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Displacement and household adaptation: insured by the spouse or the state?

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Abstract We investigate the added worker effect in a setting where female labour supply is high and the welfare state is generous. We trace couples' labour supply and income development following the husband's job displacement. We find no support for the added worker effect for the full sample of households. However, the added worker effect seems to be at work for subsamples characterised by households where the spouses are not working in the same industry and where the wife did not work full time pre-displacement. When using a measure of total household income, which includes public transfers, we find that the negative income impact of displacement is reduced by approximately 60 to 70 % when we also adjust for lower tax payments. Results suggest that income loss due to displacement is mitigated more by social welfare payments than by labour supply responses of the spouse.

Keywords Labour supply · Added worker effect · Displacement · Welfare benefits

JEL Classification J15 · J63 · J65

1 Introduction

There is a substantial amount of empirical literature describing the negative employment effects of displacement. Displacement affects both the short- and long-term wage and employment prospects of workers (Rhum 1991; Stevens 1997; Huttunen et al. 2011; Eliason and Storrie 2006; Røed and Fevang 2007). However, much less is

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known about the effect of displacement on the household as a whole. In this paper, we analyse the impact of displacement on the spouse's labour-market outcome and on the total economic welfare of the household. We use the husband's job displacement as the source of the negative shock on the household.

One potential advantage of marriage is that it comes with opportunities for risk sharing. For example, if the husband loses his job and becomes unemployed, the wife may respond by entering the labour market to make up for the reduction in family earnings. In the economic research literature, this phenomenon is labelled as the 'added worker effect' (see e.g. Lundberg 1985; Stephens 2002; Juhn and Potter 2007). The added worker effect predicts that individuals respond to negative income shocks when another family member loses his/her job by increasing their own labour supply. The need for intra-family risk sharing, however, will depend on market conditions and public support as well as on the changing characteristics of marriage. To the extent that publically provided welfare benefits offer a possible and attractive alternative, the spouse may play a less important role in the smoothing out of household income variations over time.

Norway represents a good case for testing the strength and limits of the added worker effect hypothesis. From the discussion above, there are reasons to believe that the added worker effect is smaller in countries with a generous welfare system and high female labour force participation rate. Since the beginning of the 1970s, the female labour force participation rate has increased dramatically in Norway from about 30 to approximately 75 %, a figure that is almost on a par with that of men's (Organisation for Economic Co-operation and Development [OECD] 2011). Together with Denmark and Sweden, Norway has the highest female labour force participation rate in the OECD. High female labour force participation rates may leave less scope for additional labour supply and may expose the household to labour market shocks, hitting both the husband and the wife. Furthermore, Norway is also characterised by generous welfare policies, which include fully wage-compensated sickness benefits from the first day of absence and relatively high and extended compensation rates for the unemployed. Therefore, the public insurance arrangements may represent a feasible alternative to self-income-smoothing efforts.

Our paper relates to several papers in the added worker effect literature (Lundberg 1985; Malony 1987; Juhn and Potter 2007; Spletzer 1997; Stephens 2002). All these studies report positive added worker effects, such that wives' labour supply is positively related to husbands' job loss. However, all these studies only present evidence from the USA. Furthermore, only Stephens (2002) uses displacement as an exogenous shock that can potentially affect wives' labour supply. He analyses the wives' responses before and after job loss to examine the life cycle labour supply adjustments and reveals, with the use of PSID data, small pre-displacement effects and large, persistent post-displacement effects. He finds that long-run labour supply increases compensate for over 25 % of the husbands' income loss. We supplement this study by presenting evidence from a labour market that differs significantly from the US labour market and by presenting results for the household based on an overall measure of income, not just wage income.

In this paper, we use high-quality Norwegian register data and present estimates for couples who were 25 to 55 years of age at the time of displacement and who

remained married throughout the years of observation. Husbands are registered as full-time workers by the end of 2001, at which time they are split into two groups: those that are displaced and those that are not displaced. Displacement is defined as being separated from a plant that either closed down or reduced the number of employees by 30 % or more in the course of 2002. These individuals are followed through to the end of 2005. Since our goal is to capture the employment reaction of wives, we choose a less lengthy period compared to most studies in the field.

We contribute to the literature in several ways: First, we use high-quality panel register data that contain detailed information on the periods of employment as well as different income components. Second, the case of Norway permits us to analyse the added worker effect in an economy characterised by high female labour supply and a generous welfare state. Third, by having access to different earnings measures, we are able to investigate the total effect of displacement on the household.

The paper proceeds as follows: The next section presents the methodological strategy. Section 3 presents the data, the variables and the sample. Section 4 presents the results and Section 5 concludes the paper.

2 Methodological approach

Our approach is well known in the empirical literature that analyses the impacts of displacement (Jacobson et al. 1993; Couch and Placzek 2010). The method is inspired by the techniques used in the programme evaluation literature (Heckman and Robb 1985; Lalonde 1986). The effect of the husband's displacement on the wife's employment is given by the following equation:

$$Ls_{it} = X_{it}\alpha_1 + \sum_{j=-2}^{3} d^{j}{}_{it}\alpha_j + \tau_t + \alpha_i + \varepsilon_{it} \tag{1}$$

Let Ls_{it} be a measure of labour supply (employment, annual earnings) for wife i at time t. X is a vector for the observable individual characteristics of the husband, the spouse and children in the household; regional characteristics; and characteristics of the plant where the husband worked at the time of displacement (the variables are explained in detail later). All variables in the X vector, except for the unemployment level in the region, are measured for the year prior to displacement (i.e. 2001). Furthermore, τ_t measures the year dummies, capturing trends in the economy.

