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The Long-Run Effects of Short-Time Compensation*

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Abstract

In light of the Covid-19 pandemic and its ensuing economic crisis, there is renewed interest in worksharing facilitated by Short-Time Compensation (STC) as a potentially effective policy response. Much of the literature concerns the effect of STC in the short run, and little is known about its consequence for employment in the long run. Theoretically on the one hand, when STC is available, the firm may choose to take STC and delay painful yet necessary downsizing/restructuring, resulting in inefficient resource allocation, further weakened competitiveness and even greater job losses in the end. On the other hand, with STC, the firm can preserve valuable firm-specific human capital, leading to greater sales, productivity, and employment growth than without STC. There are also some behavioral advantages of worksharing via STC over layoffs---reducing adverse workplace morale effect of layoffs and enhancing goal alignment and teamwork of workers through shared adversity. Using unique firm-level data on the use of STC by Japanese firms in response to the global Great Recession along with a rich set of firm-level controls, we estimate the Average Treatment effect on the Treated (ATT) of STC in the long run. Our ATT estimation yields the first rigorous econometric evidence on the positive consequence of STC for employment. The size of the ATT is neither trivial nor implausibly large---in four years following the incidence of STC, on average, the firm's employment level (excluding contingent workers and counting only standard employees) will be 5.1 percentage points higher with STC than without STC. We also find a positive and significant lasting ATT of STC on sales, TFP, and value added, while we find no evidence for the negative ATT on profitability in the long run. Our evidence favors a more sanguine view of the consequences of STC in the context of the economic recovery from the global Great Recession in Japan. (JEL codes: J23, J65, J68, H25)

Key words: Short-Time Compensation, Worksharing, Short-Time Work, Long-run effects

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The Long-Run Effects of Short-Time Compensation

I. Introduction

Short-Time Compensation (STC) is a subsidy to promote worksharing (reduced working hours) in a recession with the intended goal of curtailing layoffs and preventing a sharp rise in unemployment. The STC schemes, which have been offered in many OECD countries, such as Germany, Japan, and Italy, are often touted as a reason for the aversion of the full-scale labor market crisis in the Great Recession (Rinne and Zimmermann, 2012 and Cahuc, 2014). Naturally the empirical literature focuses on testing the efficacy of STC in reducing working hours and job losses, and provides largely favorable evidence for STC as a policy instrument to promote worksharing and prevent a sharp rise in unemployment during the Recession using cross-country or cross-state data (see, for instance, Lydon, Matha, and Millard, 2018; Cooper, Meyer, and Schott, 2017; Balleer, et al., 2016; Abraham and Houseman, 2014; Hijzen and Martin, 2013; Brenke, Rinne, and Zimmermann, 2013; Arico and Stein, 2012; Boeri and Bruecker, 2011).[1]

Currently in light of the COVID-19 pandemic and its ensuring economic crisis, the STC schemes are attracting growing attention as a potentially powerful policy response to a sharp rise in unemployment (see, for instance, Abraham and Houseman, 2020; Gilarsky, Nunn, and Parsons, 2020; Giupponi and Landais, 2020; and Gimbel, Rothstein, and Yagan, 2020). While too early to draw any definitive conclusion on the potency of STC as a policy instrument to soften the adverse impact of the current pandemic on the labor market, there are some encouraging reports from countries known for the extensive use of STC. For instance, as the coronavirus pandemic was spreading rapidly and the economic crisis was unfolding around the

[1] However, recent studies using micro-data provide less sanguine evidence on STC as a job saver (Cahuc, Kramarz, and Nevoux, 2018; Arranz, Garcia-Serrano, and Hernanz, 2018; Kambayashi, 2017; and Ariga and Kuo, 2017).

world, the U.S. unemployment rate jumped to 14.7 percent in April of 2020 from 4.4 percent in the previous month. In contrast, Japan's unemployment rate rose only to 2.6 percent in April from 2.5 percent in the previous month. On April 1, the Japanese government started to promote worksharing by making its STC program more generous and accessible. During the pandemic, the government reimburses each firm using worksharing as an alternative to layoff for 80 to 100 percent of its total STC paid to all employees (67 to 75 percent for large firms), and the application process has been streamlined considerably.[2] It appears to make sense for most Japanese firms to use worksharing by applying for such a generous STC program with easy access. A closer look at Japan's monthly Labour Force Survey (LFS) reveals that while the number of unemployed increased to 1.78 million workers in April from 1.72 million in March, a modest growth of 3.4 percent, the number of "employed not at work" surged to 5.9 million workers in April from 2.5 million workers in the previous month, an extraordinary surge of 136 percent.[3] "Employed not at work" in the Japanese LFS are defined as those who are employed AND paid but not at work for the survey week, and as such they are counted as employed. Based on the enduring practice of “long-term employment” by Japanese firms in general and their extensive use of worksharing (reduced working hours) as an alternative to layoff in particular (Kambayashi and Kato, 2017), it is highly likely that much of the surge in the number of “employed not at work” reflects workers under worksharing introduced by Japanese firms in response to the economic crisis.

[2] For most up to date institutional information on STC in Japan, visit https://www.mhlw.go.jp/stf/seisakunitsuite/bunya/koyou_roudou/koyou/kyufukin/pageL07.html

[3] The number of “Employed not at work” for the previous ten months, April 2019-February 2020 were 1.49, 1.46, 1.86, 2.02, 1.62, 1.58, 1.61, 1.86, 1.94, and 1.96 million, confirming the sudden, extraordinary surge in April of 2020.

With burgeoning interest in STC as a tool to respond to the current economic crisis, much attention has been paid to the employment stabilizing effect of STC in the short run. However, what STC will do to employment in the long run has been rarely discussed in the current discourse. Theoretically the long-run effects of STC on employment can be negative.

Delayed Definitive Treatment: STC may distort the firm's efficient use of inputs, and ultimately worsen performance of the firm with STC (see, for instance, Cahuc, 2014). More specifically when STC is available, the firm may choose to take STC and delay painful yet necessary downsizing/restructuring, resulting in further weakened competitiveness and even greater job losses in the end. In addition, STC-induced worksharing may lead to adverse worker sorting, i.e., high-productivity workers leave the firm for a different firm without STC where he/she can work full time (Abraham and Houseman, 2014). Again, such negative worker sorting may lead to deteriorating performance of the firm with STC, and ultimately more stagnant sales, productivity, and labor force growth than otherwise. Finally STC can impede efficiency-enhancing relocation of workers, leading to an economy-wide efficiency loss (see, for instance, Cooper, Meyer, and Schott, 2017 and Giupponi and Landais, 2018). In sum, STC can be viewed as a potent short-term fix with a possible long-term adverse side effect on employment.

