WORKING PAPER 2019:13

Unemployment insurance and wage formation

Mathias von Buxhoeveden

IFAU INSTITUTE FOR EVALUATION OF LABOUR MARKET AND EDUCATION POLICY

The Institute for Evaluation of Labour Market and Education Policy (IFAU) is a research institute under the Swedish Ministry of Employment, situated in Uppsala.

IFAU's objective is to promote, support and carry out scientific evaluations. The assignment includes: the effects of labour market and educational policies, studies of the functioning of the labour market and the labour market effects of social insurance policies. IFAU shall also disseminate its results so that they become accessible to different interested parties in Sweden and abroad.

Papers published in the Working Paper Series should, according to the IFAU policy, have been discussed at seminars held at IFAU and at least one other academic forum, and have been read by one external and one internal referee. They need not, however, have undergone the standard scrutiny for publication in a scientific journal. The purpose of the Working Paper Series is to provide a factual basis for public policy and the public policy discussion.

More information about IFAU and the institute's publications can be found on the website www.ifau.se

ISSN 1651-1166

Unemployment insurance and wage formation[a]

by

Mathias von Buxhoeveden[b]

13th May, 2019

Abstract

Wage setting models typically posit a tight relationship between the generosity of unemployment insurance (UI) and equilibrium wages. This paper estimates the effect of UI on workers' wages. I build on a unique feature of the unemployment policy in Sweden, where workers can opt to buy supplement UI coverage above a minimum mandated level. In January 2007, the government sharply increased the price of UI, and the share of workers with supplement coverage fell from 90% to 80%. I exploit variation in the price of UI across industries to measure the effect of industry level UI-coverage on wages. My estimates suggest that a 10 percentage point reduction in the share of workers covered by supplement UI reduce wages by 5%. Since I rely on variation in UI-coverage at the industry level, these estimates contain wage adjustments from collective and individual level bargaining. Finally, I use the estimated UI-wage effect to derive bounds on worker bargaining power in a simple DMP model and find that it can be at most 0.12. This evidence support wage setting mechanisms that tie wages to the generosity of UI.

JEL-codes: J65, J31

[a] I would like to thank Björn Öckert, Johan Vikström, Kurt Mitman, Erik Öberg, Oskar Nordström Skans, Peter Fredriksson, Mikael Carlsson, Nils Gottfries, seminar audiences at Uppsala University, IFAU, Uppsala Labor Economics Workshop, UCLS and the Swedish Ministry of Finance. I gratefully acknowledge generous financial support from Forte.

[b] IFAU, mathias.vonbuxhoeveden@nek.uu.se

Table of contents

1 Introduction

The Great Recession displaced 25 million workers around the world (ILO, 2012). In the United States, unemployment insurance (UI) benefit duration was extended from the usual 26 weeks to as long as 99 weeks. The policy response was controversial. Barro (2010) raised concerns that UI discourages job search, and that this could have contributed to the slow recovery. Others emphasized the potential stimulus effect of UI benefits (Summers, 2010).

Despite a long literature on the impact of UI on individual-level job search behaviour,[1] there is limited evidence on the macroeconomic effects of UI-policies. The reason for this is simple. Economic theory does not provide a one-to-one mapping between the micro-economic effect of UI and aggregated unemployment. For instance, large microeconomic effects could be consistent with small macroeconomic effects, if benefit extensions decrease job finding rates among UI recipients, but increase jobfinding among non-recipients (Lalive et al., 2015; Levine, 1993). Alternatively, in the standard DMP model (Mortensen and Pissarides, 1994) with exogenous search effort, a benefits extension improves workers' outside option, puts upward pressure on wages and this depresses vacancy creation. Exogenous search effort implies a zero microeconomic effect of UI, but the decline in vacancy creation leads to a rise in aggregated unemployment.

