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ORIGINAL PAPER

# The response of Japanese wives' labor supply to husbands' job loss

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**Abstract** This paper examines how Japanese wives react to their husbands' involuntary job loss and tests the existence of complementarity of a wife's labor supply to her husband's. Utilizing panel data on Japanese households from 1993 to 2004, we found that wives' labor supply is stimulated when husbands suffer involuntary job loss. The detailed statistics show that not only do working wives raise their labor hours but also nonworking wives begin to participate in the labor market. The added worker effect is evident during the period of job insecurity in Japan following the mid-1990s.

**Keywords** Added worker effects · Within-family risk-sharing · Household panel data

**JEL Classification** D12 · J22 · C23

## 1 Introduction

Unemployment rates in Japan have skyrocketed since the mid-1990s. Not only young unskilled workers but also middle-aged male workers have been laid off. These middle-aged workers are often the main income earners in a household. How have Japanese households reacted to these changes? This paper examines

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their reactions to husbands' involuntary job loss, focusing on wives' labor supply.

When a household's main income earner loses a job, other household members might supply more labor either sequentially or simultaneously to compensate for the job loss. This is called the *Added Worker Effect* and has been examined in several countries. Heckman and McCurdy (1980) use data from the Panel Study of Income Dynamics for 1968 to 1975 to show that the wife participates more in labor markets when the husband is unemployed. In contrast, Lundberg (1985) and Cullen and Gruber (2000) show that the added worker effect may exist but is quite small in the United States. Spletzer (1997) shows that there is the added worker effect in the United States, but that this is largely explained by unobservable heterogeneity between wives whose husbands have lost their jobs and wives whose husbands have not. The heterogeneity causes an endogeneity between the husband's unemployment and the wife's labor supply. Bingley and Walker (2001) take this endogeneity into consideration and show that the added worker effect is small but that it becomes large when the husband's unemployment period is long. Stephens (2002) emphasizes the use of involuntary job loss as an exogenous employment shock and shows that the wife's labor supply does not react promptly to the husband's involuntary job loss. Fernandes and Felicio (2005) finds that the added worker effect exists in Brazil, focusing on non-working wives' reaction to their husbands' unexpected job loss.

The fact that wives flexibly change their labor supply might be surprising. Despite the huge research on household behavior, much of it neglects households' leisure/labor decisions and concentrates on consumption behavior. For example, many empirical investigations have examined whether households' consumption responds to idiosyncratic shocks (e.g., tests of the applicability of the life-cycle permanent income and full insurance hypotheses). There is little empirical research that deals with both consumption and leisure at the same time.[1]

The present paper clarifies whether or not household members change their labor decisions in response to unexpected shocks surrounding them. In order to examine this, we focus on the existence of surplus labor and its reaction to shock experienced by main income earners. That is, the first purpose of our paper is to reexamine the existence of the added worker effect. Empirical analysis on the added worker effect has some difficulties such as lack of detailed information on wives' working hours, their working history, households' savings/consumption patterns, and causes of husbands' job loss. We utilize panel data containing extensive household information so that we

[1] Exceptionally, Low (2005) and Pijoan-Mas (2006) describe an individual's life-cycle labor supply behavior with precautionary motive, and shows that one can change labor supply flexibly in response to his/her uncertainty as well as wages. Attanasio et al. (2005) simulate the changes in consumption, savings and wives' labor supply in relation to income uncertainty, and find that female labor supply is responsive to idiosyncratic shocks especially in those households with borrowing constraints.

can specify a better estimation model. Unlike previous studies that use a one-shot event or cross-sectional data, our data represent 9 years of annual changes that enable us to control for unobserved panel heterogeneity and autocorrelation. As previous studies suggest, information on husband's involuntary and unanticipated job loss makes any endogeneity problem smaller when testing the wives' reaction in response to the household shock.

Another purpose of the paper is to clarify the existence of the added worker effect in Japan. We not only use Japanese household data but also highlight the period when the added worker effect could exist if there is any in this country. That is, our sample period (1993–2004) includes the period when Japan's unemployment rate increased dramatically and stayed at a high level.

It is important to examine the existence of the added worker effect in Japan for four reasons. First, as mentioned in the last paragraph, Japan has experienced a sharp rise in unemployment and a dramatic change in the employment atmosphere in the past decade, which provides us with a suitable context in which to examine the changes in households' economic behavior such as labor supply and consumption. We can add another result to the existing arguments on the added worker effect.

Second, Japan is famous for having a large proportion of women who are housewives, especially among wealthy households. Many women become housewives after marriage or at least after having a child. According to *OECD Economic Studies* in 2002, the labor force participation rate of women aged 25–54 in Japan is about 67%, which is less than other OECD countries: over 80% in Scandinavian countries, about 80% in Canada and France, about 77% in the U.S. and Great Britain, and about 72% in Australia. It is interesting to observe how Japanese labor-risk-sharing within a household has changed (or not changed) after about a 3% rise in middle-aged male unemployment.

Third, Japan is known for its high household saving rates. *OECD Economic Outlook* in 2002 shows that Japan is one of the countries with high household saving rates: about 11% in 2001, compared with 16% in France, 14% in the Czech Republic, 13% in Belgium and Korea, and 11% in Spain and Italy. As drawing down savings is one way to cope with the main earner's job loss, the level of savings can make a difference to a household's labor-risk-sharing. The Japanese data may reveal interesting differences to other countries' results.