There are, however, some theoretical cases for the positive employment effect of STC in the long run, as discussed in Abraham and Houseman (2014).

Preserved Human Capital: It may be optimal in the short run to let go workers in a recession. However, some of those downsized workers may find jobs elsewhere and never come back to the firm when a recession is over. As such, in the long run, the firm's past investment in firm-specific human capital of those workers will be wasted. STC will help the firm use worksharing, and minimize such layoffs and hence the waste of human capital investment. Furthermore, the

firm may take advantage of STC and ask workers with reduced working hours to participate in off-the-job training programs, which will result in more productive labor force. STC is sometimes combined with subsidy for training, which is the case in Japan, as explained in the next section. In sum, STC may help the firm preserve workers with valuable firm-specific human capital, which can make the firm with STC more competitive and grow faster in the long run than its counterpart without STC.

Enhanced Workplace Morale: The immediate use of layoffs may impact the remaining workforce adversely, resulting in the deterioration of workplace morale and unity, and hence productivity loss.[4] Such adverse effects of layoffs on the remaining workers are likely to be nontrivial, especially for the team-based workplace with considerable complementarity among team members. STC can lessen such adverse consequences for workplace morale/unity and productivity, making the firm with STC more competitive and grow faster in the long run than its counterpart without STC. Furthermore, instead of asking a few employees to bear the burden of downward adjustment of labor input in a recession, worksharing spreads the burden equally among all employees, and helps them overcome the adversity (or the recession) together. We posit that worksharing which STC promotes can be viewed as shared adversity in the psychology literature, which increases each employee's identity with and commitment to the group to which he/she belongs (the firm) and promotes supportive interactions among coworkers (see, for instance, Bastian, et al., 2018). As such, worksharing can enhance the goal alignment between workers and the firm by providing them with shared experiences of overcoming adversity together. The enhanced goal alignment helps the firm implement needed corporate reforms with minimum friction, which results in outcompeting its comparable firms without STC.

[4] See, for instance, Iverson and Zatzick (2011); Trevor and Nyberg (2008); Zatzick and Iverson (2004); and Mishra and Spreitzer (1998).

In sum, it is possible that in the long run the firm with STC may end up becoming more productive than its counterparts without STC, thus outcompeting them, and having more sales and labor force.

On our reading of the literature, there is no rigorous econometric evidence on the consequence of STC for employment of the firm with STC. We are aimed at filling this important gap in the literature by providing the first evidence on the lasting effect of STC on employment. The data are from Japan, a country known for its generous STC, as detailed in the next section. STC has been used extensively in Japan as well as Germany and Italy, in particular during the global Great Recession following the financial meltdown of 2008 in the U.S (Cahuc, 2014).

Specifically we apply the Propensity Score Matching (PSM) with Difference-in-differences procedure to unique firm-level micro data on the use of STC by Japanese firms, and estimate the Average Treatment effect on the Treated (ATT). Our ATT estimation yield the first rigorous econometric evidence on the positive consequence of STC for employment in the long run, favoring the optimism about STC's long-run effects over the pessimism.

The data allow us to use a rich set of covariates---especially two proxies for the firm's expectation on its future business outlook, three proxies for the firm's ability to take advantage of government programs, and the strength of the firm's practice of long-term employment---in the first stage of PSM estimation. As such, we believe that our matching is less subject to the threat of unobservables. Our ATT estimates also pass a placebo test, lending further credence to our causal interpretation of the ATT estimates.

Our results are congruous with prior studies using aggregate data which tend to report favorable labor market outcomes of STC. The size of the ATT is neither trivial nor implausibly

large---in four years following the incidence of STC, on average, the firm's employment level (excluding contingent workers and counting only standard employees) will be 5.1 percentage points higher with STC than without STC. To be further consistent with the sanguine view on the long-run effect of STC on employment, we further find a positive and significant ATT of STC on sales and productivity.

Finally we find no evidence for the adverse consequence of STC for profitability. The absence of evidence on the long-run negative effect of STC on profitability, combined with the significant positive and lasting effect of STC on employment, sales, and productivity, suggests that it is unlikely that STC incentivizes the firm to delay necessary downsizing, resulting in sales and productivity losses and ultimately even greater job losses.

In the next section we provide some institutional details of STC in Japan. In section III, we describe the data we use and provide our empirical strategy. Section IV presents the results, followed by concluding remarks.

II. STC in Japan

STC in Japan, called Koyo Chosei Joseikin, was established in 1975. It was introduced as a policy response to exogenous and temporary recessions such as the first oil crisis in 1973 and its aftermath, under the premise that it is more efficient for the firm facing a temporary drop in demand for its product to use worksharing (reduced hours) rather than layoffs (reduced labor force), for the firm with worksharing can respond to demand recovery promptly and effectively by simply increasing hours without going through time-consuming and costly hiring process.

The Japanese government was, however, concerned about the possibility that STC may cause an excessive use of worksharing and thereby a deviation from the optimal allocation of

resources. To this end, first, the government designated certain industries for STC-eligible industries, based on two criteria: (i) monthly average production/sales and employment over the last three months is at least 5-percent lower than a year ago; and (ii) such a fall in production/sales and employment is expected to end within a year. A list of such STC-eligible industries were published every month. Only those firms in the STC-eligible industries were able to apply for STC. Second, being in one of the STC-eligible industries was a necessary condition for STC but not a sufficient one. Despite being in the STC-eligible industries, some firms did not experience a drop in production over the last twelve months, and some experienced an increase in employment. Such firms without a fall in production and/or with an increase in employment were made ineligible even if they are in the STC-eligible industries.

As indicated by the second criteria used for the determination of STC-eligible industries, STC was supposed to be used for only those industries in a temporary recession. However, following the burst of financial buddle at the end of the 1980's, the Japanese economy fell into a prolonged stagnation, "Lost Decade". The list of STC-eligible industries ended up including those experiencing persistent structural declines such as iron and steel industry, and a significant portion of STC went to such structurally declining industries. For instance, over 1990-2002, approximately 40% of the total amount of STC subsidies went to iron and steel industry (Griffin, 2010).[5] As a result, there was a growing concern that STC might be delaying much needed corporate reforms including downsizing/restructuring.