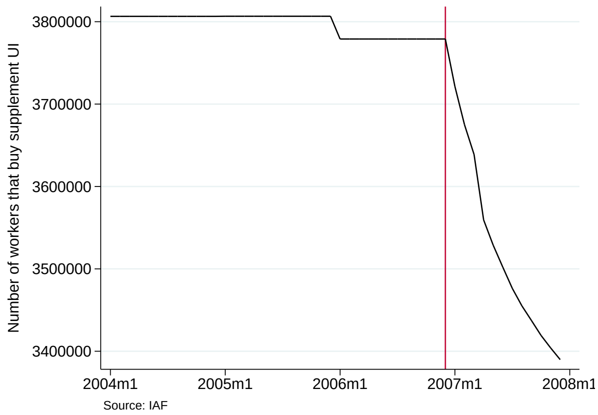
Therefore, the UI-wage-pressure channel is crucial for a complete evaluation of the macroeconomic effects of UI, and the sensitivity of wages to changes in UI has important implications for the design of UI-policy and for economists' understanding of wage formation.[2]

In this paper, I estimate the effect of industry level UI-coverage on wages. I focus on UI-coverage at the industry level for institutional reasons. Sweden, like other northern European countries, has very strong unions that play a major role in wage determination.

[1] See for example Caliendo et al. (2013); Card et al. (2007); Card and Levine (2000); Carling et al. (2001); Van Ours and Vodopivec (2008); Nekoei and Weber (2015); Lalive (2007)

[2] Conventional wage-setting protocols typically posit a tight relationship between the generosity of UI and equilibrium wages. See for instance the literature on "efficiency wages" (Krueger and Summers, 1988; Weiss, 2014; Katz, 1986; Akerlof and Yellen, 1990; Shapiro and Stiglitz, 1984) and union bargaining models (Calmfors and Driffill, 1988; MaCurdy and Pencavel, 1986; McDonald and Solow, 1981; Nickell, 1982; Ulph, 1982; Brown and Ashenfelter, 1986)

Figure 1: Number of workers with supplement UI over time



Furthermore, unions are tied to industries, which implies that variation in UI-coverage at the industry level will capture wage adjustments that occur through collective *and* individual-level bargaining.

The identifying variation is derived from a unique feature of the Swedish UI system. *All* workers are entitled to a minimum level of UI but can opt to buy supplemental coverage through UI-funds. In January 2007, the newly elected right-wing government sharply increased the price of supplement UI. As visible in *Figure 1*, this lead to a significant decline in the take-up rate of supplement UI. In 2007, approximately 380,000 workers opted out of the UI system. Importantly, the sharp decline in UI-coverage coincided with a period when 85% of wage-agreements expired and were subject to renegotiations.

To estimate the effect of industry level UI-coverage on wages, I exploit an institutional feature of the premia hike. In addition to a general increase, the reform introduced a fee that tied the premium in each UI fund to the average unemployment rate in that fund. Furthermore, any given UI fund will typically provide insurance to workers from several different industries. Therefore, the premia for supplement UI workers in any given industry face is partly determined by the unemployment rate in other industries that buy UI from the same fund. I use this part of the premia increase as an instrument for changes in industry level UI-coverage.

Table 1 illustrates the approach with two industries. Both had unemployment rates of 2% in 2006. Still, the yearly premium for supplement UI was 60 USD higher for workers in the saw milling industry. This is because they share UI funds with industries that have higher unemployment rates. Furthermore, the additional cost of UI was associated with a sharper decline in UI-coverage and weaker growth in wages.[3] My instrumental variable approach amounts to asking whether this pattern generalizes to a larger sample.

Table 1: IV example

Industry	Unemployment rate, 2006	UI premium, 2007
Saw milling	2%	540 USD
Electricity components	2%	480 USD

I begin the analysis by simply relating wage growth to changes in industry level UI-coverage using a difference-in-difference (DID) approach. I find that wage growth declines significantly in industries where a larger share of workers opt out of UI. Quantitatively, the results suggest that a 10 percentage point reduction in industry level UI-coverage reduce wages by 1 percent.

To bolster confidence in the results, I exploit the entire pre-treatment period (2002-2006) and conduct a series of placebo exercises which verify that there were no significant differences in wage growth prior to the reform. Although encouraging, this analysis is not completely satisfactory since the choice to opt out of UI is most likely endogenous. In particular, the choice to leave UI should be related to factors such as perceived displacement risk.