Fourth, so far, there have been no tests of the added worker effect for Japanese households, while there is research examining the negative relationship between the wife's labor force participation and the husband's income (see Higuchi 2001, for example). The present paper is the first attempt to clarify the existence of the added worker effect in Japan.

Our empirical investigation shows that wives' labor supply was indeed stimulated by the husbands' involuntary job loss in Japan between 1993 and 2004. The detailed statistics suggest not only that working wives raised their work hours, but also that nonworking wives came to participate in the labor market. Moreover, we find that nonworking wives started seeking work after their husbands lost their jobs. Our results suggest that about 1.6–2.0% of newly emerged female workers in 2000 (and about 2.1–2.7% in 2001) can be

explained by a reaction to their husband's job loss. Clearly, the added worker effect was present during the high unemployment period in Japan following the mid-1990s. The effect could become large if we counted potential labor supply.

The rest of the paper consists of four sections. Section 2 explains the theoretical background and the empirical model. Section 3 introduces the data used in the empirical analysis. Section 4 presents the estimation results. The final section concludes the paper.

## 2 The background theory and the estimation model

The explanation of the added worker effect (hereafter, AWE) is descriptive, but the underlying theory is summarized as a form of risk-sharing behavior within a family. A family that maximizes their expected life time utility subject to their life time constraints faces an intertemporally optimal condition such that today's leisure and consumption equate to the discounted present values of future leisure and consumption as long as the marginal utility, which is expected lifetime wealth, is unchanged over time. The so-called Euler equations imply that a rational household does not react to temporary shocks, while they may react to unexpected permanent shocks. This smoothing behavior is a central hypothesis to be tested by the evidence of a simple life-cycle permanent income hypothesis.

A household also faces intratemporally optimal conditions such that the marginal utility of leisure weighted by wage equals the marginal utility of consumption and that this weighted marginal utility of leisure is equal between the wife and the husband. The wife's optimal leisure/labor decision depends on complementarity or substitutability between leisure and consumption, and between the husband's and the wife's leisure time.

Thus, when the husband unexpectedly loses his job and family income decreases, the wife may raise her labor supply, partly as a reaction to unexpected permanent shocks and partly as complementarity between the husband's and the wife's leisure time.[2] The literature on the AWE focuses on the shock of job loss or the displacement of the main income earner, and examines the response of surplus labor in a family. Because the main income earner is usually the husband, the question to be answered is whether or not wives can sacrifice their leisure and afford working time to compensate for their husbands' job loss.

We can test the existence of the AWE, examining if wives' labor hours increase as their husbands lose their jobs involuntarily. We regress changes in wives' labor hours, $\Delta WL_{it}$, on the variables including husbands' job loss,

[2]If we also take home production into consideration, the wife's reservation wage for labor supply could fall according to the husband's unemployment and his increased time for home production. The realization of the wife's lower reservation wage raises her labor supply in the market.

$HU_{it}$, such as

$$\Delta \mathrm{WL}_{it} = \alpha_0 \mathrm{HU}_{it} + \sum_{j=1} \alpha_j \mathrm{HU}_{it-j} + \Delta \mathbf{X}_{it}\delta + \varepsilon_{it} \tag{1}$$

where $i$ is a household and $t$ is a survey year ($i = 1, \cdots, N$ and $t = 1, \cdots, T_i$). WL is wives' paid labor hours, HU is a dummy variable indicating whether or not husbands lost jobs involuntarily, and $\mathbf{X}$ is a matrix of the other households' characteristics. This is a general specification that the existing literature has examined. We mainly estimate this equation, with appropriate modifications utilizing our panel data sets.[3]

We write the error components as $\varepsilon_{it} = \mu_i + u_{it}$, where $\mu_{it}$ satisfies $E(u_{it}|\mathbf{X}) = 0$, and $E(u_{it}u_{js}|\mathbf{X}) = \sigma_u^2$ if $i = j$ and $t = s$ (and 0 otherwise). We use either a fixed effects model allowing for non-stochastic individual effects of $\mu_i$, or a random effects model assuming stochastic $\mu_i$ satisfying $E(\mu_i|\mathbf{X}) = 0$, $E(\mu_i u_{it}|\mathbf{X}) = 0$, and $E(\mu_i\mu_j|\mathbf{X}) = \sigma_\mu^2$ if $i = j$ (and 0 otherwise). We also consider non-stochastic time effects of $v_t$ adding year dummy variables. The null hypothesis is no existence of the AWE; $\alpha_0 = 0$. That is, the wife does not alter her labor supply in the year when her husband loses his job, so that the household can pool the shock of job loss.

Note that a husband's resigning from a job, but not an unexpected job loss, could be endogenous in a decision regarding a wife's labor supply. As previous literature points out, the more hours a wife works, the more easily the husband may choose to resign from a job. This is not the AWE. In order to avoid this endogeneity problem, we first take *HU* as involuntary job loss but not job resignation.

As another treatment, we regress the changes in wives' labor time but not its levels on the husbands' job loss. That is, we examine the wives' reaction to the husbands' job loss but not a simple relationship between the length of the wife's labor time and her husband's unemployment condition. Examining dynamic changes but not levels of wives' labor hours have additional merit that we can remove the problem of time-invariant omitted variables.[4]

In Eq. 1, there may be a time lag between husbands' involuntary job loss, $\mathrm{HU}_{it-j}$ ($j \geq 1$), and wives' reaction. In this case, the coefficients of $\alpha j$ ($j \geq 1$) can be positive. However, the sign of $\alpha j$ ($j \geq 1$) can be positive even if there is no time-lagged AWE. Suppose that wives respond to their husbands' job loss in the same year: $t$ is the year in this paper, and there exists a within-1-year

[3]Unless consumption and the wife's leisure are additively separable in the utility function, changes in a wife's leisure are influenced by the substitutability or complementarity between her leisure and consumption. We assume an additive separability and do not treat households' simultaneous decisions on consumption and leisure explicitly. As mentioned later, we cannot find any significant effect of consumption changes on wives' leisure changes, even if we include consumption changes as an explanatory variable. Further consideration of simultaneous decisions between consumption and leisure remains for future research.

