WAGE INSURANCE FOR DISPLACED WORKERS

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Extended Abstract

Trade and automation have contributed to substantial job losses in the United States in recent decades. Such rapid secular changes to the labor market underscore the importance of considering innovative programs that provide financial protection to displaced workers. Wage insurance is one approach that provides both compensation for job loss and incentives to return to work. As part of the Re-Employment Trade Adjustment Assistance program, displaced workers receive up to half of the difference in wages between their old job and their new job for up to two years. Our research examines how this policy influences the amount of time people remain unemployed and their wages upon returning to work. Our methods compare people who are just below the age eligibility cutoff for wage insurance (age 50) to those who are just above this age. The wage insurance program we study is only available to workers who lose their jobs due to trade, but the findings may also have implications for other types of workers.

Under Re-Employment Trade Adjustment Assistance (RTAA), workers over age 50 who lose their job to import competition can receive up to half of the difference in their pre-displacement and post-displacement earnings ("wage insurance"). We use a regression-discontinuity (RD) design based on eligibility age to estimate the causal effect of this program on labor market outcomes. Merging administrative data on trade-displaced workers with nationally representative employer-employee linked data from the Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) dataset, we track the long-run effects of wage insurance on re-employment wages, unemployment durations, wage growth, and occupational quality over time at the national level.

We then use our RD estimates in connection with a sufficient-statistics framework to evaluate welfare effects. Workers receiving wage insurance payments may smooth consumption while accumulating human capital in a new industry or occupation. The program may, however, generate moral hazard by incentivizing workers to take lower-paying, less demanding jobs, because part of their lost wages are covered by insurance. Our model quantifies the magnitude of these two effects. Although the wage insurance structure of RTAA was conceived as a way to compensate older trade-displaced workers, for whom retraining might be less effective and more socially costly, it also provides a laboratory in which to examine wage insurance as a potential alternative to standard unemployment insurance systems.

1. Introduction

Trade and automation have contributed to substantial job losses in the United States in recent decades. Between 2000 and 2016, the United States shed approximately 6 million manufacturing jobs, resulting in the lowest level of manufacturing employment since the onset of World War II (BLS, 2017). Such rapid secular changes to the labor market underscore the importance of considering innovative programs that provide financial protection to displaced workers. One promising policy proposal is wage insurance, which pays for part of the wages lost when a worker is laid off and subsequently takes a lower-paying job (Kletzer and Litan, 2001; LaLonde, 2007; Kletzer, 2016; Shiller, 2016).

Since 2002, the US Department of Labor has experimented with wage insurance as part of the Trade Adjustment Assistance (TAA) program, which compensates workers who lose employment as a result of international trade. Displaced workers in the traditional TAA program participate in mandatory job training and receive extended unemployment insurance payments. Starting in 2002, older workers were eligible for an alternative program known as Reemployment Trade Adjustment Assistance (RTAA), which does not require job training and instead provides wage insurance, paying up to half of the difference between the worker's pre- and post-separation wages for two years.[1] The policy differs from standard unemployment insurance (UI) in that benefit amounts are benchmarked to prior earnings and are redeemable only if workers find new jobs within a designated time period. In contrast to UI, wage insurance incentivizes job search, in an effort to avoid moral hazard and other costs associated with long benefit durations (see for example Johnston and Mas, 2016). Although the wage insurance structure of RTAA was conceived as a way to compensate older trade-displaced workers, for whom retraining might be less effective and more socially costly, it also provides a laboratory in which to examine wage insurance as a potential alternative to standard unemployment insurance systems.

This research project uses a regression-discontinuity (RD) design to estimate the causal effects of wage insurance on the labor market outcomes of displaced workers. The RTAA program is limited to TAA-eligible workers aged 50 and older, which enables comparisons of workers just below and just above this age cutoff for eligibility. Merging administrative data on eligible trade-displaced workers with nationally representative employer-employee linked data from the US Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) dataset, we can track the long-run effects of wage insurance on re-employment wages, unemployment durations, wage growth, and occupational quality over time.

Establishing credible causal estimates regarding the labor market effects of wage insurance is essential when judging whether a wage insurance policy improves on benchmark UI and retraining programs. However, even with these estimates in hand, many questions will remain regarding how to design and implement an effective wage insurance program. What is the optimal level of wage insurance subsidy that maximizes its benefits while minimizing moral hazard costs associated with the program? What types of frictions would lead to more efficient outcomes in a wage insurance scheme relative to UI? If these frictions primarily affect certain subpopulations, what types of groups should be targeted for wage insurance relative to other available programs like UI and workforce retraining incentives that do not link benefits to prior earnings?

The second part of this research program proposes to use the RD estimates to inform the optimal design of wage insurance in a sufficient-statistics framework (Chetty, 2009). Wage insurance may affect worker welfare in a variety of ways. The program may reduce inequality by targeting payments to displaced workers in declining industries. Workers receiving wage insurance payments may more effectively smooth consumption while accumulating human capital in a new industry or occupation. The program may generate moral hazard by incentivizing workers to take lower-paying, less demanding jobs, because part of their lost wages are covered by insurance. Our

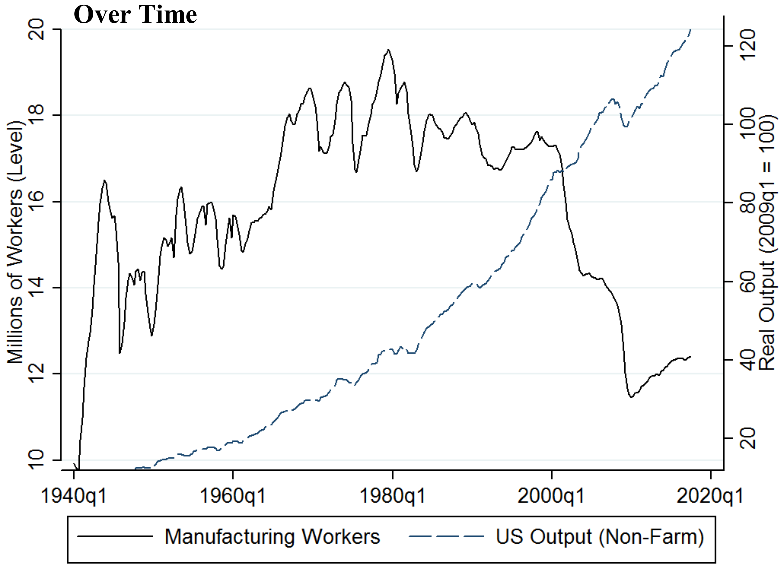
[1] The program was called Alternative Trade Adjustment Assistance (ATAA) prior to 2009.