The main variables of interest are the displacement variables, d^{j}_{it}. These are dummy variables that measure whether the husband of wife i at time t experienced a displacement j years ago or, if j is negative, whether the husband of wife i will experience a displacement j years later. The year of displacement is always 2002. In this set-up, displacement can affect labour market outcomes from 2 years before its occurrence to 3 years after its occurrence ($j = -2, -1, 0, 1, 2, 3$).

The individual fixed effect (FE) α_i captures the time invariant unobserved individual FEs. The benefit of estimating Eq. 1, including the individual FE, is that it sweeps away any time invariant unobserved individual characteristics that are potentially affecting the outcome variables. The parameter α_j captures the impact of the husband's displacement before, during and after the event occurs. Finally, ε_{it} is a stochastic error term, assumed to have a constant variance and to be uncorrelated across individuals and time.

We estimate both an Ordinary least square (OLS) and an OLS individual FE version of Eq. 1. In this way, we can control both for the observed and unobserved characteristics that may be correlated with displacement. Specifically, it is in the first two tables that we include both approaches. Thereafter, we only estimate the FE models. When we estimate OLS models, we always contrast them with the OLS FE variant to see to what extent the unobserved time FE matters.

In the empirical section, we estimate Eq. 1 for the whole sample of wives as well as for subsets of wives. The subsets are constructed to shed light on the issues raised earlier, such as whether the magnitude of the added worker effect is affected by parallel shocks hitting both partners and whether it varies with the magnitude of the wives' initial labour supply. The first question is answered by leaving out couples working in the same industry. To answer the second question, we carry out two exercises: we leave out pre-displacement full-time working wives and we leave out pre-displacement working wives.

3 Data, sample and variables

3.1 Data and sample

The database consists of several individual registers covering information on employment, unemployment, income, wealth, education, social welfare and demographic characteristics, which are administered and merged by Statistics Norway. The data have a panel structure, making it possible to follow individuals over time with regard to wages, civil status and, most importantly, transitions in and out of the labour market and welfare arrangements. A unique identifier makes it possible to link these men to their spouses and other members of the household. Moreover, we have a unique identifier linking individuals to the plants where they worked and, hence, to characteristics of the workplace.

The sample comprises all native males registered as full-time workers by the end of 2001. In the course of 2002, they either experienced a displacement or they did not. For this group, we include two pre-years (2000, 2001), one displacement year (2002) and three post-years (2003–2005). All in all, there are 6 years in total. We confine the analyses to couples that stayed married during the whole 6-year window. This implies that we disregard the possible correlation between displacement and divorce (see e.g. Eliasson 2012 or Rege et al. 2007 for Swedish and Norwegian evidence on the positive relationship between displacement and future divorce). This is necessary, since to investigate how a husband's displacement affects his wife's labour supply, we need

them both to remain in the same household.[1] In addition, we confine the analyses to people from 25 to 55 years of age at the end of 2001. The upper age limit is set to avoid problems related to early retirement, which, in Norway, is from the age of 62.

3.2 Definition of displacement

The database, which consists of all employed full-time working married men by December 31, 2001, is divided into two groups: displaced and non-displaced. Workers separated from plants that either closed down or reduced their number of employees by 30 % or more in the course of 2002 are defined as displaced workers.[2] For plants that closed down, we also require that the plant did not reopen in the following year. Furthermore, we require that the plants were registered as having at least five employees by the end of 2001. To avoid the potential contamination from very short-lived plants, we require that the plant also existed on December 31, 2000. Hence, for a plant that closed down between 2001 and 2002, we require that the plant existed in 2000 and that it did not reopen in 2003. For both displaced and non-displaced workers, we also require that they must have been registered as wage earners in the three subsequent years preceding the time of displacement. This is our target group—the group we wish to make inferences about. In line with many other studies in this field, we choose a calendar year as the time window when displacement can occur.

In setting up the treatment (displaced workers) and comparison group (non-displaced workers) as discussed above, we strive to construct two groups that are as identical as possible, with the exception that one group experienced a displacement and the other group did not. In Table 1 at the end of this section, we present some descriptive statistics for the two groups, which are reassuring in this respect.

3.3 Dependent variables

We use two measures of labour supply. One is a binary measure taking the value of 1 if the wife is registered as an employee at the end of the year, and 0 otherwise. The other is a continuous measure, namely, annual labour market income during the calendar year (for a 12-month period). We also include wives with no labour market income in the analysis. Therefore, spouses who are not registered as having labour market income are given the value of 0.

[1] In our sample, approximately 7 % of couples divorced in the period 2001–2005. Furthermore, we find a positive correlation between experiencing a displacement and the likelihood of divorce. However, running a regression on the whole sample (including future divorced couples) did not change the coefficients significantly. The main change is in having somewhat more precise coefficients when we focused on couples who remained married. The results are available upon request.

[2] Workers who left plants in 2002 but who are not classified as displaced are included in the analysis sample.

Table 1 Descriptive statistics, displaced and non-displaced households, mean values and standard errors