[4]We attempted to analyze the levels (length) of wives' labor hours and found the same implication for the existence of the AWE as shown in the present paper.

AWE. Also suppose that wives' labor hours are shorter in this year as their labor hours were longer in the previous year: wives' labor hours are negatively correlated between years.[5] When a husband loses his job in a given year, his wife will increase her labor supply in the same year, which in turn decrease her labor supply in the following year. If wives' labor hours are positively correlated between years, wives will raise their labor supply in the following year. That is, without a time-lagged effect of husbands' job loss, the signs of the coefficient on husbands' past job loss, $\alpha_j$, could become positive, zero, or even negative depending on the existence of a within-1-year AWE and time dependencies in wives' labor hours. Thus, we can test at least the existence of within-1-year AWE by $\alpha_0$, while we cannot always test the existence of the time-lagged AWE by $\alpha j$ ($j \geq 1$).

It is important to deal with time dependency in wives' labor hours properly if there are any, even when we test the existence of within-1-year AWE. We can include wives' past labor hour changes, $\Delta \mathrm{WL}_{it-k}$ ($k \geq 1$), explicitly as explanatory variables in the Eq. 1. The coefficients on $\Delta \mathrm{WL}_{it-k}$ ($k \geq 1$) are positive, negative or zero depending on the relationships of wives' labor hours between years. This estimation, however, raises a problem of autocorrelation, since the model now includes lagged dependent variables on the right-hand side. Following Arellano and Bond (1991), we take the first difference to remove individual fixed effects and conduct GMM estimation of

$$\Delta \mathrm{WL}_{it} = \alpha_0 \mathrm{HU}_{it} + \sum_{j=1} \alpha_j \mathrm{HU}_{it-j} + \sum_{k=1} \beta_k \Delta \mathrm{WL}_{it-k} + \Delta \mathbf{X}_{it}\delta + \eta_{it} \qquad (2)$$

with appropriate instruments of $Z = \left[Z_1^{'}, \cdots, Z_N^{'}\right]^{'}$ where $E\left(Z_i^{'}\eta_i\right) = 0$. The possible instruments are $WL_{i1}, \cdots, WL_{it-2}, x_{i1}^{'}, \cdots, x_{it}^{'}$ for $\Delta WL_{it-1}$, where $x_{it}$ is a vector of all the exogenous variables in $\mathbf{X}_{it}$.

There are additional considerations regarding this specification. First, there may be a problem of multicollinearity between husbands' past job loss, $\mathrm{HU}_{it-j}$ ($j \geq 1$) and wives' past labor hour changes, $\mathrm{WL}_{it-k}$ ($k \geq 1$). Therefore, we examine the case excluding husbands' past job loss from the explanatory variables. Second, we include the amount of financial asset holdings 1 year before the time period of labor hour changes in $\mathbf{X}_{it}$. This can be important since family decisions on labor supply could be related to the behavior of its precautionary savings. Households' precautionary behaviors may differ, which then affects wives' reaction to husbands' employment shocks. We include the amounts of savings accumulated by the end of the previous year, $\mathrm{S}_{it}$, as an additional explanatory variable in Eqs. 1 and 2. The amount of savings, $S_{it}$, might be endogenous: $E\left(S_{it}\eta_{is}\right) \neq 0 \quad \forall s \leq t$, since the wife's labor decisions may affect the household saving decisions, or unobserved components in the error term may be correlated with amounts of savings. In this case, the instruments are $\mathrm{WL}_{i1}, \cdots, \mathrm{WL}_{it-2}, S_{i1}, \cdots, S_{it-2}, x_{i1}^{'}, \cdots, x_{it}^{'}$ for $\Delta WL_{it-1}$.

[5] Wives' labor hours actually have negative time dependencies in our sample.

Control variables in $\mathbf{X}_{it}$ are mostly based on the past literature testing the AWE, such as family needs and a wife's age. Time-invariant variables are dropped by the first-difference operation. The interaction terms with a wife's educational attainments are included, as educational attainments may be essential factors in the Japanese household's economic decisions. We can simply estimate Eq. 1 if there is no time dependency in the wife's labor hours, while we should estimate Eq. 2 if there is.[6]

## 3 The data

The present paper uses the *Japanese Panel Survey of Consumers* (JPSC, hereafter) conducted by the Institute for Household Economy in Japan. This is one of the few panel data sets in Japan. The survey questions women aged between 24 and 34 in the starting year of 1993. The women are asked about their families and themselves with regard to labor status including questions about job change, income, occupation and labor hours, consumption and saving behavior, and asset holdings.[7]

The survey collects detailed information on job changes by the husband during the previous year. Using the survey information, we can identify those husbands who lost their jobs at least once during the previous year between the last survey and the present survey. The reason why we limit this to 1 year is that most unemployed in Japan start working within a year after they lose a job.[8] We can further distinguish whether or not the job loss was involuntary by looking at the reasons for it. Involuntary reasons include being laid off, the plant closing, or bankruptcy.