In response to the concern, in October of 2001, the government reformed the STC application process. The two-step process was converted into a simple one-step application process without the designation of the initial STC-eligible industries and with a much stricter

[5] Once designated, establishments in the government-designated industries could receive the subsidy relatively easily.

eligibility condition--- monthly average production/sales over the last six months is at least 10-percent lower than a year ago and there is no increase in employment.

Japan's Lost Decade ended in 2003, and Japan experienced the longest uninterrupted positive (though modest) economic growth in the postwar era till another bubble burst on the other side of the Pacific in the fall of 2008 which led to the global Great Recession. In response to the global Great Recession, the eligibility conditions for STC were significantly relaxed, and eligible establishments were able to receive STC for a longer time period. First, the reference timeframe was shortened from six to three months---monthly average production/sales over the last three months instead of the last six months is at least 10-percent lower than a year ago. Second, the employment condition---there was no increase in employment---was eliminated.

Once approved by the government, the establishment uses its STC subsidy from the government to compensate each employee under worksharing for 2/3 of his/her lost pay due to reduced working hours (4/5 in the case of small to medium-size firms). In Japanese STC, establishments could receive an additional subsidy when their STC employees participate in training program. The STC program can last up to 3 years and 300 days. As a result of the relaxation of the requirements, according to a recent research report by JILPT (Japan Institute of Labor Policy and Training), the use of STC among Japanese firms was unprecedentedly high in 2009. There were only 250,000 employees receiving STC in 2008 (amounting to about 68 million dollars in total). In 2009, the number of employees receiving STC rose to over 21 million people and the total amount of STC reached 6.5 billion dollars (JILPT, 2017).

III. Data and Empirical Strategy

We analyze unique data from Japan for 2005-2014, the time period covering before and after the Great Recession following the financial crisis in the fall of 2008. We constructed the data by linking the Basic Survey of Japanese Business Structure and Activities (BSJBSA) to the Survey of Corporate Management and Economic Policy (SCMEP) by using unique firm IDs.[6] The BSJBSA has been conducted annually by the Ministry of Economy, Trade and Industry since 1992. The sample universe is all firms with 50 or more employees and at least 30 million yen of paid-up capital. It is one of the "Fundamental Statistical Surveys" based on Japan's Statistics Act (Act No. 53 of 2007). As such, in principle, all firms are required to respond. The data include over 30,000 firms each year.

Most importantly the BSJBSA provides us with our key dependent variable, firm-level annual data on the number of standard employees. The Japanese labor market is segmented between the primary sector consisting of standard employees (termed "seishain" in the workplace) and the secondary sector consisting of non-standard employees. Standard employees enjoy high wage/benefit, job security, control over own work, and opportunities for extensive training including job rotation, and career ladders. All other employees lack such job attributes and often function as shock absorbers in a recession so that standard employees can continue to enjoy the aforementioned job attributes (Kambayashi and Kato, 2016 and 2017). Considering that the firm uses STC in part to preserve standard employees accumulating firm-specific capital through extensive on-the-job training and minimize the adverse morale effect of breaking implicit long-term employment contracts for standard employees, STC is likely to apply to

[6] As compared to the unmatched sample, the matched sample is found to have 4% more employment, 2.8% less standard employment, 2.5% less sales, 0.5% lower TFP, 0.2% lower ROA, and 0.2% lower sales growth from t-1 to t. Overall, the difference is quite small.

standard employees only. In fact, the fact that nonstandard employees often function as shock absorbers in a recession suggests that it may be even in the interest of Japanese firms and standard employees that STC does not apply to nonstandard employees. In addition, the BSJBSA allows us to explore alternative firm outcome measures such as sales, TFP[7], value added[8], average wage, and return on assets (ROA).

The SCMEP was conducted by the Research Institute of Economy, Trade and Industry (RIETI) from December 2011 to February 2012.[9] The questionnaire was sent to 15,500 Japanese companies in manufacturing and service sectors, and a total of 3,444 companies responded to the survey. The SCMEP provides us with unusually rich firm-level data on management practices/policies, corporate governance, and corporate strategy and restructuring activities. Particularly noteworthy are whether the firm receives STC; whether the firm plans to expand in the future; whether the firm expanded its businesses globally in the last three years; whether the firm has prior experience of applying for and succeeding in getting government tax incentives designed to promote investment, R&D, and energy conservation and new energy; and the strength of the firm's long-term employment practice; whether the firm has a company-sponsored education and training policy. In addition, the data allow us to control for whether or

[7]To construct TFP, we used the index number method (Good et al. 1997), which is a non-parametric method used by Nishimura et al. (2005), Fukao and Kwon (2006), and Morikawa (2021). The TFP of each firm is calculated as the productivity compared to the hypothetical representative firm. The input and output of a hypothetical representative firm are calculated as the geometric means of the input and output of all firms. The cost shares of labor and capital are calculated as arithmetic means of firm *i* and the hypothetical representative firm. To get real values, we use the output deflator and capital deflator in the JIP Database. Van Biesebroeck (2007) compares 5 productivity measurement methods: (a) index numbers, (b) data envelopment analysis (DEA), (c) stochastic frontiers, (d) instrumental variables (GMM), (e) semiparametric estimation, and evaluates the index number method is excellent for estimating productivity growth and is among the best for estimating productivity levels.

[8] The total of gross salaries, welfare expenses, depreciation, interest expenses, lease payments, real estate rentals, and taxes and dues were used as nominal intermediate inputs, which were realized using the value-added deflator in the JIP Database.

[9] See Morikawa (2019) for more detail.

not the firm is listed on Japan's stock exchanges; whether the firm is an owner company; whether the firm is unionized; whether the firm has a main-bank; and if so, whether the firm is under the influence of its main-bank. We exclude firms that their employment was actually growing prior to their STC applications from our analysis, resulting in 3,384 firm-year observations which satisfy common support condition for our analysis.[10]

The objective of our empirical analysis is to estimate the consequences of STC for employment, firm performance and other related outcomes. More formally, we estimate the following treatment effect on employment and other outcomes:

$$\tau_i = \mathrm{Y}_i(STC = 1) - \mathrm{Y}_i(STC = 0) \qquad (1)$$

where $\mathrm{Y}_i(STC = 1)$ is outcome for firm *i* (=1,…,N) if firm *i* receives treatment (STC) and $\mathrm{Y}_i(STC = 0)$ is outcome for firm *i* (=1,…,N) if firm *i* does not receive treatment. For each firm, we observe only $\mathrm{Y}_i(STC = 1)$ or $\mathrm{Y}_i(STC = 0)$ but not both. Thus, τ_i cannot be observed directly.