analysis will first quantify the magnitude of consumption smoothing benefits in comparison to costs related to moral hazard, and will then extend the analysis to decompose the welfare benefits and costs of wage insurance into those emanating from liquidity effects and search disincentives. These estimates will allow policymakers to consider the various tradeoffs they face when designing wage insurance programs in the future.

2. Social Insurance and Job Displacement in the Modern Economy

For many decades, economists argued that the potential adverse labor market effects of removing barriers to international trade were quantitatively small because imports from low-wage countries had been relatively inconsequential until the 1990s (Autor et al., 2016). More recently however, influential papers in empirical trade and labor economics have documented that trade-displaced workers may remain persistently underemployed and underpaid (with respect to prior earnings) for years beyond their initial job separation (Bartik, 2017; Lachowksa et al., 2017; Pierce and Schott, 2016; Flaaen et al., 2018; Autor et al., 2013, 2014; Autor and Dorn, 2013; Harrison and McMillan, 2011). Figure 1 demonstrates the broader disintegration of labor market recovery among manufacturing workers during the last two business cycles:

Figure 1. Manufacturing Employment and Real Output Over Time



Notes: Figure from Hyman (2018). Monthly manufacturing employment from BLS Current Employment Statistics. Quarterly index of nonfarm business sector real output from BLS Labor Productivity and Costs, 2009q1=100.

As jobs and tasks become increasingly outsourceable and automated, there is also growing concern about how future generations of US workers will be able maintain their earnings and employment in a rapidly transforming innovation economy. For example, 1.3 million truck drivers will likely compete with the emergence of self-driving vehicle technology by 2026 (CEA, 2016). A related and equally pressing concern is whether current social insurance programs are keeping up with these rapid changes. For example, Kroft and Notowidigdo (2016) consider the costs and benefits of indexing unemployment insurance to local unemployment rates and other such extensions.

While workforce retraining programs for displaced workers exist, they require both household liquidity to cover expenses during training, and foresight about the sectors and geographic locations of future job growth. Even with these assets and information, retraining programs are not always the most effective tool for workers for whom the learning curve is particularly steep. Wage insurance policies seek to address these concerns by supporting workers' wages as they learn on the job, relaxing liquidity constraints and job targeting issues that arise with traditional training programs. Unemployment insurance also provides benefits for many workers suffering job losses, though many others do not qualify due to insufficient wage histories. A central concern with traditional unemployment insurance programs is that they reduce the incentive to search for a new job, potentially leading to protracted periods of unemployment. An extensive literature has shown that long-term unemployment is associated with declining job finding rates due to worker discouragement (Krueger and Mueller, 2011) or hiring firms' perception that long-term unemployed workers are of lower productivity (Kroft et al., 2012). Wage insurance policies counteract this incentive by including provisions requiring workers to find reemployment within a relatively short period of time and by subsidizing reemployment wages.

The US Trade Adjustment Assistance program, which has been in place in its current form since 1974, is available to workers "who lose their jobs or whose hours of work and wages are reduced as a result of increased imports or shifts in production out of the United States."[2] The program was designed to compensate workers who lose from trade liberalization and to help maintain support for continued reductions in trade barriers. The central program benefits are up to $10,000 per year for qualified retraining programs, extended unemployment insurance benefits for up to three years, and modest job search and relocation allowances. Training is required in order to maintain benefits. To qualify for TAA, displaced workers or their representatives must petition the Department of Labor to certify that their displacement resulted from foreign competition. Eligibility is determined at the plant level, so all workers displaced from a certified plant during the relevant time window are eligible for TAA benefits. As discussed below, this plant-level certification process enables us to identify TAA-eligible workers in Census Bureau data.

The wage insurance portion of TAA was introduced in 2002 as an alternative way to compensate older TAA-certified workers who are less likely to retrain, while still providing incentives for re-employment. In particular, wage insurance is restricted to workers aged 50 and older at the time of displacement and covers up to half of the difference between pre-displacement and post-displacement wages, up to a maximum of $10,000 over a two-year period. Workers who earn up to $50,000 upon re-employment are eligible. This income threshold helps to target those with low and moderate incomes, but imposes high effective marginal tax rates around this salary cutoff. Workers who earn more than $50,000 annually forfeit all wage insurance benefits because benefits are not phased out smoothly as salary increases. For much of the wage insurance program's history, workers were required to find a new job within 26 weeks of displacement, although we discuss time variation in this requirement in Section 3.3 below.

Two market failures may explain the absence of a private market for wage insurance. First, imperfections in credit markets may prevent workers from pledging future earnings as collateral. This market failure is similar to the case of student loans, in which securitizing human capital is rarely observed. The second possibility is adverse selection. Workers likely have private information about their probability of unemployment, and those who expect to face unemployment would be more likely to purchase wage insurance policies than those who believe their job is safer. Private information about future job loss can explain the absence of a market for unemployment insurance that supplements government benefits (Hendren, 2017). In the case of wage insurance, workers can also influence the magnitude of the insurance benefit by accepting a lower-paying job

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[2] Department of Labor, Employment and Training Administration. https://www.doleta.gov/tradeact/taa_wdp.cfm. See Monarch et al (2017), Kondo (2018), and Hyman (2018) for additional institutional detail.

upon re-employment. Selection on this dimension of the contract may further complicate the ability for insurers to price on expected costs.