The JPSC asks respondents separate questions about their paid regular working hours, their paid overtime working hours, and their unpaid overtime working hours per week. We sum paid regular and overtime working hours because we are interested in looking at whether the wife compensates for

[6]In order to control for differences in risks surrounding households, we estimated the model including income or consumption variances over the past 4 years within a household. Inclusion of them does not alter the implications of the following results at all. We also controlled for consumption changes as an endogenous explanatory variable, and the coefficient on consumption changes was not statistically significant while the exogeneity was accepted.

[7]The young sample may not be representative of the entire society. However, we cannot conclude this sample makes our empirical results on the AWE either overestimated or underestimated. It underestimates the AWE because older wives do not have a time constraint associated with child rearing, meaning that they can add labor supply more flexibly, while it overestimates the AWE because females in older generations have a tendency not to participate in the labor market.

[8]We do not divide a year into shorter time periods, since it decreases the number of households who experienced the husband's unexpected job loss. We also do not utilize the information on unemployed periods, because the estimation results using such a small sample may be seriously affected by the existence of outliers. Our estimated sample, which does not make use of unemployed periods, includes households facing both temporary and long-lasting unemployment shocks. Thus, we cannot discuss the differential in the AWE between seriousness of husband's job loss depending on his unemployment period.

the husband's negative shocks. An increase in unpaid working hours does not always mean compensation for the husband's loss.[9] The defined working hours are zero for non-workers. This may cause a nonlinearity in dependent variables, since the changes in labor hours for working wives may be different from those for non-working wives. To check this possibility, we took the log of changes in wives' labor hours and conducted the same estimation, but the sign and significance were unchanged.[10]

As expected, factors other than complementarity with the husband's job loss could also cause an increase in the wife's labor supply. For example, if the wife's firm is growing or if she is promoted as her job tenure increases, her working hours may increase. To control for these effects, we include the wife's age and the interaction of several characteristics with educational attainment as control variables. As mentioned, time-invariant variables, such as wives' educational attainments and time-invariant characteristics of their working environments, are dropped by the first-difference operation. Other control variables are the number of children, and the stock of saving (the outstanding balance of savings accounts and holdings of securities) at each survey point.

Twelve waves of the JPSC, from 1993 until 2004, are available, but our estimation uses (at most) nine differenced periods from 1995–1996 to 2003–2004. This is because 2-year lagged information is needed to instrument for the first-differenced transformation of 1-year lagged wife's labor hours. The sample is also limited to married women, to the non-self-employed sample, and to the sample containing sufficient variables required in the regressions. The total number of observation is 4,212 (884 households) for the estimation under an assumption of exogenous financial assets, and 4,052 (856 households) under an assumption of endogenous financial assets. The descriptive statistics are summarized in Table 1.

Before introducing the estimation results, we first overview the movements of husbands' and wives' employment rates in Japan, using our JPSC data. According to Fig. 1, husbands' and wives' employment rates move in opposite directions, suggesting the possibility that wives' labor supply is complementary to husbands' job loss. In our sample, about 1.5% of the households experienced the husband's involuntary job loss during the previous year, between 1993 and 2004. This small percentage is close to what the macro statistics show: the unemployment rate of household heads was about 1.5% in 1999 according to the *National Survey of Family Income and Expenditure* (Statistics Bureau).

[9]Excluding unpaid overtime working hours does not mean that unpaid working hours have no information on wives' reaction to the husbands' job loss. For example, working unpaid overtime leads to future income growth. However, unpaid working hours often increase for firm-specific reasons such as wife's promotion, good sales in her firm, and so on. Because firms' conditions are not completely observable, they could be omitted variables in explaining working hour changes, which gives us a biased estimator of the AWE.

[10]The present paper includes non-workers together with workers, since we do not want to lose the information on changes from non-workers to workers. We cannot conduct the empirical estimation for non-workers because of insufficient observations. We will discuss the difference between non-workers and workers later at the end of Section 4.

**Table 1** Descriptive statistics

| | Mean | Standard deviation | Min | Max |
|---|---|---|---|---|
| Wife's paid labor hours (hours per week) | 14.680 | 16.864 | 0 | 65 |
| Wife's paid labor hours in the last year (hours per week) | 13.735 | 16.686 | 0 | 65 |
| Husband's job loss (yes/no) | 0.015 | 0.121 | 0 | 1 |
| Husband's job loss in the last year (yes/no) | 0.014 | 0.117 | 0 | 1 |
| Husband's job loss 2 years before (yes/no) | 0.014 | 0.118 | 0 | 1 |
| Husband's job loss 3 years before (yes/no) | 0.013 | 0.114 | 0 | 1 |
| Financial asset holdings (10 thousands of yen) | 445.408 | 738.462 | 0 | 8700 |
| Wife's age | 36.683 | 4.113 | 28 | 46 |
| Wife's age × wife low education | 18.688 | 18.490 | 0 | 46 |
| Number of children | 1.984 | 0.884 | 0 | 7 |
| Number of children × wife low education [after taking the first difference] | 1.053 | 1.212 | 0 | 7 |
| ΔWife's paid labor hour in the last year | 0.945 | 10.213 | −65 | 65 |
| ΔFinancial asset holdings | 11.645 | 398.360 | −7300 | 6900 |
| ΔNumber of children | 0.043 | 0.221 | −2 | 2 |
| ΔNumber of children × wife low education | 0.018 | 0.152 | −2 | 2 |

Total number of the observations to be used for the main estimations is 4,212

The JPSC asks about income sources when the husband was laid off, which is listed in Table 2. Although 40% do not have unemployment periods, a quite high percentage answers *wife's* or *parent's income*. The wife's labor may be an important candidate for complementing the husband's labor. Savings may be another important income source for unemployed households. In the following regressions, we estimate the effect of the husband's involuntary job loss on the wife's labor supply after controlling for household savings.