Instead, we estimate the average treatment effect (ATE):

$$\tau_{ATE} = \mathrm{E}\big(Y(STC = 1) - Y(STC = 0)\big) \qquad (2)$$

Here, we introduce propensity score, $e(X) = \Pr(D = 1|X)$ where X is a vector of observed covariates, and D is propensity of being treated that are not directly observed (for exposition, we omit subscript *i* for the remainder of the paper). According to Rosenbaum and Rubin (1983), if treatment assignment is strongly ignorable given X, then it is strongly ignorable given any propensity score. That is,

[10] We exclude those firms receiving STC in spite of their growing employment, for STC in such firms is incongruous with its primary objective and they would have been ineligible under the original form of Japanese STC. Nonetheless we did repeat the same analysis including those STC firms with growing employment prior to STC. The results are similar though less precise, as expected. Those and other unreported results are available upon request from the corresponding author.

$$\begin{cases} E(Y(STC=1)|e(X),\ D=1) = E\big(Y(STC=1)\big|e(X)\big) \\ \qquad\qquad and \\ E(Y(STC=0)|e(X),\ D=0) = E\big(Y(STC=0)\big|e(X)\big) \end{cases}$$

Therefore,

$$\tau_{ATE} = \mathrm{E}\big(Y(STC=1) - Y(STC=0)\big)$$

$$= \mathrm{E}\left(E\big(Y(STC=1)\big|e(X)\big) - E\big(Y(STC=0)\big|e(X)\big)\right)$$

$$= \mathrm{E}\big(E(Y(STC=1)|e(X),\ D=1) - E(Y(STC=0)|e(X),\ D=0)\big) \quad (3)$$

Similarly, we can estimate the average treatment effect on the treated (ATT) as below:

$$\tau_{ATT} = \mathrm{E}(\mathrm{Y}(STC=1) - \mathrm{Y}(STC=0)|D=1)$$

$$= \mathrm{E}(\mathrm{Y}(STC=1)|D=1) - \mathrm{E}(\mathrm{Y}(STC=0)|D=1)$$

$$= \mathrm{E}(\mathrm{Y}(STC=1)|e(X),\ D=1) - \mathrm{E}(\mathrm{Y}(STC=0)|e(X),\ D=1)$$

$$= \{\mathrm{E}(\mathrm{Y}(STC=1)|e(X),\ STC=1) - \mathrm{E}(\mathrm{Y}(STC=0)|e(X),\ STC=0)\}$$

$$- \{\mathrm{E}(\mathrm{Y}(STC=0)|e(X),\ STC=1) - \mathrm{E}(\mathrm{Y}(STC=0)|e(X),\ STC=0)\} \quad (4)$$

This procedure, Propensity Score Matching (PSM), will be valid only if conditional on observable covariates, X, in the treated firms with STC and in the control firms without STC would exhibit a similar outcome under the same circumstances, X, or the second term on the last line of equation (4) = 0. This assumption is likely to be violated unless a set of covariates are sufficiently comprehensive that the influence of unobserved firm characteristics can be minimized.

We are most fortunate that our data allow us to use an unusually rich set of covariates for the first stage. As such, we are reasonably confident that the treated firms and the control firms are comparable, conditional on the observed set of covariates. Specifically, to yield the

propensity score, we estimate a probit model of the odds of getting STC in year *t* conditional on not getting STC in year *t-1* as a function of a variety of firm characteristics. Note that once receiving STC in year *t*, the firm will be excluded for any subsequent time periods.

For the firm characteristics, first, in light of the primary objective of STC—promoting worksharing as an alternative to layoffs for firms experiencing a fall in production/sales, we consider annual rate of changes in sales from *t-1* to *t*. Second, to reflecting the explicit condition for STC eligibility (10% or higher drop in sales/production from the previous year), we construct and add a dummy variable, 10% or higher drop in sales from *t-1* to *t* (=1 if the firm's sales drop from year *t-1* to year *t* by at least 10 percent, 0 otherwise).[11]

Second, some firms may have pessimistic expectations about their future businesses and opt to start downsizing employment rather than applying for STC and delaying the eventuality of downsizing. Fortunately the data allow us to construct two variables which are likely to account for the firm's future business outlook: (i) ***No plan for future expansion*** which takes a value of one if the firm's future direction of business is status quo, retreat, or closed business, zero otherwise; (ii) ***Recent global expansion*** which takes a value of one if in the last three years the firm started to export; engage in foreign direct investment; or acquire foreign firms, zero otherwise. Our prior expectation is that the firm with ***No plan for future expansion*** = 1 and/or ***Recent global expansion*** = 0 is likely to have a more pessimistic expectation about the firm's future, and hence more likely to start downsizing rather than applying for STC and preserving its workers with firm-specific human capital.

[11]Our dummy variable of At least 10% drop in sales from t-1 to t does not perfectly correspond to the condition for STC eligibility, for the length of the timeframe is shorter (three months) for the STC eligibility than for the dummy variable (12 months).

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Third, it is plausible that some firms may have a well-informed and experienced team of managers who are capable of taking advantage of various government tax incentive programs, including STC (e.g., being fully aware of the STC option; being abreast of any recent changes; knowing how to prepare successful applications; and networking with relevant government employees). [12] Naturally such firms are more likely to apply for STC successfully.[13] To control for the firm's ability to make good use of government support programs, we use the following three variables: (i) ***Investment subsidy*** which takes a value of one if the firm successfully apply for the government's investment subsidy program, zero otherwise; (ii) ***R&D subsidy*** which takes a value of 1 if the firm successfully apply for the government's R&D subsidy program, zero otherwise; and (iii) ***Efficient and new energy subsidy*** which takes a value of one if the firm successfully apply for the government's efficient and new energy subsidy program, zero otherwise.