	Displaced				Non-displaced			
	Mean	Std. error	Min	Max	Mean	Std. error	Min	Max
Wife characteristics								
Experience (years)	18.78	7.53	0	35	19.31	7.56	0	35
Compulsory school	0.20	0.40	0	1	0.19	0.39	0	1
Secondary school	0.48	0.50	0	1	0.47	0.50	0	1
University/college low	0.28	0.45	0	1	0.29	0.45	0	1
University/college high	0.04	0.20	0	1	0.04	0.20	0	1
Unknown education	0.00	0.03	0	1	0.00	0.04	0	1
Annual income	232,693	123,124	0	2,086,151	233,867	121,582	0	
Employed $t-1$	0.90	0.30	0	1	0.90	0.29	0	1
Net wealth (NOK)	72,550.5	429,108.1	−4, 961, 833.2	13,900,000.5	95,949.2	910,797.1	−5, 013, 569.9	22,200,000.3
Husband characteristics								
Age (years)	46.42	8.93	25	59	47.16	8.84	25	59
Net wealth (NOK)	33,235.9	567,888.6	−5, 460, 087.5	4,790,000,006	67,153.4	316,789.1	−6, 562, 458.7	78,800,000.4
Compulsory school	0.15	0.35	0	1	0.14	0.35	0	1
Secondary school	0.53	0.50	0	1	0.51	0.50	0	1
University/college low	0.22	0.41	0	1	0.23	0.42	0	1
University/college high	0.11	0.31	0	1	0.11	0.31	0	1
Unknown education	0.00	0.06	0	1	0.00	0.05	0	1
Annual income	445,662	313,501	0	24,600,000	431,918	207,426	0	12,200,000
Unemployment rate (per cent)	3.10	0.82	1.3	5.7	3.12	0.81	1.3	5.7
Common characteristics								
Number of children below 6	0.38	0.67	0	4	0.35	0.65	0	6
Number of children below 11	0.73	0.94	0	5	0.69	0.94	0	7
N	76,750				1,137,003			

In the analyses, we also include controls for residential county (19 counties) and the husband's industry (12 industry codes)

To analyse the total economic consequence of a displacement on the household, we use four different income components, which are added up one by one:(1) annual labour income (as defined above); (2) *adds* unemployment benefits; (3) *adds* health-related benefits, which include sick leave benefits, rehabilitation benefits and disability benefits; and (4) *adds* public transfers such as child benefits, lone parent support and social assistance. Lastly, we investigate the impact of displacement on disposable income (after-tax income of the household).

3.4 Explanatory variables

The key explanatory variables are dummy variables measuring the years before and the years after the displacement, as presented in Eq. 1. In addition, we include a battery of explanatory variables. Individual characteristics of the wives include age, work experience, educational attainment, number of children below 6 years old, number of children below 11 years old and net wealth. For the husbands, we include age, educational attainment and net wealth. Work experience for the wife is based on register information and measures the number of years that the wife has had a labour income above the minimum requirement in the Norwegian social security system (which was approximately 7,500 euro annually in 2005). Educational attainment is measured by five dummy variables, which include compulsory school, secondary education, low-level college or university degree, high-level college or university degree and unknown education. For both spouses, we also have information on the level of public transfers that they received, including unemployment benefits, child-related transfers, sickness benefits, and rehabilitation and disability benefits.

Regional characteristics include unemployment rate in the county as well as fixed county effects (19 county dummies). Finally, we include information on the industry where the husband worked at the end of 2001 (12 dummy variables based on two-digit NACE codes).[3] All explanatory variables, except for the local unemployment rate, are measured in the last pre-displacement year. Table 1 presents the descriptive statistics for the husband and wife. We distinguish between displaced and non-displaced households.

To accept with certainty that the comparison group can approximate counterfactual development, the differences in pre-displacement mean values between the two groups should be small. Table 1 presents the mean values for some of the included individual explanatory variables. The table shows that wives in displaced households have a slightly lower educational level and that they have more children on average. The remaining mean values are very similar between wives of displaced workers and wives of non-displaced workers. There are also hardly any differences between displaced and non-displaced husbands. In short, Table 1 suggests that displaced households do not differ in any significant way from non-displaced households and, hence, are appropriate for simulating counterfactual development.

[3] NACE is the European Industrial Activity Classification.

4 Results

4.1 Labour supply of the husband

First of all, we need to establish that being affected by a displacement represents a sizeable negative shock for the husband's labour market outcome. If this were not the case, there would be no reason to expect a response from the wife. We pursue this in Table 2, which presents the direct displacement effects for the husband using the binary as well as the continuous measure (annual labour income) of the labour supply of the husband. We present results from both OLS and OLS FE models. The OLS model does not control for individual unobserved heterogeneity. To see how important individual unobserved heterogeneity is in our sample, we compare results from OLS and OLS FE models. In the OLS models, the full battery of controls presented in the data section is included. Since most explanatory variables are measured in the last pre-displacement year, we only include the local unemployment rate as an explanatory variable in the FE model, in addition to time effects and the key explanatory variables measuring the impact of displacement.

The year 2002 is defined as the displacement year (recall that displacement occurs when plants either closed down or reduced their staff by at least 30 % from the end

Table 2 Labour supply of displaced and non-displaced workers (dependent variables: employment, annual labour market income and unemployment; OLS and OLS FE models)

	Binary measure		Annual income	
	OLS	OLS FE	OLS	OLS FE
d_2	-0.016^{*} (0.002)		$7{,}945.33^{*}$ (1,967.41)	
d_1	0.001 (0.001)	0.017^{*} (0.002)	$8{,}579.45^{**}$ (1,967.52)	645.37 (1,583.83)
d_0	-0.218^{*} (0.002)	-0.202^{*} (0.002)	$3{,}914.32^{***}$ (1,967.25)	$-3{,}873.41^{**}$ (1,583.25)
d1	-0.072^{*} (0.002)	-0.056^{*} (0.002)	$-1{,}6327.2^{*}$ (1,967.52)	$-23{,}931.3^{*}$ (1,584.53)
d2	-0.062^{*} (0.002)	-0.046^{*} (0.002)	$-17{,}084.0^{*}$ (1,968.02)	$-24{,}663.1^{*}$ (1,584.87)
d3	-0.056^{*} (0.002)	-0.040^{*} (0.002)	$-16{,}919.6^{*}$ (1,968.01)	$-24{,}444.9^{*}$ (1,584.95)
Individual controls?	Yes	Yes	Yes	Yes
Spouse controls	Yes	Yes	Yes	Yes
Industry and residential county?	Yes	Yes	Yes	Yes
N	1,213,753	1,213,753	1,213,753	1,213,753
R^2-adj	0.032	0.033	0.212	0.026

In all models, we also control for (but do not report) year dummies and the full battery of control variables. In the fixed-effect specification, the only additional time-varying explanatory variable is the local unemployment rate

$^{*}p < 0.01$; $^{**}p < 0.05$; $^{***}p < 0.1$ (level of significance)

of 2001 through to the end of 2002). We include six dummy variables to measure the impact of displacement: d_2 is 2 years prior to displacement, d_1 is 1 year prior to displacement, d_0 is the displacement year, d1 is 1 year after displacement, d2 is 2 years after displacement and d3 is 3 years after displacement.