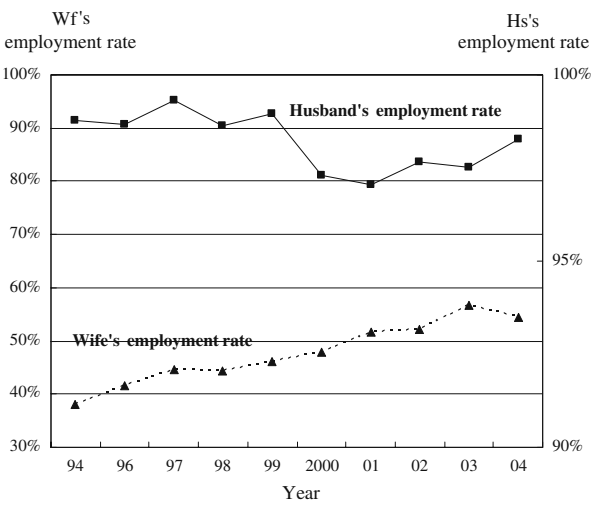


**Fig. 1** Husband's and wifes's employment rates

**Table 2** The source of living after the husbands' job loss

| | |
|---|---|
| Savings | 39.68% |
| No unemployed periods | 34.92% |
| Retirement allowance or unemployment insurance | 28.57% |
| Wife's income or transfers from parents | 23.81% |
| Borrowings or use of credit card | 3.17% |
| Others | 4.76% |

## 4 The results

### 4.1 Does the AWE exist in Japan?

Table 3 summarizes the results using a fixed-effects model (columns (1) to (4)) and a random-effects model (columns (1′) to (4′)). Hausman's specification tests do not reject that stochastic individual effects are uncorrelated with the explanatory variables, which supports a random-effects model. Columns (1) and (1′) do not include their past job loss, and columns (2) and (2′) to (4) and (4′) do include 1-, 2-, and 3-year lagged effects. Either result shows that husbands' job loss during the previous year has a positive effect in the present year. This is statistically significant mostly at the 5% significance level in the random-effects models. The coefficient on husbands' job loss in the previous year (which occurred from 12 to 24 months before) is negative and significant at the 5% level, the 2-year lagged job loss is negative and significant at the 15% level, but the 3-year lagged job loss is insignificant. As mentioned before in the model, the negative effects of husbands' past job loss do not deny the existence of wives' added worker effect. If wives' labor hours in the previous year were responsive to that year's husbands' job loss, and if wives' labor hours had persistence, a negative sign would be expected. The results in Table 3 suggest that a wives' added worker effect exists in Japan.[11]

In order to take account of persistence in wives' labor hours over time, Table 4 shows the results of GMM estimation including wives' lagged labor hour changes.[12] Columns (1a) and (1b) in Table 4 drop the husbands' job loss in the previous year, while columns (2a) and (2b) include it, and columns (3a) and (3b) include additionally the two-year lagged job loss. We do not show the results including 3-year lagged job loss, since this is not statistically significant

[11] Breusch–Pagan tests reject the assumption of zero variance of the stochastic individual effects, and $F$ tests accept the assumption of no individual effects. Therefore, we attempted pooled OLS estimation with clustering robust standard errors. The results are the same as the ones shown in Table 3. The coefficient on husbands' job loss is 3.31 with a standard error of 1.51 when excluding husbands' past job losses, 3.38 with a standard error of 1.52 when including husbands' 1- or 2-year lagged job loss, and 3.22 with a standard error of 1.51 when including husbands' 3-year lagged job loss.

[12] Simply including the lagged dependent variables in the estimation of Table 3 raises a problem of autocorrelation: modified Durbin-Watson statistics in the case including wives' past labor hour changes are 1.863, 1.866, 1.865 and 1.866, respectively, for columns (1), (2), (3) and (4) of Table 3, implying existence of AR(1) serial correlation.