Fourth, some (but not all) Japanese firms maintain its traditional employment practice of "long-term employment," as a complementary element of the Japanese High Involvement Work System (Kambayashi and Kato, 2017). Such firms are more likely to use STC and avoid layoffs. To this end, we use ***Job Security*** which takes a value of one if the firm views laying off employees as the most difficult thing to implement when firm performance deteriorates, zero otherwise.

In addition, the data allow us to control for ***Union*** which takes a value of one if the firm is unionized, zero otherwise; ***Having main-bank*** which take a value of one if the firm has a main-bank, zero otherwise; ***Influenced by main-bank*** which takes a value of one if the firm is

[12] Chuma et al. (2002) report that STC applications require cumbersome paperwork.

[13] Houseman, et al. (2017) report that a major challenge for STC in the U.S. is the lack of awareness of the STC option among U.S. employers, which results in a low take-up rate.

influenced by a main-bank, zero otherwise; ***Listed company*** which takes a value of one if the firm is listed on Japan's stock exchanges, zero otherwise; ***Owner company*** which takes a value of one if the firm is an owner company, zero otherwise as well as ln (asset), ln (employment), and ROA in the previous year. Industry fixed effects are also controlled for.

The propensity score, or the predicted odds of treatment in our study is the probability that firm *i* applies for and succeeds in getting STC in year *t*, conditional on firm *i* not receiving STC in year *t-1*[14]. Based on those propensity scores obtained in the first stage, in the second stage, we estimate the difference in changes in firm outcome, Y from *T-1* to *T+s* (*T* is the year of receiving STC, *s*=0, 1, 2, 3, or 4) between the treatment group and the control group. We employ an inverse probability weighting to estimate ATT and ATE.[15]

The weight used in ATT is:

$$w^{ATT} = \mathrm{D} + (1 - D)\frac{e(X)}{1 - e(X)}$$

The weight in ATE is:

$$w^{ATE} = \frac{D}{e(X)} + \frac{1 - D}{1 - e(X)}$$

IV. Results

Summary statistics are presented in Table 1. Firm *i* in year *t* is considered "treated" if $STC_{it-1} = 0$ and $STC_{it} = 1$. The treated sample is 4% of all observations. Average annual rate of change in sales from *t-1* to *t* was -4%. One in four firms experienced 10% or higher drop in sales

[14] The control group is firms which never receive STC during the entire time period under study. Once firm *i* receives STC in year *t*, firm *i* drops from the sample for the rest of the time period.

[15] We also use k-Nearest (k=5) matching procedure with 300 bootstrapping for robustness check, and find no discernible change in our results.

from *t-1* to *t*. About 6% of firms had no future plan to expand, and 17% engaged in global expansion in the last three years. About 9%, 8%, and 5% of firms have a prior experience of successfully applying for investment tax subsidy, R&D tax subsidy, and efficient and new energy tax subsidy respectively. The proportion of firms with long-term employment is 52% and the proportion of firms with company-sponsored training 88%. 8% of all observations come from listed firms; 60% from owner companies; and 29% from unionized firms. Close to 90 percent had a main bank; and 40% reported to have been under the influence of the main bank.

Table 2 presents the first-stage results, the probit estimates of our propensity score equation. As expected, the estimated coefficient on ***Annual rate of change in sales from t-1 to t*** is negative and statistically significant at the 5 percent level, suggesting that the firm experiencing greater sales loss (or lower rate of change in sales) is more likely to apply for STC and succeed in getting it. Though not statistically significant, the estimated coefficient on ***At least 10% drop in sales from t-1 to t*** is positive (of an expected sign).

The estimated coefficients on the two proxy variables for the firm's expectation on its future business outlook, ***No plan for future expansion*** and ***Recent global expansion***, are of expected signs and the positive coefficient on ***Recent global expansion*** is statistically significant at the 10 percent level, suggesting that the firm expanded its business globally in the last three years (and hence optimistic about its future business outlook) is more likely to apply for STC and preserve its employees with firm-specific human capital rather than start downsizing immediately.

The estimated coefficients on the three proxy variables for the firm's ability to take advantage of government help such as STC, ***Investment subsidy***, ***R&D subsidy,*** and ***Efficient/new energy subsidy*** are all positive, and the one on ***R&D subsidy*** is statistically

significant at the 5 percent level, confirming our prior expectation that the firm with higher ability to make good use of government subsidies is more likely to apply for STC and succeed in getting it. The estimated coefficient on ***Job security*** is also of an expected sign although not quite statistically significant.

The estimated coefficients on the remaining covariates are not precisely estimates, except for ***ROA_lag1***, the estimated coefficient on which is negative and statistically significant at the 5 percent level. We interpret the negative coefficient on accounting profitability in the last year as an indication that the firm experiencing weaker accounting profitability has more limited opportunities to raise money to weather the recession while keeping its labor force, which generates stronger incentive to seek government help (a similar finding is reported by Morikawa, 2021 on the most recent relief policies provided by Japanese government during the COVID-19 pandemic). As shown in Table 3, the balancing test indicates that our ability to consider a rich set of covariates is paying off, and that our matching is working.

Table 4 summarizes our estimates on ATT of STC on standard employment measured in log as the dependent variables. As shown in the upper part of the Table 4, our estimates on ATTs on standard employment are positive and statistically significant except for the first year of STC.[16] As time passes, the size of the estimated ATT grows and become more statistically significant, pointing to the lasting and growing positive effect of STC on standard employment. In four years following the incidence of STC, standard employment will be 5.1 percentage points

[16] This does not necessarily mean that the level of standard employment of treated firms has increased, but rather that the decline in the level of standard employment is significantly smaller for treated firms than for control firms.

higher than without STC. The size of the lasting effect of STC on standard employment is neither trivial nor implausibly large.[17]

When we use total employment including both standard and non-standard workers, as shown in the table at the bottom of Table 4, none of the estimated ATTs is statistically significant, and its size is small, pointing to the absence of any lasting employment effect of STC for total employment, which is consistent with our prior expectation that the main beneficiary of STC is standard employees.[18]

Table 5 present the estimated ATEs of STC on standard employment. Reassuringly the estimated ATEs do not differ much from the estimated ATTs although ATEs are less precisely estimated than ATTs.