3. Empirical Framework for Evaluating the Impact of Wage Insurance

3.1 Identification Challenge and Estimation Strategy

Estimating the causal effect of any voluntary social insurance problem is challenging. Those receiving social insurance are self-selected on a number of characteristics that may affect future outcomes. For example, lower productivity workers could adversely select insurance, and thus any estimated impact on this group relative to a control group might simply reflect differences in group characteristics, biasing estimates downwards. Alternatively, workers that choose to take up benefits might in fact be more motivated, biasing estimates upwards.

To circumvent these challenges when examining the effects of the RTAA wage insurance program, we leverage the requirement that workers must be age 50 or older at the time of displacement to be eligible for wage insurance.[3] After the TAA petition relating to a given displacement episode is certified by Dept. of Labor investigators, the associated workers qualify for the baseline TAA benefits of training and extended UI payments described above. Those age 50 or older have the option of receiving standard TAA benefits or wage insurance under RTAA, while younger workers only qualify for standard TAA. The relevant dates determining eligibility are defined at the petition level and do not vary across workers covered by the same petition, so an individual worker is unable to manipulate their displacement date relative to their birth date to influence wage insurance eligibility. Therefore, workers who are laid off just above the age threshold will be on average otherwise identical to those laid off just before age 50, while only the slightly older group is eligible for wage insurance. This administrative structure facilitates a regression-discontinuity (RD) design estimating the intent-to-treat effect of wage insurance on worker outcomes.

Formally, let $Y_{i\tau}$ be labor market outcomes of each TAA-eligible individual i, τ periods before or after worker i separates from their initial employer. We will pursue a variety of approaches to estimate the following statistic, which compares average outcomes for those just below the age cutoff to those just above it.

$$\beta_\tau = \lim_{a \downarrow 50} E[Y_{i\tau} \mid age_i = a] - \lim_{a \uparrow 50} E[Y_{i\tau} \mid age_i = a] \qquad (1)$$

For this object to reflect the causal effect of wage insurance eligibility on worker outcomes, it must be the case that applicants who narrowly exceed or fall short of the age 50 threshold are otherwise identical on average. We will reinforce this assumption by (i) documenting the continuity of various worker characteristics measured at the time of separation (e.g. firm tenure, education, sex, race, etc.) around eligibility threshold and (ii) testing for manipulation around the eligibility threshold using density estimators provided by Cattaneo et al. (2017), who build on the original

[3] To be more precise, the worker must be age 50 or older at the reemployment date, and must be reemployed within 26 weeks of the separation date, so the actual eligibility cutoff requires that the worker is age 49.5 or older at the separation date (see Appendix A in the Dept. of Labor, Employment and Training Administration *Training and Employment Guidance Letter No. 5-15*, September 4, 2015). Our analysis will follow this accurate cutoff rule, but for simplicity, in this proposal we will describe the cutoff as being age 50 at displacement.

McCrary (2008) test.[4] We will utilize nonparametric, semiparametric, and parametric approaches to estimating β_τ. In our parametric setting, we will estimate variants of the following equation:

$$Y_{i\tau} = \alpha + \beta_\tau d_i + \gamma f(age_i) + \delta d_i * g(age_i) + \epsilon_{i\tau} \tag{2}$$

Here, d_i is a dummy variable equal to 1 if a worker separates after age 50, and 0 otherwise. $f(age_i)$ and $g(age_i)$ are flexible polynomials on either side of the age 50 cutoff. β_τ thus captures the difference between the two polynomials evaluated at the age cutoff.[5] This compact or "pooled" equation was originally proposed in Lee and Lemieux (2010), and has since been used in prominent RD designs such as Keys et al. (2010) and others.

For nonparametric and semiparametric designs, Imbens and Kalyanaraman (2012) provide guidance on choosing an optimal bandwidth as a function of the underlying data, and Calonico et al. (2014) provide various methods for choosing both bandwidth and polynomial order. We will provide results using a variety of kernels, bandwidths, and functional forms to ensure that our results are robust to the choice of estimation method.

Our dependent variables of interest are unemployment durations, discounted lifetime earnings, occupational and spatial mobility outcomes, and the take-up of various means-tested benefit programs.

3.2. Data

In order to implement the regression discontinuity design just described, we must be able to (i) identify workers involved in a TAA-certified displacement episode, (ii) observe workers' age at displacement to determine RTAA wage insurance eligibility, and (iii) measure worker-level labor market outcomes in the years preceding and following displacement. We build such a database by combining administrative data from the TAA program with longitudinal matched employer-employee data from the Census Bureau's LEHD.

TAA Petition and Worker Data

We have acquired the universe of TAA petitions (1974-2016) through Freedom of Information Act (FOIA) requests at the US Dept. of Labor. This dataset contains an observation for each petition (roughly 84,000 in total), including two critical pieces of information for all approved and denied petitions. First, each petition contains the plant (establishment) name and address, which we leverage for matching to Census Bureau establishments and the workers who separate from those establishments. Second, each petition contains a series of dates, including the petition filing date, determination (TAA approval decision) date, impact (separation) date, and eligibility expiry

[4] Since our data measures age in months, we will also implement tests that can be applied when the running variable is discrete, rather than continuous (e.g. Frandsen, 2017).
[5] To see this clearly, consider plugging in d=1 and d=0, which will estimate different parts of the support of the running variable.

date. We use these dates to identify the set of workers laid off in the eligibility window who qualify for TAA benefits.

The petition database additionally includes information on petitioner filer types (company, union, worker-group, or state career center), DOL-assigned 4-digit Standard Industrial Classification (SIC) codes, and the company's main product or service (recorded as a qualitative value), allowing us to observe what industries were most influenced by the program. Finally, each petition contains an estimate of the number of workers eligible for the program under the relevant petition, allowing us to corroborate the number of eligible workers measured in Census data.