**Table 3** Wives' reaction to the husbands' job loss (1)

| Dependent variable: Wife's paid labor hour changes from the previous year | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (1′) | (2) | (2′) | (3) | (3′) | (4) | (4′) |
| Husband's job loss | 2.764 | 3.306 | 2.358 | 3.381 | 2.124 | 3.375 | 2.172 | 3.219 |
| | (1.594) | (1.294) | (1.601) | (1.295) | (1.630) | (1.295) | (1.630) | (1.300) |
| Husband's job loss in the last year | | | −2.820 | −2.194 | −3.052 | −2.180 | −2.907 | −2.146 |
| | | | (1.851) | (1.348) | (1.853) | (1.350) | (1.862) | (1.350) |
| Husband's job loss 2 years before | | | | | −1.284 | −0.357 | −1.152 | −0.432 |
| | | | | | (1.938) | (1.338) | (1.969) | (1.339) |
| Husband's job loss 3 years before | | | | | | | 0.895 | 1.858 |
| | | | | | | | (2.149) | (1.390) |
| Financial asset holdings | −0.001 | −0.001 | −0.001 | −0.001 | −0.001 | −0.001 | −0.001 | −0.001 |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Wife's age | 0.090 | −0.064 | 0.092 | −0.063 | 0.092 | −0.063 | 0.092 | −0.063 |
| | (0.131) | (0.043) | (0.131) | (0.043) | (0.131) | (0.043) | (0.131) | (0.043) |
| Wife's age × wife's low educational attainment | −0.161 | 0.003 | −0.156 | 0.003 | −0.152 | 0.003 | −0.153 | 0.003 |
| | (0.160) | (0.009) | (0.160) | (0.009) | (0.160) | (0.009) | (0.160) | (0.009) |
| Number of children | −3.359 | −3.878 | −3.414 | −3.905 | −3.378 | −3.896 | −3.381 | −3.900 |
| | (1.041) | (0.977) | (1.040) | (0.977) | (1.037) | (0.978) | (1.036) | (0.978) |
| Number of children × wife's low educational attainment | 0.853 | 1.099 | 0.904 | 1.109 | 0.879 | 1.100 | 0.874 | 1.099 |
| | (1.814) | (1.418) | (1.815) | (1.417) | (1.813) | (1.418) | (1.813) | (1.418) |
| Constant | 0.476 | 3.309 | 0.342 | 3.305 | 0.331 | 3.311 | 0.327 | 3.285 |
| | (3.737) | (1.556) | (3.738) | (1.556) | (3.745) | (1.556) | (3.744) | (1.556) |
| Model specification (fixed effects/random effects) | FE | RE | FE | RE | FE | RE | FE | RE |
| Hausman test | 5.32 | | 6.35 | | 6.90 | | 5.78 | |
| *F* test (Wald test for RE) for all the exclusion restrictions | 2.14 | 42.60 | 2.16 | 45.27 | 2.04 | 45.33 | 1.92 | 47.12 |
| *R*-squared | 0.01 | | 0.01 | | 0.01 | | 0.01 | |
| *F* test for no individual effects | 0.53 | | 0.53 | | 0.53 | | 0.53 | |
| LM test for zero variance of stochastic individual effects | | 117.02 | | 117.00 | | 116.95 | | 117.21 |

*1* The number of the observations is 4212, and the number of the individuals is 884 in all the estimations, *2* Columns (1)-(4) show the estimation results of a fixed effects model, columns (1′)–(4′) show the results of a random effects model. For the fixed effects model, robust standard errors are in parentheses, *3* All the estimation models include year dummy variables for 1995–2004, *4* Wife's labor hour changes, Financial asset holdings, Number of children are changes from the last year, *5* Modified Durbin-Watson Statistics are 2.309, 2.313, 2.312 and 2.313 respectively in (1), (2), (3) and (4), which imply no AR1 serial correlations at 5% significance level (Table II in Bhargava et al. 1982)

**Table 4** Wives' reaction to the husbands' job loss (2): dynamic model

| Dependent variable: Wife's paid labor hour changes from the last year | | | | | | |
|---|---|---|---|---|---|---|
| | (1a) | (1b) | (2a) | (2b) | (3a) | (3b) |
| Husband's job loss | 2.808 | 2.052 | 2.549 | 2.277 | 2.237 | 2.444 |
| | (1.380) | (1.302) | (1.521) | (1.439) | (1.518) | (1.442) |
| Husband's job loss in the previous year | | | −0.618 | 0.469 | −1.160 | 0.739 |
| | | | (1.339) | (1.199) | (1.371) | (1.312) |
| Husband's job loss 2 years before | | | | | −1.042 | 0.191 |
| | | | | | (1.595) | (1.445) |
| Wife's paid labor hour changes in the previous year | −0.291 | −0.291 | −0.291 | −0.291 | −0.291 | −0.290 |
| | (0.023) | (0.021) | (0.023) | (0.021) | (0.023) | (0.021) |
| Wife's paid labor hour changes 2 years before | −0.103 | −0.090 | −0.103 | −0.090 | −0.103 | −0.089 |
| | (0.018) | (0.017) | (0.018) | (0.017) | (0.018) | (0.017) |
| Financial asset holdings | −0.001 | −0.000 | −0.001 | −0.000 | −0.0010 | −0.000 |
| | (0.000) | (0.001) | (0.000) | (0.001) | (0.000) | (0.001) |
| Financial asset holdings in the previous year | | −0.000 | | 0.0000 | | −0.000 |
| | | (0.001) | | (0.001) | | (0.001) |
| Wife's age | 0.080 | 0.116 | 0.084 | 0.117 | 0.076 | 0.106 |
| | (0.697) | (0.556) | (0.693) | (0.553) | (0.692) | (0.553) |
| Wife's age × wife low educational attainment | 0.136 | 0.063 | 0.136 | 0.068 | 0.144 | 0.075 |
| | (0.177) | (0.168) | (0.177) | (0.168) | (0.178) | (0.169) |
| Number of children | −2.235 | −2.030 | −2.249 | −2.027 | −2.255 | −2.057 |
| | (0.746) | (0.748) | (0.745) | (0.746) | (0.744) | (0.746) |
| Number of children × wife low educational attainment | 0.403 | 0.772 | 0.419 | 0.777 | 0.433 | 0.817 |
| | (1.310) | (1.258) | (1.309) | (1.258) | (1.308) | (1.258) |
| Constant | −0.073 | 0.071 | −0.0840 | 0.0680 | −0.0920 | 0.0780 |
| | (0.838) | (0.546) | (0.835) | (0.542) | (0.833) | (0.542) |
| Wald test for all the exclusion restrictions | 210.36 | 237.46 | 211.55 | 237.27 | 212.14 | 236.69 |
| Sargan's OID test | 50.00 | 101.35 | 49.88 | 101.48 | 49.73 | 101.90 |
| Test for $E(\Delta \text{uit} \Delta \text{uit-2}) = 0$ | 0.51 | 0.11 | 0.52 | 0.11 | 0.53 | 0.12 |