Table 6 summarizes our estimates on ATTs of STC on other firm-level outcomes. First, the estimated ATTs on sales (measured in log) are positive and statistically significant at the 1 percent level except for the first two years in which the estimated ATTs are still positive yet not statistically significant. The size of the estimated ATTs is considerable and grows over time. The estimated ATTs on TFP and value added are somewhat less precisely estimated but still consistent with the results on sales. The use of STC is found to have positive and growing effects not only on standard employment but also on sales and productivity. The table also shows that STC also has a positive and lasting effect on total wage payment, suggesting that lasting sales

[17] If firms with STC are significantly more likely to go bankrupt and exit than their counterparts without STC, our positive estimates on ATT of STC on standard employment will be biased upward. To this end, we estimated a probit model of the odds of exit as a function of STC and controls as in the first stage. Reassuringly we found no evidence for a systematic difference in the conditional odds of exit between firms with and without STC.

[18] Prior studies using firm/establishment-level microdata also fail to find such positive employment effect (see, Arranz et al., 2018 for Spain, Cahuc et al., 2018 for France, and Kambayashi, 2017, Ariga and Kuo, 2017, and Kawaguchi, Kodama and Tanaka, 2021 for Japan), although prior studies using aggregate data at the regional level find positive employment effects (see, for instance, Abraham and Houseman, 2014).

and productivity gains from STC are shared with workers. Finally, the estimated ATTs on profitability (ROA) are mostly positive yet small and insignificant. As such, we find no evidence that STC distorts resource allocation and ultimately harms firm profitability.

In sum, our estimated ATTs of STC on employment, sales, productivity, wage, and profitability in the long run suggest that by using STC to engage in worksharing in response to the global financial crisis in 2008, the firm ended up experiencing greater gains in employment, sales, and productivity during the subsequent recovery period than its counterparts that did not use STC. In addition, we find no evidence that the STC firm suffered poorer profitability than their counterparts without STC. As such, our results favor the sanguine view of STC (Preserved Human Capital and Enhanced Workplace Morale) over the critical view (Delayed Definitive Treatment).

Table 7 presents the result of the placebo test. It is possible that our estimated ATTs are confounded by pre-treatment differences between the treatment and control groups that are not accounted for by a set of control variables, though our observed control variables are rather broad and exhaustive. To account for such pre-treatment differences, we conduct the following Placebo test---we follow the same PSM procedure and estimate ATT with one exception---instead of using the actual year of STC introduction, we make a false assumption that STC were introduced seven years earlier than the actual year of introduction. The starting year of the Placebo test (seven years earlier than the actual year of STC) was chosen so that we have the same time frame (one year prior to the treatment year and subsequent four years) and avoid any overlap between the Placebo test time frame (*t-7* to *t-2*) and the actual time frame (*t-1* to *t+4*). The Placebo test works as follows: if under the false assumption of the Placebo test we still obtain the positive and significant effect of STC on standard employment as we did under the

correct assumption on the year of STC, we will not be able to rule out the possibility of our ATT estimates being confounded by the pre-treatment differences. As shown in Table 7, the ATT estimates under the false assumption that STC were introduced seven years earlier than the actual year of STC introduction are consistently insignificant, and small (sometimes even negative). In sum, our ATT estimates pass the Placebo tests, suggesting that it is unlikely that they are confounded by pre-treatment differences between the treatment and control groups that are not accounted for by observable controls.

V. Conclusions

Using unique firm-level micro data on the use of STC by Japanese firms as well as an unusually rich set of controls, we have estimated the ATTs of STC on employment, sales, productivity, wages, and profitability in the long run. Our ATT estimation has yielded the first rigorous econometric evidence on the positive consequence of STC for employment in the long run. The size of the ATT is neither trivial nor implausibly large---in four years following the incidence of STC, on average, the firm's employment level (excluding contingent workers and counting only standard employees) will be 5.1 percentage points higher with STC than without STC. Furthermore, we have found a positive and significant lasting ATT of STC on sales, TFP, and value added, while we have found no evidence for the negative ATT on profitability in the long run. As such, our evidence favors a sanguine view on the consequences of STC (STC promoting worksharing as an alternative to layoffs, resulting in the preservation of firm-specific human capital and the prevention of adverse workplace morale effect of layoffs and the enhancement of goal alignment and teamwork of workers through shared adversity) over a critical view (STC causing the postponement of definitive treatment). It is, however, still an open

question exactly which mechanism behind the sanguine view is more relevant to STC used in response to the global financial crisis of 2008.

Finally, Japanese policymakers and regulators are often blamed for keeping "zombie firms" alive with lax regulations and subsidies, ending up turning other "healthy firms" into "zombie firms", and delaying the recovery (Caballero, Hoshi, and Kashyap, 2008). Our evidence suggests that insofar as STC is concerned, Japanese policymakers' efforts to help firms in the midst of the global Great Recession through STC did indeed help them in terms of sales, TFP, and value added, resulting in better employment outcomes for standard employees in the long run. However, our positive assessment of STC does not apply to non-standard employees. It is important for any future discussions on STC to include non-standard employment as a group of workers who warrants careful attention. Moreover, the observed positive long-term employment effect of STC ought to be interpreted in the context of the recovery of the Japanese economy to the global Great Recession. If the economic downturn after the Great Recession had been more persistent and of structural nature, the result might not have been as favorable for the efficacy of STC.[19] Our findings of largely favorable consequences of STC for employment ought not to be interpreted as pointing to the universal efficacy of STC.

[19] Cahuc et al. (2018) offer a similar caution and stress the importance of exit strategies for STC---when to end STC and how to end it.

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Table 1. Summary statistics

Variables	Obs	Mean	Std. Dev.
STC	3384	0.04	0.20
Annual rate of change in sales from t-1 to t	3384	-0.04	0.17
At least 10% drop in sales from t-1 to t	3384	0.25	0.43
No future plan to expand	3384	0.06	0.24
Recent global expansion	3384	0.17	0.38
Investment subsidy	3384	0.09	0.28
R&D subsidy	3384	0.06	0.25
Efficient and new energy subsidy	3384	0.05	0.22
Job security	3384	0.52	0.50
Having main bank	3384	0.89	0.31
Influenced by main bank	3384	0.40	0.49
Company-sponsored training	3384	0.88	0.33
Union	3384	0.29	0.46
Listed company	3384	0.08	0.28
Owner company	3384	0.60	0.49
ln(asset)_lag1	3384	8.16	1.21
ln(employment)_lag1	3384	5.13	0.98
ROA_lag1	3384	0.04	0.06
Total number of employees	3384	379	2194
Number of standard employees	3384	278	1995
Sales	3384	25896	310774
Total factor productivity (TFP)	3206	0.95	0.12
Total wage payment	3383	2041	20323
Value added	3298	5200	56605
ROA	3379	0.04	0.06

Sources: Firm-level micro data from the Basic Survey of Corporate Management and Economic Policy (SCMEP) linked to firm-level micro data from the Survey of Japanese Business Structure and Activities (BSJBSA), 2005-2014.