All measures reveal that displacement has a clear negative impact on the husband's labour supply, both in the short run and in the medium-long run. Note also that the binary measure captures whether the husband is employed or not by the end of the year, while annual labour income covers the whole year, not necessarily for those employed by the end of the year but also for those who are not registered as employed at the end of the year. The difference is visible and the estimates suggest that income effects seem to work with a lag.

Applying OLS to the binary measure shows an employment reduction of approximately 22 percentage points for the first year. Thereafter, the employment deficit falls in the following years and is down to approximately six percentage points by the end of the observation period, as shown in the first column.

Using annual labour income as the outcome variable, there is also a clear indication of a negative labour supply effect. In the second post-displacement year, the effect is estimated to be approximately 17,000 Norwegian kroner (NOK). Considering that the displaced workers were earning 4,000 NOK more in the years prior to displacement, the implied impact of displacement is 21,000 NOK, which is a reduction of approximately 5 % compared to the mean value of the annual income for non-displaced workers in the last year prior to displacement.[4] The negative labour supply effect remains at approximately the same level 4 years after displacement, indicating a more lasting impact of displacement on annual labour income.[5] These results, when combined, indicate that even though a large percentage of displaced workers return to work, the earnings gap remains. This suggests that they work shorter hours and/or that they have lower hourly wages. Furthermore, if we compare the immediate impacts of displacement on employment and annual labour income, we see that the negative short-run effect is much stronger for employment than for labour income.[6] Such a finding is in line with the results obtained by Huttunen et al. (2011), who report on displacement results for male workers in the Norwegian manufacturing industry. The earnings regression results in Huttunen et al. (2011) show negative earnings results that peak at 14,000 NOK. This is 4.8 % of the average earnings of the non-displaced workers.

Results suggest negative wage effects in the range of 4 to 5 % for Norway. Compared to US evidence, such an impact seems relatively modest. For example, Couch

[4] Approximately 0.15 euro is equal to 1 NOK. Therefore, 20,000 NOK is, equal to approximately 3,000 euro.

[5] We have also experimented with a specification where, in addition to the chosen sample selection, we also required that the husband should have more than 1 year seniority. This did not change the results significantly. The only visible difference was somewhat stronger wage effects.

[6] Note that we do not require that people report a positive labour income for them to be included in the labour income analyses. People without a reported labour income are given the value of 0. Since we are interested in the labour supply of the wife in the aftermath of displacement, we think it is necessary to include also those husbands who are not employed.

and Placzek (2010) report a negative wage effect in the range of 7 to 15 % 6 years after displacement, depending on the degree of displacement. However, the Norwegian results are not exactly comparable, as Couch and Placzek (2010) only include individuals with continuing wage observations. Stephens (2002) also reports negative wage effects from the displacement in the USA, in the range of 20 % 2 to 5 years after displacement. Furthermore, he points out that since he uses log earnings and drops observations with zero earnings, it is likely that his results understate the true impact of displacement on earnings.

Furthermore, the OLS results in Table 2 provide evidence that displaced workers differ in unobserved ways from non-displaced workers. They are less likely to be employed but have higher earnings. These differences motivate the OLS FE specification. However, the FE results present with very similar findings. The FE specification measures the effects on labour supply relative to employment 2 years before the displacement. Hence, this dummy variable is removed to avoid perfect collinearity. For example, when using the binary measure, the OLS estimate suggests that there is an early employment deficit among the displaced workers of 1.6 percentage points. This corresponds approximately to the difference between the OLS and FE estimates. The binary OLS FE estimates show an immediate employment deficit of approximately 20 percentage points. The impact is sharply reduced in the following year, and by the end of the observation period, it is down to four percentage points. Using annual income, the post-OLS FE displacement coefficients reveal negative effects and effects that are comparable in size to the OLS coefficients. In the last 2 years of observation, the negative effect is estimated to be approximately 24,000 NOK in both years or approximately 5 %. In summary, using both measures and both methods, we find a sizeable, negative labour supply effect for the husband following displacement.

Having established that displacement has a sizeable negative effect for the husband, albeit smaller than in the US estimates, we now turn to whether these negative effects have had any effects on the wives' labour supply.

4.2 Labour supply of the wife

Table 3 presents the first estimates of the labour supply effect for the wife. We include the same two measures of labour supply and the same two models as above. The sample in Table 3 consists of all wives, without any limitations.