From 1998 to 2008, the Dept. of Labor has also retained individual-level data on program participants in the Trade Adjustment Participant Report (TAPR) dataset, also obtained via FOIA request. These data include anonymized records of all individuals receiving TAA-related benefits, and indicate which individuals participated in the RTAA wage insurance program. This information will allow us to calculate takeup rates for the wage insurance program and to observe the characteristics of those workers relative to the broader population of TAA participants. For a subset of years, these data also allow us to observe occupational transitions using standard occupational codes (O*Net 4.0 8-digit codes).

Census Data

We merge the TAA petition data to the US Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) administrative files following the procedure discussed in detail in Hyman (2018). The LEHD files allow for the construction of a detailed person-level panel dataset which tracks workers' quarterly employment status, earnings, and educational status across employers, geographies, and time. The core data are compiled from employer-reported UI filings at the state-level for every paid employee. While the LEHD data partnership spans all 50 US states and covers over 90 percent of US workers, for this project, 24 states and the District of Columbia approved data access.[6] We use the 2014 LEHD snapshot which provides a relatively balanced panel from 1990 to 2014.[7]

Leveraging each worker's (de-identified) social security number, we also merge in worker age, gender, and race from the Social Security Administration Numident file (available in the LEHD Individual Characteristics File). Educational attainment variables are also available for Decennial Census and American Community Survey (ACS) respondents (roughly 1 in 6 workers), while imputed education values based on Census Bureau multiple-imputation and probabilistic record linking methods are available for other workers.

Together, the TAA petition and Census databases allow us to identify TAA-eligible workers just above and below the RTAA wage insurance eligibility age cutoff and to observe their labor market outcomes over a period of many years. Please note that we have already received Census Bureau approval for the work proposed here and have received Special Sworn Status, allowing us to access

[6] These include the following states: AR, AZ, CA, CO, DC, DE, FL, IA, ID, IL, IN, KS, MD, ME, MO, MT, NM, NV, OK, OR, PA, SC, TN, WA, WV.

[7] See Abowd et al. (2009) and Vilhuber and McKinney (2014) for further details on the LEHD.

the LEHD and other confidential Census data through the Bureau's network of Research Data Centers.

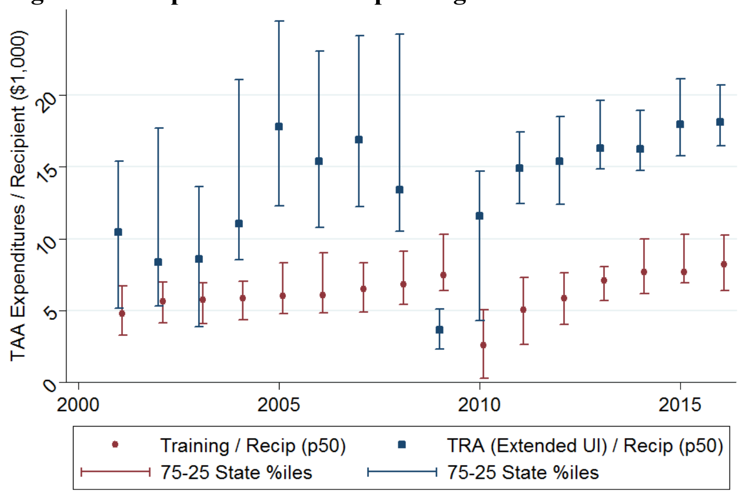
3.3 Heterogeneity and External Validity

Along with our main research design described above in Section 3.1, we will take advantage of variation in program benefits over time to analyze the influence of different policy parameters on worker outcomes. There have been a variety of minor changes to RTAA benefits since its inception in 2002. The most relevant change for our study is the removal of the 26-week re-employment deadline during three distinct periods that correspond to different Trade Act amendments (May 2009–February 2011, October 2011–January 2014, and June 2015–present). We expect that unemployment durations will be shorter when the 26-week deadline is in effect compared to when there is no deadline. By comparing differences in re-employment wages across these two policy regimes, we can determine whether longer re-employment deadlines enable better job matches or distort search incentives. In addition, there was a temporary increase in the maximum wage insurance payment from \$10,000 to \$12,000 (May 2009–February 2011), which can be used to examine how workers' labor market outcomes respond to changes in wage insurance benefits. The precise timing of these policy changes is presented in Appendix Table 1.

Our focus on workers displaced by import competition raises questions about whether the results would generalize to displaced workers in other industries. We leverage several sources of variation to explore the external validity of our results. First, we examine whether the RD estimates are similar across workers displaced from jobs in different sectors. The 2002 program restricted TAA benefits to manufacturing workers, but since 2009 workers in "service" sectors who can demonstrate displacement by international trade have been eligible for both TAA and RTAA. Comparing whether the effects of wage insurance eligibility are similar for these groups provides a way to assess the external validity of a wage insurance program for future displaced workers who work in high value-added services industries, which increasingly compete internationally.

A second potential concern regarding our strategy is that the object of interest—the effect of wage insurance on eligible workers—is estimated with respect to a control group that is also offered retraining incentives. To isolate the effect of wage insurance relative to the alternative of standard unemployment insurance, we make use of the fact that the generosity of investments in unemployment insurance relative to training expenditures varies substantially across states. This can be seen clearly in Figure 2. While TAA training benefits are relatively consistent across states, the generosity of TAA's extended unemployment insurance payments is determined by UI payments in the relevant state. We will use this state-level variation in baseline UI generosity to trace out how the relative impact of wage insurance varies when receiving a benefit package that is more heavily weighted to unemployment insurance (i.e. closer to the baseline of interest) versus retraining incentives. To implement this strategy, we generate RD estimates for subsets of states with different expenditure shares and expenditure levels for each benefit category.