*1* The numbers of the observations are 4212 and 4052, respectively in (a) and (b). The numbers of the individuals are 884 and 856, respectively in (a) and (b), *2* To treat dynamic aspects of wife's labor supply, we conduct GMM estimations (Arellano and Bond 1991), *3* All the estimations include year dummy variables for 1995–2004, *4* Instruments used in the estimation (a) are 2-year-lagged wife's labor hours, and levels and lagged variables of all the other explanatory variables. Those in the estimation (b) are two-year-lagged wife's labor hours, two or more lagged husband's job loss, and all the other explanatory variables. *5* Also see the footnotes in Table 3

in any estimation. The difference between (a) and (b) is whether or not we include the previous year's financial asset holdings.

In either estimation, the husbands' job loss coefficient in the present year is positive and significant at least at the 10% level. On the other hand, husbands' job losses in the previous years mostly become statistically insignificant even at the 15% level. That is, if we control for dynamic persistence of wives' labor hours, we cannot find a negative effect for husbands' past job loss, while we still have a positive effect of husbands' job loss on the wives; labor hours in the present year. The husbands' job loss increases the wives' paid labor hours by about 2.1–2.8 h per week. There exists at least within-1-year AWE in Japan.

As another important point, the coefficients on changes in financial asset holdings in this year are negative and significant at the 5% level. This suggests that labor supply and savings should be substitutes, and households with more savings supply less labor and more leisure. This may suggest the importance of taking account of precautionary saving behaviors in explaining households' decisions. We found the same implication even when taking financial asset holdings as endogenous variables: as shown in (1b), (2b) and (3b) of Table 4, the coefficients on the present husbands' job loss are 2.05, 2.28 and 2.44, respectively; all the signs are positive and consistent with the AWE; the coefficients on the previous year's husbands' job loss are not significant; and the coefficients on wives' paid labor hour changes in the past years are all the same signs, size, and significance.[13]

As for the specification, the wives' labor hour changes in the past years are negative and significant at the 1% level. It is important to consider dynamic persistence of wives' labor hours. We show the results including only 1- and 2-year lags, as we do not find any statistically significant effect of more lagged values. As for other significant variables, households with more children decrease the wife's labor hours. This is a natural result for mothers' labor supply.

The estimation models in Table 4 satisfy over-identification conditions and there is no second-order serial correlation for the disturbances of the first-differenced equation ($E(\Delta u_{it}\Delta u_{it-2}) = 0$). Because our estimation is derived from about 1,000 households over a maximum of nine years, an Arellano-Bond GMM estimator may have a finite-sample downward bias, as usually criticized. So, we conducted one-step GMM estimation and found that the coefficients on the husbands' job loss are 3.55, 4.05 and 3.58, and all of them are statistically significant at least at the 5% level, respectively for (1b), (2b) and (3b). The husbands' previous year's job loss are not statistically significant, and the wives' past labor hour changes are negative and significant, which are all the same as the implications in Table 4. Wives raise their labor hours in response to their husbands' involuntary job loss by 3–4 h per week.

[13]The present paper points out the importance of households' precautionary savings but does not deal with it explicitly. More detailed investigation should be considered in future research.

It might be surprising that wives reacted to their husbands' job loss during a severe recession in Japan. During a recession, there may be a *Discouraged Worker Effect* such that wives do not try to supply labor because of fewer employment opportunities. Even in such state of the economy, there are possible reasons why we found wives' positive labor supply responses. First, our definition of the husband's involuntary job loss is job loss *during the previous 1 year*, which includes not only a present condition of unemployment but also experiences of unemployment during the previous 1 year between the last survey and the next survey. Wives' responses may look rapid but they actually include responses 1 year after their husbands' job loss. Second, the job loss of a husband, who is usually the main income earner, may give a severe shock to a household. Serious economic conditions during this sample period made households expect the shock to last rather a long time, lowering their life-time wealth. Third, there was indeed surplus labor in many families in Japan. As is well known, the rate of labor participation of married women is low ,and their labor hours are short in Japan. The changes in the labor market, where many full-time jobs were replaced by part-time jobs during the recession of post mid-1990, may have motivated them to participate in the labor market.

### 4.2 Who raises working hours?

We found that many Japanese wives actively reacted to their husbands' job loss. Did working wives increase their labor hours? Or did nonworking wives start working? To examine this, we create a dummy variables indicating either group 1: the wives who have not experienced their husband's job loss during period $t$, group 2: the wives who had worked in $t-1$ and have experienced their husband's job loss during $t$, or group 3: the wives who had not worked in $t-1$ and have experienced their husband's job loss during $t$. We conduct the same regression as in the previous section, including two dummy variables indicating groups 2 and 3, using group 1 as a benchmark. As already clarified, compared with the wives in a group 1, those in groups 2 and 3 (or either in group 2 or 3) would increase their working hours. Moreover, if working wives and nonworking wives reacted differently, we would find a difference in working-hour changes between groups 2 and 3.

Table 5 lists the results using the same specifications as (1a) and (1b) in Table 4, including the abovementioned two dummy variables indicating groups 2 and 3.[14] According to Table 5, the coefficient on the dummy variable indicating group 3 is positive and significant at the 10% significance level when excluding the previous year's financial assets. Nonworking wives started working on the occurrence of an unexpected husband's job loss. Note that we obtained this result even though the power of the test is lower because of a small sample size.