The results for the binary measure in models 1 (OLS) and 2 (OLS FE) in Table 3 reveal that we do not find any general support for an added worker effect in the Norwegian labour market. Model 1 shows that prior to displacement, wives of displaced workers have approximately the same labour supply compared to wives in households who do not experience a displacement. In the first post-year, the employment deficit is equal to 1.2 percentage points. Compared to the mean employment rate among wives of non-displaced husbands, this represents a reduction of approximately 1.5 %. Such a finding is in contrast to the hypothesis postulated in the added worker literature but may be in line with a hypothesis supporting the importance of contemporary labour market shocks affecting both spouses (Juhn and Potter 2007). The negative effect is reduced somewhat in the years that follow and has vanished all

Table 3 Labour supply of the wives of displaced and non-displaced workers (dependent variables: employment and annual labour market income; OLS and OLS FE models)

	Binary measure OLS (1)	Binary measure OLS FE (2)	Annual income OLS (3)	Annual income OLS FE (4)
d_2	−0.001 (0.003)		1,335.72 (1,032.8)	
d_1	−0.004 (0.003)	−0.003 (0.003)	663.97 (1,032.7)	−652.71 (686.71)
d_0	−0.012* (0.003)	−0.012* (0.003)	915.7 (1,032.7)	−403.98 (686.25)
d1	−0.008* (0.003)	−0.007** (0.003)	−37.77 (1,032.7)	−1, 293.8 (686.0)
d2	−0.008** (0.003)	−0.007** (0.003)	279.95 (1,032.9)	−949.76 (686.58)
d3	−0.002 (0.003)	−0.001 (0.003)	908.43 (1,032.6)	−280.54 (687.12)
N	1,213,753	1,213,753	1,213,753	1,213,753
R^2-adj	0.033	0.010	0.252	0.079

In all models, we also control for (but do not report) year dummies and the full battery of control variables. In the fixed-effect specification, the only additional time-varying explanatory variable is the local unemployment rate

* $p < 0.01$; ** $p < 0.05$ (level of significance)

together by the end of the observation period. The difference in the estimates between OLS and OLS FEs is generally small. The descriptive statistics in Table 1 suggest that wives of displaced husbands had somewhat lower educational levels compared to wives of non-displaced husbands. This might raise concern if these wives also have unobserved characteristics that are negatively correlated with employment and wages. One way to correct for this potential bias is to include individual, specific FEs to control for unobserved individual characteristics. However, the results in model 2 suggest that unobserved characteristics are not driving the OLS results in model 1.

When examining the annual income variable in model 3 and model 4, the coefficients are generally small and far from significant. Hence, results in Table 3 provide no support for the added worker hypothesis.[7] If anything, it appears that couples are hit by parallel shocks, leading to a reduction in female labour supply measured on the extensive margin.

[7]With regard to the control variables, we find that labour supply increases with the wives' own education and work experience. It is lower for women with children, especially among those with small children (younger than 6). Labour supply also decreases with the level of the wife's wealth. With regard to the husband's characteristics, the wife's labour supply decreases with the age of the husband. With regard to the husband's education, we do not find a monotonic relationship, as is the case for the wife's own education. If the husband has higher education, particularly if he has a university or college degree of the highest level, this is negatively related to the spouse's labour supply. This result is indicative of specialisation within the household. The level of wealth of the husband is also negatively related to the labour supply of the wife. Finally, the level of unemployment in the county is also negatively related to the labour supply of the wife.

Table 4 Labour supply of the wives of displaced and non-displaced workers depending on the wives' previous employment (dependent variables: annual labour market income; OLS FE models)

	Excluding couples working in the same industry		Excluding women working in the pre-period
	1	2	3
d_2			
d_1	−159.79 (745.21)	−106.77 (991.55)	204.98 (2,790.39)
d_0	553.46 (745.63)	412.83 (991.25)	495.25 (2,791.56)
d1	33.77 (745.45)	1,672.91* (991.50)	1,981.38 (2,793.76)
d2	309.12 (745.75)	2,294.91** (991.43)	2,440.55 (2,794.80)
d3	1,490.79** (745.79)	4,366.10*** (991.65)	8,802.21*** (8,802.86)
Excluding women working full time in the pre-period	No	Yes	Not relevant
N	983,427	492,581	117,020
R^2-adj	0.08	0.099	0.113

The only additional time-varying explanatory variable is the local unemployment rate

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$ (level of significance)

4.3 Selection based on the wife's characteristics

In this section, we investigate whether the added worker effect is still important among subsets of couples. Specifically, we create subsets of couples based on the characteristics of the wife. The results are presented in Table 4. Almost 90 % of the wives were employed by the end of the year leading up to the displacement (year 2001). This means that there is little scope for extra labour supply measured on the extensive margin (job vs no job). Therefore, in Table 4, we choose to leave out the binary labour supply measure and to focus on the annual labour market income. Furthermore, we confine the presentation only to the FE models. To ease the interpretation of the results, we present the corresponding evidence in Table 7 in the Appendix on the pattern for the husbands' labour supply across the same subsamples as in Table 4.

In model 1, we leave out couples working in the same industry. We do this to control for the importance of parallel shocks. This could potentially be important, since the Norwegian labour market is characterised by two-breadwinner couples.[8] When we remove all couples from the sample who were registered as working in the same industry in the last pre-displacement year (defined as working in the same

[8]The importance of this phenomenon is also presented in Juhn and Potter (2007). They use matched March CPS files to examine labour market transitions for husbands and wives. They find that the added worker effect is still important among a subset of couples but that the overall value of marriage as a risk-sharing arrangement has diminished due to the greater positive co-movement of employment within couples.

one-digit NACE code), the estimates change. The sign of the coefficients change and we see signs of a small added worker effect operating with a lag. In the last year of observation, wives of displaced workers have an approximately 1,500 NOK higher labour income compared to wives of non-displaced workers. Compared to the mean labour income among wives of non-displaced husbands, this represents an increase of approximately 1 %. In summary, controlling for parallel labour market shocks has the expected effects. However, even after this control procedure, we do not find any strong support for a sizeable increase in the labour supply. Table 7 in the Appendix presents the corresponding results for the husband. In the last 3 years of the observation period, the coefficients show negative labour income effects above 20,000 NOK. Since the wives responses are approximately 1,500 NOK, this suggests that wives compensate rather modestly for the wage loss of their husbands (approximately 7 to 8 %).