Figure 2. Composition of TAA Spending Across States and Time



Notes: Figure from Hyman (2018), displays median TAA expenditures on training and extended UI (Trade Readjustment Allowances (TRA)), along with their inter-quartile range across states within each year, from DOL Trade Act Participant Report (TAPR), 2001 to 2016.

Our regression discontinuity approach estimates the effect of wage insurance *eligibility* on labor market outcomes for workers around the age-50 cutoff. However, this intent-to-treat (ITT) effect likely understates the treatment effect on the treated (TOT) due to imperfect compliance with wage insurance. To obtain an estimate of the TOT effect, we will use detailed take-up data at the individual level (from the TAPR data described above) matched to worker-level Census data, using wage insurance eligibility as an instrument for take-up, as is common with one-sided attrition models (Angrist and Pischke, 2009).

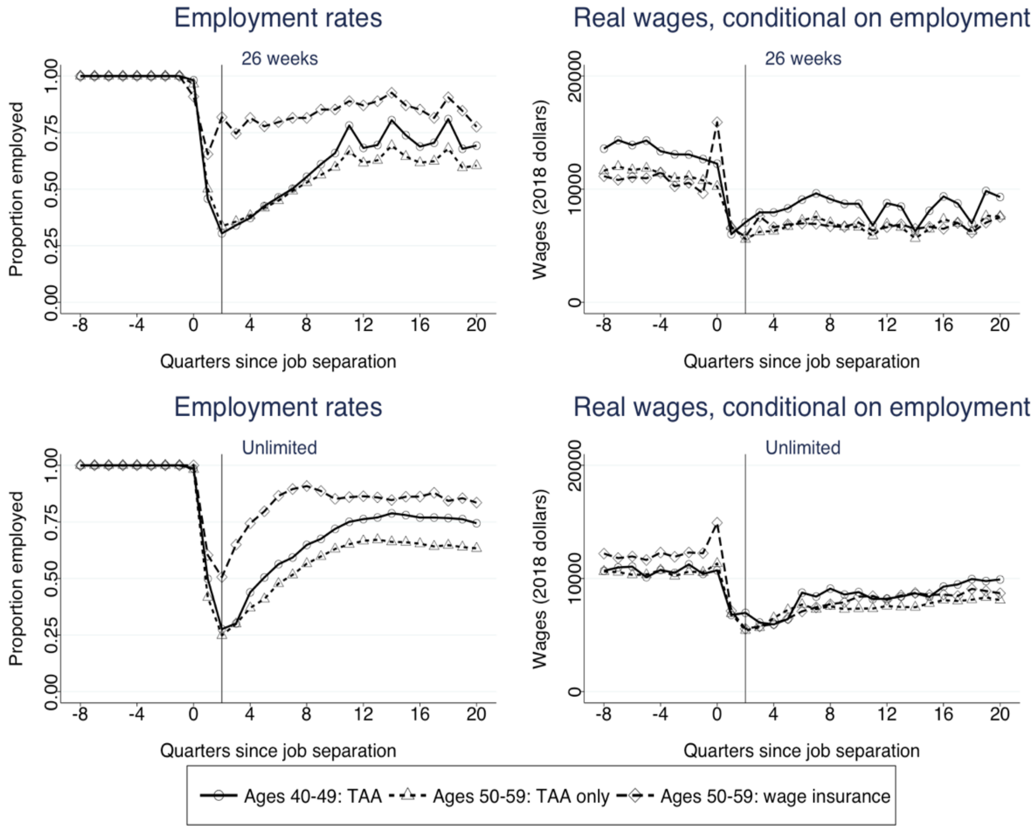
4. Proof of Concept with Virginia Data

We have compiled a database of linked administrative records from Virginia allowing us to validate our research design. We have linked quarterly wage records, UI benefits data, and worker-level administrative records from TAA (TAPR) covering 2008 to 2016. We observe 13,965 TAA recipients in Virginia during this period. Among this group, 810 enrolled in wage insurance (RTAA), which represents about 13 percent of those over age 50.[8]

In spite of its detail, the Virginia database has an important limitation when compared with the data we will use in our main analysis (see Section 3). The Virginia data do not include firm identifiers or TAA petition numbers, so we cannot identify TAA-eligible workers who do not enroll. This limitation introduces a potentially important selection problem, because workers only receive TAA benefits after exhausting the standard 26 weeks of state-funded UI payments. For example, if the most productive 49-year-old workers quickly find jobs after displacement, they will not appear as TAA recipients, and we will fail to observe these high-performing members of the control group. In contrast, 50-year-olds who quickly find reemployment are eligible for wage insurance payments and are therefore more likely to appear in the database. This differential sample selection on either side of the age eligibility cutoff will likely confound the Virginia results, so the findings in this section are merely meant to preview our main study design. Because our main analysis will link the universe of TAA petitions to exhaustive LEHD data, we will observe all TAA-eligible workers irrespective of when they find reemployment or whether they take up TAA benefits, and will avoid this selection problem.

[8] We also have data on Supplemental Nutritional Assistance (SNAP) and Medicaid enrollment for these TAA participants in the Virginia subsample. We will use this additional information to determine whether wage insurance substitutes for these means-tested benefits, generating fiscal externalities.

Figure 3. Event Studies



Notes: Graphs in the first column plot employment rates in each quarter since separation for workers with high labor force attachment. Graphs in the second column plot wages in 2018 dollars among those employed. Graphs in the first row include workers who separate when the 26-week re-employment deadline is in effect; the second row includes workers who separate when there is no re-employment deadline.

