | | | |
| Mean | .0880 | .0955 | .1080 |
| N | 379596 | 379596 | 379596 |

*Notes:* $^{+}$, * and ** denote significance at the 10, 5 and 1 percent level. Neighborhood DP rate calculated over similarly-aged individuals in worker's 1994 neighborhood (age 40-61 in 1994). Robust standard error in parenthesis, corrected for non-independent residuals within neighborhood. All estimates adjusted for neighborhood, municipality and peer characteristics in 1994, and worker characteristics in 1999 (described in text), omitting covariates capturing percent of 1994 neighbors in each of the following categories: employed FT/PT, employed MPT, self-employed, receiving day money, unemployed without day money, receiving rehabilitation pension, receiving permanent DP, receiving temporary DP. F-stat refers to test of joint significance for the three PDR coefficients.

Table 7: Estimates for Neighborhoods with Presumed Difference in Prevalence of Norms Against Living on Welfare

| | 1994 DP part. rate | | 1994 work force part. rate | | 1994 voting behavior | |
|---|---|---|---|---|---|---|
| | < 0.098 | > 0.098 | < 0.63 | > 0.63 | socialist | conservative/center |
| Dependent variable: 2003 DP utilization | | | | | | |
| Peer 2000 DP utilization | .4159 | .8060** | .6567** | .4903* | .9593* | .4865* |
| | (.2841) | (.2237) | (.1965) | (.2491) | (.4786) | (.2159) |
| *1st stage coefficients:* | | | | | | |
| PDR 5-25% | .0201+ | .0262* | .0171+ | .0275* | .0127 | .0164+ |
| | (.0106) | (.0108) | (.0098) | (.0125) | (.0120) | (.0100) |
| PDR 25-65% | .0241+ | .0312** | .0215+ | .0427** | .0108 | .0321** |
| | (.0136) | (.0117) | (.0113) | (.0140) | (.0132) | (.0116) |
| PDR 65-100% | .0452** | .0648** | .0668** | .0521** | .0389** | .0577** |
| | (.0125) | (.0119) | (.0107) | (.0143) | (.0132) | (.0110) |
| F-stat | 4.93 | 10.60 | 12.96 | 6.03 | 2.73 | 10.18 |
| *p-value* | .0020 | <.0001 | <.0001 | .0004 | .0423 | <.0001 |
| Mean | .0571 | .0804 | .0771 | .0604 | .0714 | .0662 |
| N | 189210 | 190386 | 189783 | 189813 | 189638 | 189958 |

*Notes:* +, * and ** denote significance at the 10, 5 and 1 percent level. Robust standard error in parenthesis, corrected for non-independent residuals within neighborhood. All estimates adjusted for neighborhood, municipality and peer characteristics in 1994, and worker characteristics in 1999 (described in text). F-stat refers to test of joint significance for the three PDR coefficients.