Table 2. Probit Estimates of Propensity Score Equation

	Coefficient	s.e.
Annual rate of change in sales from t-1 to t	-0.827**	(0.343)
At least 10% drop in sales from t-1 to t	0.088	(0.129)
No plan for future expansion	-0.068	(0.176)
Recent global expansion	0.193*	(0.099)
Investment subsidy	0.173	(0.131)
R&D subsidy	0.272**	(0.139)
Efficient/new energy subsidy	0.064	(0.171)
Job security	0.100	(0.081)
Having main bank	0.005	(0.143)
Influenced by main bank	0.068	(0.085)
Company-sponsored training	0.140	(0.138)
Union	-0.002	(0.090)
Listed company	0.137	(0.135)
Owner company	0.015	(0.088)
ln (asset)_lag1	0.020	(0.047)
ln (employment)_lag1	0.047	(0.059)
ROA_lag1	-1.640**	(0.706)
Industry FE	YES	
Number of obs	3,384	
Pseudo R2	0.039	

Sources: Firm-level micro data from the Basic Survey of Corporate Management and Economic Policy (SCMEP) linked to firm-level micro data from the Survey of Japanese Business Structure and Activities (BSJBSA), 2005-2014.
Notes: ***, **, * denote significance at the 1, 5, and 10 percent level, respectively.

Table 3. Balancing test between treated and control

		Treated	Control	t	
Annual rate of change in sales from t-1 to t	Unmatched	-0.092	-0.038	-5.020	***
	Matched	-0.097	-0.108	0.500	
At least 10% drop in sales from t-1 to t	Unmatched	0.394	0.251	5.220	***
	Matched	0.379	0.407	-0.490	
No plan for future expansion	Unmatched	0.080	0.076	0.190	
	Matched	0.050	0.021	1.290	
Recent global expansion	Unmatched	0.212	0.152	2.640	***
	Matched	0.264	0.164	2.050	**
Investment subsidy	Unmatched	0.143	0.086	3.140	***
	Matched	0.136	0.129	0.180	
R&D subsidy	Unmatched	0.130	0.062	4.340	***
	Matched	0.121	0.136	-0.360	
Efficient/new energy subsidy	Unmatched	0.064	0.053	0.710	
	Matched	0.064	0.100	-1.090	
Job security	Unmatched	0.576	0.532	1.410	
	Matched	0.571	0.586	-0.240	
Having main bank	Unmatched	0.875	0.868	0.310	
	Matched	0.907	0.879	0.770	
Influenced by main bank	Unmatched	0.395	0.374	0.670	
	Matched	0.436	0.457	-0.360	
Company-sponsored training	Unmatched	0.909	0.881	1.390	
	Matched	0.914	0.957	-1.460	
Union	Unmatched	0.366	0.296	2.370	**
	Matched	0.314	0.314	0.000	
Listed company	Unmatched	0.073	0.057	1.050	
	Matched	0.121	0.079	1.190	
Owner company	Unmatched	0.587	0.552	1.120	
	Matched	0.607	0.643	-0.620	
ln(asset)_lag1	Unmatched	8.152	8.152	0.000	
	Matched	8.279	8.448	-1.030	
ln(employment)_lag1	Unmatched	5.214	5.129	1.360	
	Matched	5.241	5.354	-0.800	
ROA_lag1	Unmatched	0.026	0.038	-2.940	***
	Matched	0.028	0.033	-0.690	

"Sources: Firm-level micro data from the Basic Survey of Corporate Management and Economic Policy (SCMEP) linked to firm-level micro data from the Survey of Japanese Business Structure and Activities (BSJBSA), 2005-2014.
Notes: ***, **, * denote significance at the 1, 5, and 10 percent level, respectively."

Table 4. ATT of STC on standard employment and total employment

ATT	(1)	(2)	(3)	(4)	(5)
	(t-1)->t	(t-1)->(t+1)	(t-1)->(t+2)	(t-1)->(t+3)	(t-1)->(t+4)
ln (standard employment)					
Treatment	0.021	0.037**	0.033**	0.038**	0.051***
	(0.013)	(0.017)	(0.016)	(0.018)	(0.019)
Observations	3,060	3,060	3,060	3,060	3,060
R-squared	0.003	0.005	0.004	0.005	0.007

ATT	(6)	(7)	(8)	(9)	(10)
	(t-1)->t	(t-1)->(t+1)	(t-1)->(t+2)	(t-1)->(t+3)	(t-1)->(t+4)
ln (total employment)					
Treatment	0.012*	-0.000	0.002	0.002	0.018
	(0.007)	(0.013)	(0.013)	(0.014)	(0.016)
Observations	3,060	3,060	3,060	3,060	3,060
R-squared	0.002	0.000	0.000	0.000	0.001

Sources: Firm-level micro data from the Basic Survey of Corporate Management and Economic Policy (SCMEP) linked to firm-level micro data from the Survey of Japanese Business Structure and Activities (BSJBSA), 2005-2014.

Notes: ATTs show average treatment effect on the treated from the matching exercise using inverse probability weighting (IPW). The reported coefficients are changes in a given outcome between the treated firms and the matched controls from the previous survey wave (T-1) to (T+k), where k = 0, 1, 2, 3, 4 pertains to the subsequent waves. Robust standard errors are presented in parentheses.

***, **, * denote significance at the 1, 5, and 10 percent level, respectively.

Table 5. ATE of STC on standard employment

ATT	(1)	(2)	(3)	(4)	(5)
	(t-1)->t	(t-1)->(t+1)	(t-1)->(t+2)	(t-1)->(t+3)	(t-1)->(t+4)
ln (standard employment)					
Treatment	0.037**	0.042*	0.037*	0.035	0.021
	(0.017)	(0.022)	(0.021)	(0.024)	(0.029)
Observations	2,961	2,961	2,961	2,961	2,961
R-squared	0.010	0.008	0.006	0.005	0.001

Sources: Firm-level micro data from the Basic Survey of Corporate Management and Economic Policy (SCMEP) linked to firm-level micro data from the Survey of Japanese Business Structure and Activities (BSJBSA), 2005-2014.