We first provide descriptive evidence on the impact of wage insurance on labor market outcomes through a series of event studies. The left column of Figure 3 presents employment rates in each quarter before and after separation for three groups: (i) TAA participants aged 40-49 (ineligible for wage insurance) (ii) TAA participants aged 50-59 who do not enroll in wage insurance, and (iii) wage insurance recipients aged 50-59.[9] We report results separately for periods when wage insurance eligibility was subject to the 26-week re-employment deadline or not.[10] When the re-employment deadline was in effect (top left panel), employment rates for those on wage insurance are 80 percent two quarters after separation, compared to 30 percent for other TAA participants. Without a re-employment deadline (bottom left panel), employment rates are still higher for those receiving wage insurance, but the difference is considerably smaller (50 percent versus 25 percent).

[9] These graphs only include workers classified as having a "High Labor Force Attachment" for comparison to the labor literature. We define these workers as those with at least 8 quarters of positive earnings prior to separation at or above the full-time minimum wage equivalent ($7.25 multiplied by 2,082 average working hours in 2010 equates to roughly $15,000). We observe similar patterns if we include all TAA participants.

[10] Whether a worker is subject to the deadline depends on the firm's petition number. Since the Virginia data lacks petition numbers, we only include observations for which we can uniquely match to one of the policy regimes based on their separation date, zip code, and core-based statistical area (CBSAs). This procedure enables us to identify whether or not the deadline was in place for 62 percent of the sample.

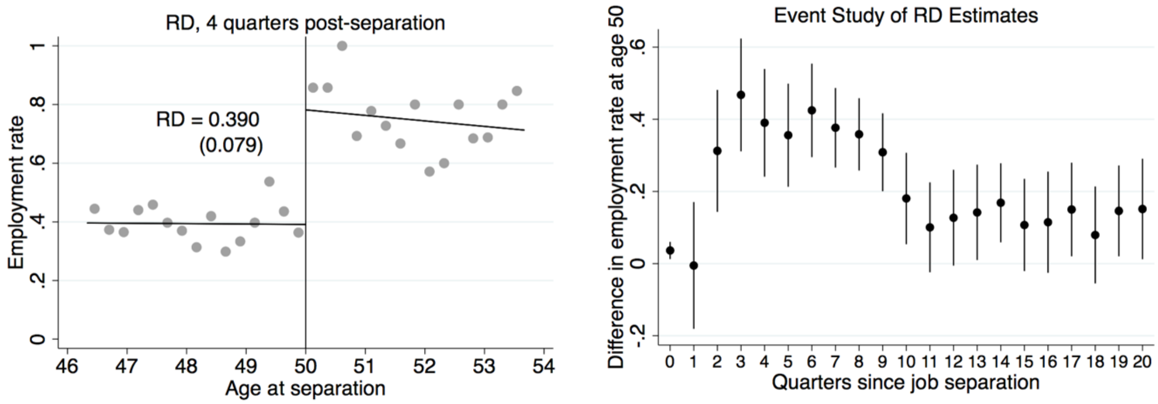
These short-term differences in employment rates may be driven by the fact that participation in standard TAA requires enrollment in training programs, likely depressing short-run employment rates for the younger cohort of TAA recipients. More striking is the fact that the differences in employment rates persist even four years after displacement, long after TAA-funded training has ended. Keeping in mind the sample selection concern just discussed, these results nonetheless strongly suggest an important effect of wage insurance on short- and long-run reemployment rates.

The right column of Figure 3 presents the same type of analysis for quarterly earnings conditional on employment. Earnings are converted to 2018q1 dollars using the all-items CPI (not seasonally-adjusted). The differences in earnings across groups are less pronounced than the differences in employment rates. In general, TAA participants below age 50 have the highest average re-employment earnings. Among those over age 50, post-displacement earnings are similar for wage insurance recipients and standard TAA participants when the re-employment deadline is in effect (top right panel). Without a re-employment deadline (bottom right panel), those on wage insurance initially have lower re-employment wages for the first six quarters, but then have higher earnings starting nine quarters after separation. These results suggest that wage insurance recipients and other workers find job matches that are of similar quality, even when the 26-week reemployment deadline is in place.

While the preceding results are suggestive, they may be confounded by systematic differences in reemployment outcomes for younger (aged 40-49) and older (aged 50-59) workers irrespective of their policy eligibility. The regression discontinuity analysis described in Section 3.1 is specifically designed to avoid this confounding by flexibly comparing outcomes just on either side of the age eligibility cutoff. As an illustration, we present RD estimates for employment rates, comparing wage insurance recipients versus all TAA participants under 50. The left panel of Figure 4 graphically presents the RD results for employment rates in the fourth quarter post-separation, comparing wage insurance recipients to all TAA participants under 50. We pool periods with and without the 26-week re-employment deadline to increase sample size. In implementing equation (1), we use local linear regression, a uniform kernel, and the MSE-optimal bandwidth based on Calonico et al. (2014), which is equal to 3.75 years. There is an estimated 39 percentage point increase in the employment rate one year after separation at age 50. This large and statistically significant estimate is consistent with the summary data presented in Figure 3. We repeat these regressions separately from zero to 20 quarters since displacement, and graphically display the results in the right panel of Figure 4.[11] There is a marked increase in employment rates through the first 10 quarters. Although the magnitudes decrease beyond that point, the employment rate for wage insurance recipients remains over 10 percentage points higher than for TAA recipients below age 50 at displacement.

[11] We use the same bandwidth of 3.75 years in each regression.

Figure 4. Regression Discontinuity of Employment Rates: Wage Insurance versus TAA Under Age 50



Notes: The left graph plots the local linear regression of employment rates 4 quarters after displacement against age at displacement within the MSE-optimal bandwidth of 3.75 years. N = 1,123. The right graph plots the RD estimates and 95 percent confidence intervals for the discontinuity in employment rates at age 50 for each quarter since separation. Each regression uses the same bandwidth of 3.75 years.

We now examine the validity of the RD design using the Virginia data. Keep in in mind that our main analysis will utilize higher quality data without selection concerns, so these results are merely suggestive of the types of analyses we will implement with those data. We first verify that the density of the age distribution is smooth at the cutoff based on the manipulation tests in Frandsen (2017) and Cattaneo et al. (2017). We then examine workers' pre-displacement observable characteristics on either side of the eligibility cutoff, shown in Table 1, and find a few important differences. Those receiving wage insurance are more likely to be male, have longer employer tenure, and earn over $4,000 more per quarter than those under age 50 (equal to one-third of the under-50 group's mean).