Model 2 resembles model 1 with the exception that wives working full time in the pre-period are now left out, potentially leaving us with a sample with a larger excess labour supply. The results suggest that there is only a small difference between displaced and non-displaced wives prior to the time of displacement but that the difference increases as time elapses. Again, the results suggest that the wives' labour supply response works with a lag. It builds up from the year of plant closure but does not turn significant until towards the end of the observation period. Compared to model 1, the labour supply effects are somewhat larger. In the last year of observation, wives of displaced workers have an approximately 4,400 NOK higher labour income compared to wives of non-displaced workers. Compared to the mean labour income among wives of non-displaced husbands, this represents an increase of approximately 2 %. Larger effects for the subset of couples in model 2 are in accordance with our expectations. Results for model 2 in Table 7 in the Appendix show that the wage loss for the husbands in this subgroup is in the range of 23,000–25,000 NOK. This means that the wife compensates with approximately 10 to 20 % of the husbands' wage loss, a considerable increase compared to the first model. Results from these two subsets of couples give some support to the added worker hypothesis.

Finally, in Model 3, we exclude all wives working prior to the displacement of the husbands and we are, therefore, left with a group of wives with a large reservoir of labour supply. Of course, non-working pre-displacement wives may also be strongly limited from the demand side. This may limit their opportunities in the labour market and, therefore, their response after the displacement of their husband. Therefore, the estimated results will involve a mixture of mechanisms on the supply and demand side. However, the results show that the positive response of the wife becomes stronger when we leave out all pre-displacement working wives. In the last year of observation, the coefficient suggests that wives of displaced husbands increase their labour market earnings by approximately 8,800 NOK. Compared to the mean level of the labour market income of non-displaced wives, this represents an increase of approximately 5 %. Again, model 3 in Table 7 in the Appendix presents the corresponding results for the husbands in this subgroup. The negative wage effect is in the range of 20,000 NOK until it drops to 12,000 NOK in the last year of observation. When displaced wives increase their earnings by approximately 8,800 NOK in the last year, this implies that the wife compensates strongly in this last year.

However, we should note that the subset of couples in model 3 is a selected group of non-working wives, comprising only 10 % of the original sample and, hence, making the external validity questionable.

It should also be mentioned that the business cycles in the period could play a role. The period is characterised by increasing unemployment rates in the years 2002 and 2003. In 2004 and 2005, the economy picks up again and the unemployment rate falls. The large positive change in wage income for the last group of wives (those who were not working in the pre-displacement period) may indicate that this low-attachment group has benefited from the economic upturn in 2005. If so, we could be witnessing a combination of the supply and demand effect. We are not able to fully disentangle these two mechanisms, but we do control for the regional unemployment level in the county.

The lesson from Tables 3 and 4 is that the added worker effect is generally not a predominant phenomenon in the Norwegian labour market. High female labour force participation rates make couples vulnerable to parallel shocks and provide less scope for additional labour supply. Therefore, the answer to the question put forward in the title is that in Norway, displaced workers are not insured by their partner.[9] However, for subsets of couples, and especially for couples where the wife has a larger potential pool of additional labour supply to offer, we find traces of the added worker effect in the Norwegian labour market.[10]

4.4 Impact of displacement on the total income of the household

In the following, we analyse the total economic consequences of displacement on the total income of the household. The additional income components we include are all welfare allowances that Norwegian citizens are entitled to in case of job loss, sickness, having young children and disability. Therefore, this exercise provides a measure of the extent to which the welfare state compensates for wage loss and health-related complications arising from displacement. When carrying out this exercise, we shed light on the second part of the question in the title of the paper, which pertains to the role of the state as an income buffer.

We use five different income measures, already presented in the data section. The first is annual labour income. The second measure adds unemployment benefits. The third component adds health-related benefits. The fourth measure adds public

[9] All analyses so far have focused on Norwegian natives. As an extra exercise, we have undertaken analyses for immigrants as well. We distinguish between non-Western and Western immigrants. The overall impression from these analyses is small and statistically insignificant responses. This is especially true for non-Western immigrants and might suggest that they are heavily limited on the demand side, in the sense that their productivity is too low compared to the requirements in the labour market. Such an explanation is particularly feasible in an economy such as the Norwegian one, which is characterised by a compressed wage structure, especially at the lower end of the wage distribution. The consequence is high wage floors, which is hard to reach for non-Western immigrant women.

[10] In the last set of analyses, we reverse the setting: we consider the situation where the wife is displaced and we investigate whether there is any labour supply response from the husband. The results show (these are not reported but are available upon request) that the wife's displacement does not trigger any response in the husband's labour market behaviour. This result applies in general and also for subsets of couples.

Table 5 Household economic consequences of displaced and non-displaced workers (dependent variable: annual labour income plus unemployment benefits plus health-related benefits plus public transfers minus taxes; OLS FE models)

	(1)	(2)	(3)	(4)	(5)
		+	+	+	−
	Labour market earnings	Unemployment benefits	Health-related benefits	Public transfers	Taxes
	Household	Household	Household	Household	Household
d_2					
d_1	−6.90 (1,735.6)	313.67 (1,648.61)	398.44 (1,630.78)	860.68 (1,624.98)	856.81 (1,591.88)
d_0	−4, 277.74* (1,735.67)	−1, 153.5 (1,648.74)	−687.17 (1,631.44)	183.92 (1,624.99)	900.56 (1,591.23)
d1	−25, 225.45** (1,735.99)	−19, 151.03** (1,649.86)	−17, 417.6** (1,631.65)	−16, 482.5** (1,624.86)	−8, 303.97** (1,591.99)
d2	−25, 613.21** (1,735.97)	−21, 130.22** (1,649.88)	−18, 900.33** (1,631.61)	−17, 907.3** (1,625.77)	−9, 109.44** (1,591.77)
d3	−24, 724.78** (1,736.74)	−21, 813.55** (1,649.34)	−19, 866.43** (1,631.78)	−18, 615.3** (1,625.98)	−9, 442.93** (1,592.24)
N	1,213,753	1,213,753	1,213,753	1,213,753	1,213,753
R^2-adj	0.065	0.145	0.165	0.174	0.100

The only additional time-varying explanatory variable is the local unemployment rate

* $p < 0.05$; * $p < 0.01$ (level of significance)

transfers. Finally, the fifth measure adjusts for taxes. Table 5 presents the results. For the labour income measure, we have already presented the separate estimates for the husband and wife; therefore, we limit the presentation to the household as a whole. In addition, for the other measures, we limit the presentation to the income measure of the household. The models are estimated using the OLS FE method.