[14]We list the results only using the specifications (1a) and (1b) in Table 4 because those two specifications give our main results in the previous section. However, the implication has not changed even if we use the other model specifications shown in Tables 3 and 4.

**Table 5** Who raises working hours?

| Dependent variable: Wife's paid labor hour changes from the last year | | |
|---|---|---|
| | (1a) | (1b) |
| Benchmark: husband's no job loss | | |
| Dummy of husband's job loss and previously working wives | 0.794 | 0.405 |
| | (1.287) | (1.231) |
| Dummy of husband's job loss and previously nonworking wives | 6.051 | 4.692 |
| | (3.533) | (3.159) |
| Wife's paid labor hour changes in the previous year | −0.336 | −0.345 |
| | (0.035) | (0.034) |
| Wife's paid labor hour changes 2 years before | −0.145 | −0.138 |
| | (0.028) | (0.025) |
| Financial asset holdings | −0.000 | 0.001 |
| | (0.000) | (0.001) |
| Financial asset holdings in the previous year | | 0.001 |
| | | (0.001) |
| Wife's age | 0.320 | 0.606 |
| | (0.343) | (0.476) |
| Wife's age × wife low educational attainment | −0.375 | −0.450 |
| | (0.352) | (0.331) |
| Number of children | −0.054 | 0.526 |
| | (1.636) | (1.573) |
| Number of children × wife low educational attainment | −2.041 | −1.855 |
| | (2.544) | (2.465) |
| Wald test for all the exclusion restrictions | 100.43 | 115.22 |
| Sargan's OID test | 37.48 | 55.15 |
| Test for $E(\Delta \text{uit} \Delta \text{uit-2}) = 0$ | −0.69 | −1.02 |

*1* The number of the observations is 1834, and the number of the individuals is 555 in both estimations, *2* Model Specifications are the same as (1a) and (1b) in Table 4 (GMM estimations (Arellano and Bond (1991)), *3* We categorize the entire sample into the wives who did not experience their husbands' job loss, those who worked in the previous year and experienced their husbands' job loss, and those who did not work and experienced their husbands' job loss. Using the first category as a benchmark, two dummy variables indicating the latter two groups are included. These are listed in the first two rows of this table

The coefficients on husband's job loss are 6.05 in the case excluding lagged financial asset holdings and 4.69 in the case including it, which implies that previously nonworking wives on average increase their working hours by between 4.69 to 6.05 h/week if the husband involuntarily loses his job. As shown in Fig. 1, husband's employment rate decreased from 1999 to 2001 in Japan. According to *Labor Statistics*, which is conducted by the Statistics Bureau of the Japanese Ministry of Internal Affairs and Communications, the number of involuntary job quits of males aged 25–55 increased by 10,000 from the year 1999 to 2000, and by 30,000 from the year 2000 to 2001. If nonworking wives respond by increasing their working hours by between 4.69–6.05 h/week, the result is an additional 46,900–60,500 labor hours per week between 1999 and 2000, and 140,700–181,500 labor hours per week between 2000 and 2001. Because the average labor hours among working females aged 25–55 is about 25 h/week, according to *Survey on Time Use and Leisure Activities* (2001) compiled by the Statistics Bureau, about 1,876–2,420 females (46,900–60,500 divided by 25 h) newly started working in 2000, and about 5,628–7,260

(140,700–181,500 divided by 25 h) started in 2001. This equates to about 1.56–2.02% of the newly employed females aged 25–55 in 2000 and 2.08–2.69% in 2001.

Further statistics show an interesting fact. The JPSC asks the wives who were not working at the previous survey if they started working or seeking jobs during the last year. Among previously nonworking wives in our estimated sample, 14.72% actually started working or seeking jobs. The percentage would become much higher among those who faced their husbands' job loss: 37.04% of the previously nonworking wives who faced their husbands' job loss started working or seeking jobs. This emphasizes that the AWE exists, and the potential AWE could be even larger.

Japanese wives' labor supply responds to their husbands' job loss. During the high unemployment period following the mid-1990s, there existed the added worker effect especially as nonworking wives' new labor supply. For example, about 1.6–2.0% of the newly emerged female workers are estimated to be a result of an increase in the number of involuntary job losses by husbands during 1999 and 2000 (about 2.1–2.7% during 2000 and 2001). The added worker effect could be greater, including a larger potential labor supply in the market.

The married female labor supply seems more flexible than we expect. Although most of the economic literature on households' behaviors focuses on consumption but not on the labor (leisure) decisions, we should take leisure into account when we describe the behavior and welfare of economic agents.

## 5 Conclusion

In this paper, we examined how a wife's labor supply responded to her husband's involuntary job loss following the mid-1990s. We utilized panel data containing extensive household information, which are indispensable for our analysis. This makes it possible for us to investigate wives' leisure decisions as well as households' savings behavior against unexpected shocks.

Furthermore, our sample period (1993–2004) included a period when Japan's unemployment rates were very high and growing, which was advantageous when analyzing behavioral responses to changed economic conditions. We found that a wife's labor supply was actually stimulated by her husband's involuntary job loss. The additional statistics indicate that not only working wives raised their labor hours but also nonworking wives began to participate in the labor market. In addition, nonworking wives started looking for jobs in response to their husband's job loss. Our results suggest that about 1.6–2.0% of newly emerged female workers in 2000 (and about 2.1–2.7% in 2001) can be explained by a reaction to their husband's job loss. There exists an added worker effect during a period of job insecurity in Japan following the mid-1990s, and the effect would be larger if we included potential labor supply.

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