Table 1. Covariate Balance Around Age 50

Variable	Point estimate	SE	Mean, Age < 50	N
High school	0.051	(0.093)	0.507	1083
Bachelor's or higher	-0.026	(0.061)	0.113	1083
Tenure with employer (months)	72.468***	(26.544)	136.297	1082
Female	-0.326***	(0.083)	0.392	1103
White	0.005	(0.106)	0.651	1024
Black	0.111	(0.112)	0.325	997
Veteran Status	0.056	(0.052)	0.105	1103
Quarterly wages, 1-year pre-displacement	4052.01***	(1425.33)	12239.93	1103
Δ Quarterly wages, 2-years pre-displacement	439.07	(519.18)	-327.10	1103

*Notes: Presents local linear RD estimates for outcomes prior to displacement. The point estimates reflect the jump in the regression function at age 50. *** p < 0.01.*

Together, these results highlight the kinds of descriptive analyses and causal estimates we will be able to generate using the main dataset described in Section 3. Moreover, our main data are not subject to sample selection concerns and will have much larger sample sizes and far broader geographic coverage.

5. Characterizing the Optimal Design of Wage Insurance

Having evaluated the impacts of the RTAA wage insurance program on worker outcomes, we will turn attention to the optimal design of wage insurance in a simple but general model that can easily be taken to the data. Here we have two goals. The first is to characterize the wage insurance policy that maximizes welfare. The second is to benchmark the current RTAA program's structure relative to this optimal policy.

Two key policy design choices determine welfare outcomes in our setting: (i) the choice of benefit cap b: the maximum monetary benefit amount eligible workers may claim, and (ii) the choice of benefit deadline d: the maximum amount of time a worker may remain unemployed and still receive wage insurance benefits.[12] The social planner's problem involves choosing these two parameters to maximize the consumption smoothing benefits of insurance while minimizing two sources of moral hazard, subject to a government balanced budget constraint.

Toward this end, we first adopt the sufficient statistics formula proposed by Chetty (2006), which builds on the optimal UI framework originally formulated by Baily (1978). To fix ideas, we begin by focusing on the benefit cap in isolation. Chetty's key insight is that for a small change in benefit generosity, the social planner's problem can be simplified using the envelope condition that workers optimally choose effort to maximize expected utility. With concave utility $U(\,)$, the worker is assigned to a high or low employment state with some probability, committing effort e into job search, which is normalized to be proportional to the probability of being in the high state. The worker receives UI benefit level b in the low state, which is paid for by taxing consumption in the high state. This yields the following effect of the benefit level on welfare:

$$\frac{dW(b)}{db} = (1-e)\{U'(c_L(b)) - \left(1+\frac{\epsilon_b}{e}\right)U'(c_H)\} \tag{3}$$

Here, the welfare effect of increasing benefit generosity b is a function of search effort e, consumption in each state (c_L and c_H), and the elasticity of unemployment with respect to UI benefits (ϵ_b), which is either estimated or calibrated. In the context of wage insurance, we use ϵ^{RD}, the elasticity of unemployment with respect to an increase in wage insurance as estimated from the RD design above. We assume for now that workers obtain the full benefit amount, such that $b*$ is the welfare-maximizing wage insurance cap implied by setting $\frac{dW(b)}{db} = 0$:

$$\frac{\mathrm{U}'(c_H)-\mathrm{U}'(c_L)}{\mathrm{U}'(c_H)}(b^*) = \frac{\epsilon_b^{RD}}{e} \tag{4}$$

This is the Baily-Chetty formula, which can be approximated by a Taylor expansion such that the wage insurance cap $b*$ is implicitly defined by state-specific consumption levels, a calibrated risk aversion parameter (γ), and our elasticity estimate (as in Gruber (1997)):

[12] The replacement rate is another relevant parameter, but we focus on the maximum benefit because we observe variation induced by policy changes in this parameter while the replacement rate remains constant. In addition, there is bunching at the maximum benefit in the Virginia data, suggesting that relaxing or tightening this amount would likely have important effects on behavior.

$$\frac{\gamma(C_H - C_L)}{C_L}(b^*) = \frac{\epsilon_b^{RD}}{e} \qquad (5)$$

Comparing the optimal level of $b*$ here with that offered by the program, we learn how well the program is performing in terms of its benefit level offer given potential search disincentives from the offer itself. However, one unique feature of wage insurance is that the social planner also has choice over the deadline d in which workers must voluntarily find full-time work in order to recoup these benefits. To analyze this second choice, we consider the dynamic version of equation (3) presented in Chetty (2008), which produces an analog of the Baily-Chetty formula arising from a search model in the style of Mortenson and Pissarides (1994).

$$\frac{dW(b)}{db} = \frac{p(1-e)}{T+1+pD}\frac{U'(C_U(b))}{V'(C_E)} - \tau'(D_B, T, D, b)$$

Here, the optimal choice of $b*$ is implicitly defined by the share of periods a worker remains unemployed, which itself is a function of the cap. D is the duration of unemployment, D_B is the duration of unemployment while receiving wage insurance benefits, p is the probability of being unemployed in the baseline period, and T is the total number of periods a worker is observed. The functions $U(\,)$ and $V(\,)$ are value functions for workers who are unemployed and employed respectively, and $\tau'(\,)$ is the responsiveness of taxes raised to wage insurance benefits. We can thus analyze jointly the optimal benefit level as a function of various exogenous cap levels, and further compare this to the current design of RTAA.