Notes: ATEs show average treatment effect from the matching exercise using inverse probability weighting (IPW). The reported coefficients are changes in a given outcome between the treated firms and the matched controls from the previous survey wave (T-1) to (T+k), where k = 0, 1, 2, 3, 4 pertains to the subsequent waves. Robust standard errors are presented in parentheses.
***, **, * denote significance at the 1, 5, and 10 percent level, respectively.

Table 6. ATT of STC on other firm-level outcomes

	(1)	(2)	(3)	(4)	(5)
	(t-1)->t	(t-1)->(t+1)	(t-1)->(t+2)	(t-1)->(t+3)	(t-1)->(t+4)
ln(sales)					
Treatment	0.008	0.028	0.067***	0.079***	0.106***
	(0.017)	(0.018)	(0.021)	(0.022)	(0.024)
Observations	3,041	3,041	3,041	3,041	3,041
R-squared	0.000	0.003	0.012	0.015	0.021
	(6)	(7)	(8)	(9)	(10)
	(t-1)->t	(t-1)->(t+1)	(t-1)->(t+2)	(t-1)->(t+3)	(t-1)->(t+4)
ln(TFP)					
Treatment	-0.009	0.001	0.007	0.013*	0.014*
	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
Observations	2,691	2,691	2,691	2,691	2,691
R-squared	0.002	0.000	0.001	0.004	0.004
	(16)	(17)	(18)	(19)	(20)
	(t-1)->t	(t-1)->(t+1)	(t-1)->(t+2)	(t-1)->(t+3)	(t-1)->(t+4)
ln(value added)					
Treatment	-0.009	0.015	0.034	0.036	0.103**
	(0.029)	(0.036)	(0.041)	(0.046)	(0.051)
Observations	2,648	2,648	2,648	2,648	2,648
R-squared	0.000	0.000	0.001	0.001	0.006
	(11)	(12)	(13)	(14)	(15)
	(t-1)->t	(t-1)->(t+1)	(t-1)->(t+2)	(t-1)->(t+3)	(t-1)->(t+4)
ln(total wage payment)					
Treatment	0.014	-0.024	0.008	0.045*	0.045*
	(0.022)	(0.027)	(0.024)	(0.026)	(0.026)
Observations	3,056	3,056	3,056	3,056	3,056
R-squared	0.000	0.001	0.000	0.003	0.003
	(21)	(22)	(23)	(24)	(25)
	(t-1)->t	(t-1)->(t+1)	(t-1)->(t+2)	(t-1)->(t+3)	(t-1)->(t+4)
ROA					
Treatment	0.000	-0.000	0.011	0.002	0.005
	(0.004)	(0.005)	(0.008)	(0.005)	(0.006)
Observations	3,041	3,041	3,041	3,041	3,041
R-squared	0.000	0.000	0.003	0.000	0.001

Sources: Firm-level micro data from the Basic Survey of Corporate Management and Economic Policy (SCMEP) linked to firm-level micro data from the Survey of Japanese Business Structure and Activities (BSJBSA), 2005-2014.

Notes: ATTs show average treatment effect on the treated from the matching exercise using inverse probability weighting (IPW). The reported coefficients are changes in a given outcome between the treated firms and the matched controls from the previous survey wave (T-1) to (T+k), where k = 0, 1, 2, 3, 4 pertains to the subsequent waves. Robust standard errors are presented in parentheses.

***, **, * denote significance at the 1, 5, and 10 percent level, respectively.

Table 7. Placebo test

	(1) (t-7)->(t-6)	(2) (t-7)->(t-5)	(3) (t-7)->(t-4)	(4) (t-7)->(t-3)	(5) (t-7)->(t-2)
ln (standard employment)					
Treatment	0.017	0.018	0.020	0.008	0.010
	(0.013)	(0.017)	(0.020)	(0.025)	(0.025)
Observations	2,396	2,396	2,396	2,396	2,396
R-squared	0.002	0.001	0.001	0.000	0.000

	(4) (t-7)->(t-6)	(5) (t-7)->(t-5)	(6) (t-7)->(t-4)	(7) (t-7)->(t-3)	(8) (t-7)->(t-2)
ln (total employment)					
Treatment	0.001	0.000	0.004	-0.001	-0.009
	(0.011)	(0.013)	(0.017)	(0.020)	(0.021)
Observations	2,396	2,396	2,396	2,396	2,396
R-squared	0.000	0.000	0.000	0.000	0.000

	(9) (t-7)->(t-6)	(10) (t-7)->(t-5)	(11) (t-7)->(t-4)	(12) (t-7)->(t-3)	(13) (t-7)->(t-2)
ln(sales)					
Treatment	0.018	0.009	0.015	-0.004	-0.028
	(0.016)	(0.018)	(0.023)	(0.027)	(0.032)
Observations	2,396	2,396	2,396	2,396	2,396
R-squared	0.002	0.000	0.001	0.000	0.001

	(14) (t-7)->(t-6)	(15) (t-7)->(t-5)	(16) (t-7)->(t-4)	(17) (t-7)->(t-3)	(18) (t-7)->(t-2)
ln(TFP)					
Treatment	-0.003	-0.004	0.006	0.007	0.000
	(0.008)	(0.009)	(0.010)	(0.011)	(0.011)
Observations	2,179	2,179	2,179	2,179	2,179
R-squared	0.000	0.000	0.001	0.001	0.000

Sources: Firm-level micro data from the Basic Survey of Corporate Management and Economic Policy (SCMEP) linked to firm-level micro data from the Survey of Japanese Business Structure and Activities (BSJBSA), 2005-2014.

Notes: ATTs show average treatment effect on the treated from the matching exercise using inverse probability weighting (IPW). The reported coefficients are changes in a given outcome between the treated firms and the matched controls from the previous survey wave (T-1) to (T+k), where T=-6 and k = 0, 1, 2, 3, 4 pertains to the subsequent waves. Robust standard errors are presented in parentheses.

***, **, * denote significance at the 1, 5, and 10 percent level, respectively.