The sum of the two labour income responses is reported in the first model: Since, on average, the wife's response does not compensate for the husband's wage loss, the household's loss in total annual labour income is almost identical to the husband's wage loss.

The second model adds unemployment benefits to the equation.[11] The coefficients show that unemployment benefits diminish the income loss for the household by a sizeable amount. On average, 15–20 % of the household's wage loss is compensated for by unemployment benefits. The compensatory ratio is highest in the first years after displacement, which is reasonable, since the return rate to employment increases over time and because unemployment benefits run out after 1 to 1.5 years, depending on the previous wage income.

The next model adds health-related benefits (sickness, rehabilitation, disability).[12] This reduces the negative income effect further, but the relative importance is lower compared to unemployment benefits. Compared to the income measure including unemployment benefits, the negative income effect is reduced by a further 10–12 %. In contrast to the income measure including unemployment benefits, the compensatory pattern is sustained throughout the period. This is reasonable, since work disability triggers a series of benefits, starting with sickness benefits in the first year, followed by rehabilitation benefits for another year, and eventually, vocational rehabilitation and temporarily disability pension thereafter. Compensation amounts to 100 % of previous income while on sick leave and about two-thirds of previous income while on the other health-related benefits.

In the fourth model, which adds public transfers, the negative economic impact of displacement is further reduced. Public transfers include childcare benefits, child benefits,[13] rent support, social assistance, parents' custody tax-deduction, birth allowance (lump sum), basic benefits aimed at covering extra expenses due to permanent illness or injury and lone parent support benefits. Compared to the impact on household labour income (in the first model), the impact is now reduced by approximately 25 %. This indicates that the negative impact of displacement on the

[11] Unemployment benefit is conditional on recent work experience. Compensation amounts to 62.5 % of previous labour income, and duration is of maximum 1.5 years depending on previous wage income.

[12] Rehabilitation benefits involve both medical rehabilitation and vocational rehabilitation, which are measures intended to help individual back to work. Rehabilitation benefits can last for several years and provide the same level of compensation as unemployment benefits. Disability benefits are compensation for loss of income from employment in the event of occupational disability due to illness or injury. Disability benefit is calculated the same way as old-age pension on the basis of past earning and expected earnings in the absence of disability.

[13] Childcare benefit is granted when the child must be looked after by someone else during working hours or training courses. The benefit amount is set at 64 % of actual childcare expenses up to a certain annual ceiling. When income from work exceeds six times the basic amount, there is no right to childcare benefit.

Table 6 Household economic consequences of displaced and non-displaced workers (restricted sample: wives who did not work full time prior to the displacement and couples who did not work in the same industry prior to the displacement; dependent variable: annual labour income plus unemployment benefits plus health-related benefits plus public transfers minus taxes; OLS FE models)

	(1)			(2)	(3)	(4)	(5)
	Labour market earnings			+ Unemployment benefits	+ Health-related benefits	+ Public transfers	− Taxes
	Husband	Wife	Household	Household	Household	Household	Household
d_2							
d_1	2,885.01	−106.77	2,778.22	2,844.67	2,939.45	3,519.44	1,892.44
	(2,443.5)	(991.55)	(2,630.5)	(2,487.78)	(2,461.78)	(2,447.78)	(2,240.5)
d_0	−6, 254.5*	412.83	−5, 841.5*	−3, 321.87	−2, 829.6	−1, 946.8	−1, 544.7
	(2,433.7)	(991.25)	(2,630.7)	(2,487.77)	(2,461.44)	(2,447.76)	(2,241.3)
d1	−22, 841**	1,672.91***	−21, 169.1**	−16, 408.7**	−14, 416.1**	−13, 624.4**	−7, 572.66*
	(2,434.78)	(991.50)	(2,630.78)	(2,488.99)	(2,462.86)	(2,447.9)	(2,241.7)
d2	−25, 154.2**	2,294.91*	−22, 860.2**	−19, 417.2**	−16, 678.4**	−15, 616.6**	−7, 798.11**
	(2,434.97)	(991.43)	(2,630.97)	(2,488.97)	(2,463.37)	(2,447.97)	(2,241.8)
d3	−24, 541.7**	4,366.10**	−20, 175.7**	−18, 348.7**	−15, 929.5**	−14, 916.7**	−7, 006.66***
	(2,435.88)	(991.65)	(2,632.88)	(2,489.88)	(2,463.78)	(2,449.8)	(2,241.2)
N	492,581	492,581	492,581	492,581	492,581	492,581	492,581
R^2-adj	0.028	0.099	0.062	0.135	0.169	0.163	0.101

In all models, we also control for (but do not report) year dummies and the full battery of control variables. In the fixed-effect specification, the only additional time-varying explanatory variable is the local unemployment rate

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.1$ (level of significance)

household economy is considerably reduced when we adjust for compensatory welfare measures. The results suggest that displaced workers are relatively well insured by the state. Nevertheless, the impact is still negative and significant in the final year of observation.