To address this concern, I instrument changes in industry level UI-coverage with the part of the UI premia that stems from other industries' unemployment. The point estimates suggest that a 10 percentage point decrease in industry level UI-coverage reduce wages by 5 percent.

The differential decline in industry level UI-coverage steams from additional, plausibly exogenous, sources. For instance, workers who hold part-time employment are

[3] UI coverage in the saw milling and electrical component industry fell by 8 and 4 percentage points respectively. Furthermore, monthly wages in the electricity component industry rose by an additional percent between 2006 and 2007.

particularly sensitive to changes in the price of UI (IAF, 2007, 2008). These workers are not spread out uniformly across industries. Therefore, the general increase in the price of UI will also have different implications for the take-up rate of UI across industries. In a second step, I exploit this using an IV approach. Here, I instrument changes in industry level UI-coverage with the share of workers that held part-time employment the year prior to the reform. Quantitatively, the point estimates are very similar to the IV-strategy that relies on the UI-premia differentiation, but there are large gains in precision.

In the final part of the paper, I augment the empirical analysis by interpreting the results through the lens of a simple DMP model (Diamond, 1982; Mortensen and Pissarides, 1994). Here, I use the estimated UI wage effect to derive informative bounds on worker bargaining power. My approach starts from the observation that shifts in the UI benefit level pass through into wages by one minus workers' bargaining power, such that wages are more sensitive to changes in UI if workers have low bargaining power. The initial increase in wages is partly offset by a reduction in labor market tightness since an increase in UI benefits puts upward pressure on wages, reduce vacancy creation and depresses workers' outside option.[4] The quantitative magnitude of this effect is unknown but theory restricts the sign to be non-positive. I derive bounds on worker bargaining power by considering the logical extremes where this effect is either zero or arbitrarily large. Using this strategy, I find that worker bargaining power can be at most 0.12.

Previous research on the general equilibrium effects of UI has followed two lines of inquiry. There is a large literature based on the estimation of structural models derived from Mortensen and Pissarides (1994)[5]. There is also a new line of research that employs microeconometric methods to estimate the macroeconomic effects of UI. Almost all of the available evidence relies on variation in the potential duration of UI across states in the U.S, following the Great Recession. For instance, Hagedorn et al. (2013) employ a border discontinuity design, and compare macroeconomic outcomes in neighbouring counties, separated by a state border.[6] They find that benefit extensions raise wages, lead

[4]Labor market tightness is defined as the number of vacancies divided by the number of unemployed workers.
[5]See for example Millard and Mortensen (1997); Shi and Wen (1999); Krause and Uhlig (2012).
[6]This paper is controversial, and the credibility of their research design has been challenged by Amaral et al. (2014); Boone et al. (2016); Dieterle et al. (2016).

to a contraction in vacancy creation and a rise in unemployment. However, recent work by Marinescu (2017) and Chodorow-Reich and Karabarbounis (2016) challenge these findings by documenting small effects of UI on wages and aggregated unemployment.

It is worth pointing out that changes in UI benefit entitlement may not get passed into wages in the U.S. for institutional reasons. First, conditional on separation, the take-up rate of UI is low compared to other OECD countries. Hence, UI is not a part of the non-employment scenario for many workers. Second, those who quit their jobs without a valid reason are not eligible for UI, which implies that more generous UI benefits does not necessarily shift workers' threat point in wage bargaining. Theoretically, both of these mechanisms could explain a low elasticity of wages with respect to UI, even if non-employment is the relevant outside option in wage bargaining.

However, Schoefer et al. (2018) study the effect of UI on wages using four reforms of the Austrian UI system. Workers in Austria are always eligible for UI if they quit, and the take-up rate of UI conditional on separation is high. Hence, UI should be a part of the non-employment scenario for most workers. They still find that wages are insensitive to changes in UI. Schoefer et al. (2018) argue that this presents a puzzle to conventional wage setting models, and that non-employment may not constitute the relevant threat point in wage bargaining.

A possible explanation for these results is that union-affiliation does not map one-to-one with any particular part of the earnings distribution. This implies that the treatment does not vary at a level that can capture wage-adjustments that occur through collective bargaining. I rely on variation in UI-entitlement at the industry-level, where collective bargaining occurs, which could potentially explain why I find that wages are sensitive to changes in UI.