There are a number of aspects of wage insurance programs that are not considered in the above expressions and that we plan to integrate into the welfare analysis. For example, we have not specified how benefits are indexed to a worker's prior wages. This structure may introduce a new source of moral hazard in which high productivity workers take less demanding jobs because they can "shirk," as part of their lost wages are covered by insurance. As discussed in Shimer and Werning (2007), the elasticity of reservation wages with respect to benefits can also be used as a sufficient statistic to examine the optimality of social insurance. In extensions, we intend to explore the results of modifying the Baily-Chetty framework to accommodate reservation wages. We also plan to consider how the wedge between optimal and current wage insurance compares to the wedge for broader unemployment insurance. Finally, we decompose welfare benefits and costs into those emanating from liquidity effects and search disincentives (following Chetty (2009)), and consider the effects of indexing wage insurance to prior earnings.

6. Intellectual Merit

Recent declines in manufacturing employment are likely to continue in the coming decades as emerging technologies further reshape labor markets. As workers are displaced from existing jobs, it will be increasingly important to devise effective programs to help those workers find and maintain employment. Although the idea of wage insurance has been discussed since at least the early 1980s, there are few empirical studies evaluating its effectiveness in raising workers' earnings and employment rates. To our knowledge, the only prior evaluation of a wage insurance program examined Canada's Earnings Supplement Project (Bloom et al., 1999).[13] This pilot program, conducted from July 1995 to October 1998 in five Canadian cities featured a 75 percent replacement rate up to $250 weekly over a two-year period and required participants find a new job within 26 weeks. The measured effects of wage insurance were modest, but the study had a relatively small sample size and low rates of program take-up among eligible participants. RTAA is a much larger program with national coverage spanning a much longer time period (2002-present). Our empirical analysis will therefore be the first to systematically evaluate the impacts of the largest extant wage insurance program.

There is currently no academic literature analyzing the causal effects of the RTAA wage insurance program on workers.[14] As discussed above, rigorously evaluating this program is particularly challenging because it requires combining administrative data from the TAA program with comprehensive worker-firm data in the Census Bureau's LEHD. Our team brings together scholars with expertise in the areas of labor economics, international trade, and public finance and with experience using TAA program data and confidential Census Bureau data through the network of Research Data Centers (RDCs). We have already received Census Bureau approval for the work proposed here and have received Special Sworn Status, allowing us to access RDC data.

7. Broader Impacts

Although the wage insurance program we study here is available only to workers affected by trade, our findings will have broader implications for workers who lose their jobs due to automation or other competitive forces that characterize the contemporary economy. Automation is widely seen to be a more important force than trade in affecting labor markets over the long-term (see e.g. Miller, 2016), with economically large impacts on wages and employment (Acemoglu and Restrepo, 2017). Various wage insurance schemes have been proposed as potential alternatives to the current US Unemployment Insurance program, but these proposals have been hampered by a lack of evidence on how a large-scale wage insurance program would function in the U.S. context.

Importantly, the majority of proposals recommend a structure identical to RTAA in terms of the replacement rate, benefit duration, and maximum amount, and extended the policy to all workers (Kletzer and Litan, 2001; Brainard et al., 2005; LaLonde, 2007; Burtless, 2007, Litan 2016). A wage insurance system with this exact design appeared in President Obama's 2017 final budget and State of the Union Address. Our results will provide the first systematic evidence on such a program by evaluating the effects of the RTAA wage insurance program. Moreover, the sufficient statistics framework is well suited to evaluate (local) changes to welfare from modifying current design. We expect that our evaluation results and optimal policy analysis will inform policy makers as they pursue novel ways to address the challenges faced by displaced workers in the coming years.

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[13] The UI re-employment bonus experiments in the 1990s (Decker and O'Leary, 1995) offered financial incentives to reduce unemployment durations, but did not otherwise adjust payments based on the difference between pre- and post-displacement earnings, as in the case of wage insurance.

[14] The TAA evaluation conducted jointly by Social Policy Research Associates and Mathematica Policy Research from 2004-2011 did not include a systematic evaluation of the ATAA/RTAA wage insurance program (D'Amico and Schochet, 2012). For research on TAA more broadly, see Baicker and Rehavi (2004), Dolfin and Berk (2010), D'Amico and Schochet (2012), Reynolds and Palatucci (2012), Monarch et al. (2017), Kondo (2018), and Hyman (2018).

Appendix Table 1. Variation in Wage Insurance Benefits by Trade Act Program

	2002 Trade Act	*2009 Recovery Act Expansion of TAA*	*Reversion to 2002 Trade Act*	*2011 Trade Act*	*Reversion to 2002 Trade Act*	*2015 Trade Act*
Dates	*11/04/02 to 05/18/09*	*05/18/09 to 02/14/11*	*02/15/11 to 10/20/11*	*10/21/11 to 01/01/14*	*01/01/14 to 06/29/15*	*06/29/15 to present*
Petition numbers	*50,000 to 69,999*	*70,000 to 79,999*	*80,000 to 80,999*	*81,000 to 84,999*	*85,000 to 89,999*	*90,000 and above*
Wage insurance provisions						
Maximum re-employment salary for eligibility	$50,000	$55,000	$50,000	$50,000	$50,000	$50,000
Replacement rate	50%	50%	50%	50%	50%	50%
Reemployment deadline	26 weeks	Unlimited	26 weeks	Unlimited	26 weeks	Unlimited
Maximum total benefits	$10,000	$12,000	$10,000	$10,000	$10,000	$10,000
TAA training benefits available	No	Yes	No	Yes	No	Yes
Eligible at age (of separation)	50	50	50	50	50	50
Maximum benefit period	2 years	2 years	2 years	2 years	2 years	2 years
Eligible if reemployed in part-time employment in combination with TAA-approved training	No	Yes	No	Yes	No	Yes
Health coverage tax credit (% of insurance premiums)	65%	80%	72.5%	72.5%	65%	72.5%

Notes: This table presents key program benefits by each TAA program based on information collected from the Department of Labor (www.doleta.gov/tradeact/benefits/).