Finally, the last model considers disposable income, that is, income after taxes.[14] We do this by subtracting individual information on annual taxes, collected from tax registers, from the income measure. The results indicate that the negative effect of displacement is further reduced. Compared to the income measure including transfers, the negative income effect is reduced by approximately 25 %. A comparison of the effects in the last column (model 5) with the effects in the first column (model 1) shows that the negative economic effect for the household is reduced by approximately 65 % all together. These results clearly suggest that it is the welfare state that acts as an insurance provider in the aftermath of a displacement.

To reach a better understanding of the potential of the family unit as an insurance agent, we also estimate the models presented in Table 5, but for the sample of wives who did not work full time prior to the displacement and for couples who did not work in the same industry prior to the displacement. Table 6 presents the results.

The pattern in Table 6 is quite similar to the results in Table 5, with one exception: In Table 6, we find a positive and larger compensatory response from the wife compared to Table 5. The result of this added worker response is that the negative labour income effect is reduced in the third model. However, since the wife's response does not add up to the loss of the husband's income, the household's total annual labour income is reduced as a consequence of displacement. The coefficients indicate that the response of the wife constitutes approximately 10–20 % of the husband's loss. Therefore, for subsets of couples, both the wife and the welfare state act as insurance providers in the aftermath of negative demand shocks.

5 Conclusion and discussion

In this paper, we have analysed whether, in the aftermath of a displacement, the household is insured by the spouse or by the state. The first part of the question relates to the issue of whether there is evidence of an added worker effect in Norway—to what extent does the wife respond to the husband's job loss by increasing her labour supply? We focus on displaced workers, since they constitute a less selected group of workers than the average group of job seekers. In contrast to the average job seeker, it can be argued that displaced workers have become job seekers due to an exogenous shock. That is, they are less prone to have chosen to quit their previous job or to have been fired because of low work performance, and hence, they can be regarded as more representative of the average employee who works in a plant that is exposed to the risk of being closed down or dramatically downsized.

[14]The progressive tax system of Norway means the lower labour income (due to displacement), the lower is income tax.

The majority of the previous empirical studies in this field have focused on the US labour market. Therefore, we think it is timely to analyse this question in a quite different labour market setting, which is characterised by very high female labour force participation rates and a relatively generous welfare state. In general, the results show no rise in the labour supply on the part of the wife when the husband is displaced. On the contrary, there is an indication that the husband's job loss is matched by the wife's job loss, suggesting that couples are hit by parallel shocks affecting the labour market situation of both. Such a finding gives no support for the added worker effect. However, we do find results which suggest that the added worker effect is present for subsets of couples, especially when we leave out couples working in the same industry and focus on wives who are not working full time prior to the displacement (and, therefore, have more extra potential hours to offer). For these subsets of couples, the wives' extra labour compensates for 10 to 20 % of the husbands' wage loss.

The analysis on the extent to which the state compensates for the low level of spousal insurance in the aftermath of displacement gives support to the hypothesis that the state plays an important role in smoothing out income fluctuations caused by external shocks. To do so, we construct different income measures for the household, consisting of labour income and different welfare benefits and transfers, such as unemployment benefits, health-related benefits and child-related transfers as well as adjusting for taxes paid. The results show that the initial negative wage effect of displacement is reduced by approximately 25 % when adjusting for welfare benefits. After adjusting for lower tax payments, the negative impact on the household is reduced by as much as 65 %. This suggests that in a welfare state, households are well insured against negative shocks in the labour market.

As opposed to US studies, most of which report positive added worker effects (Lundberg 1985; Malony 1987; Spletzer 1997; Stephens 2002), our results suggest that this is not the usual case in Norway. We think that there are three main reasons for this difference: First, the initial negative shock affecting the husband is smaller in the Norwegian labour market compared to what the US studies report, which estimate that the negative wage effects from displacement for those directly involved are three to four times larger than our estimates. In Norway, a more modest initial wage reduction requires a more modest response from the wife. Second, female labour force participation rates in Norway are considerably higher than those in the USA. Norway is among the OECD countries with the highest female labour force participation rates, which implies that couples in Norway are more vulnerable to parallel shocks and that there is less scope for extra labour supply compared to the USA. Third, our results suggest that couples in Norway are relatively generously insured by the state, dampening the initial negative effect on the wage income of the household. We cannot rule out that the generous welfare payments partly crowd out the added worker effect. When the state offers relatively generous compensation rates in the aftermath of negative shocks, there is less need for intra-household adaptation.

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Appendix

Table 7 Labour supply of displaced and non-displaced workers (dependent variables: annual labour income; OLS FE models)

	Excluding couples working in the same industry		Excluding women working in the pre-period
	1	2	3
d_2			
d_1	964.71	2,885.02	2,162.5
	(1,764.3)	(2,433.33)	(6,995.5)
d_0	$-3,288.4^{*}$	$-6,254.7^{**}$	−571.54
	(1,764.5)	(2,433.5)	(6,995.5)
d1	$-22,929.64^{***}$	$-22,841.9^{***}$	$-20,187.2^{***}$
	(1,764.94)	(2,434.8)	(7,001.4)
d2	$-23,308.56^{***}$	$-25,154.7^{***}$	$-23,578.4^{***}$
	(1,764.99)	(2,434.9)	(7,003.3)
d3	$-23,161.49^{***}$	$-24,541.7^{***}$	$-12,098.2^{***}$
	(1,764.6)	(2,435.9)	(7,004.5)
Excluding women working full time in the pre-period	No	Yes	Not relevant
N	983,427	492,581	117,020
R^2-adj	0.024	0.024	0.014

In the fixed-effect specification, the only additional time-varying explanatory variable is the local unemployment rate

$^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$ (level of significance)

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