The rest of this paper is organized as follows. In the next section, I introduce a simple DMP model, which clarifies the economic mechanisms at work and facilitates interpretation of the empirical results. Section 3 describes the institutional context and the UI premia increase that took place in 2007. Section 4 presents the data sources and perform some descriptive analyses. After this initial analysis, section 5 proceeds and exploits the premia increase to estimate the impact of UI benefits on wages using a difference-in-difference *and* an IV strategy. Section 6 interprets the empirical results through the lens of my theoretical framework. Section 7 concludes.

2 Theoretical framework

This section introduces a simple version of the Diamond-Mortensen-Pissarides (DMP) model, and discusses some theoretical predictions of the UI wage effect. This is an equilibrium search model where wages are determined through Nash bargaining between firms and workers.

The transmission of UI policy into equilibrium wages is determined by worker bargaining power (γ) and the responsiveness of labor market tightness, (θ), to changes in UI policy, where θ is defined as the number of vacancies divided by the number of unemployed workers. In section 6, I will use my empirical results to derive informative bounds on γ.

My point of departure is an economy populated by infinitely lived workers who are either employed or unemployed. Each firm employs at most one worker, and employed workers produce an instantaneous flow of output, y. The job separation rate, σ, is taken as exogenous. The worker value functions can be written as:

$$rW = w + \sigma(U - W) \tag{1}$$

$$rU = b + \lambda_u(\theta)(W - U). \tag{2}$$

Where rW and rU corresponds to the flow value workers obtain in employment and unemployment respectively. The value of employment consists of two parts: (i) the wage, w and (ii) the job separation rate times the loss from becoming unemployed relative to staying employed.

Similarly, the value of unemployment consists of (i) the current flow of UI benefits, b, and (ii) the job finding rate, λ_u, times the gain from finding employment over staying unemployed.

The firm value functions are given by:

$$rJ = y - w + \sigma(V - J) \tag{3}$$

$$rV = -c + \lambda_v(\theta)(J - V). \tag{4}$$

Where, rJ and rV are the flow values of a filled and an unfilled vacancy respectively. Similarly, the value of a filled vacancy consists of (i) the flow of output minus the wage and (ii) the job separation rate times the loss of an unfilled relative to a filled vacancy. The value of an unfilled vacancy consist of (i) the vacancy positing cost, c, and (ii) the job-filling rate times the gain from a filled relative to an unfilled vacancy.

The standard assumption in the DMP model is that wages are determined through Nash bargaining. Formally, when workers and firms meet, they bargain over wages such that:

$$w = \arg\max_{w} (W(w) - U)^{\gamma} \times (J(w) - V)^{1-\gamma}. \tag{5}$$

Hence, workers and firm bargain over the wage, with bargaining weights γ, (1 - γ). The first order condition from equation (5) combined with free entry ($V = 0$), produce the wage curve:

$$w = (1-\gamma)b + \gamma(y + c\theta). \tag{6}$$

Where w is the equilibrium wage. Hence, the model predicts a simple linear relationship between a change in the benefit level (db) and the change in the equilibrium wage (dw):

$$dw = (1-\gamma)db + \gamma c \frac{\partial \theta}{\partial b} db. \tag{7}$$

Equation 7 can be understood as follows. An increase in the UI benefit level (b) improves workers' outside option, and this exerts upward pressure on equilibrium wages. The transmission of changes in the outside option into equilibrium wages is determined by the term $(1-\gamma)$.

Moreover, when wages increase, firms receive smaller profits from filled jobs. This depresses vacancy creation and reduce the value of unemployment, since finding new job becomes more difficult. Hence, workers' outside option become less attractive and this counteracts some of the initial increase in equilibrium wages. This is reflected in the second term in equation 7, which is negative since $\frac{\partial \theta}{\partial b} \leq 0$. Thus, the net effect of UI on wages cannot be theoretically determined.

3 Institutional context

This section reviews the institutional details of unemployment insurance and wage setting in Sweden, and the reform that I study.

Unemployment insurance

The UI system in Sweden consists of two parts. The first part is mandated and provides basic coverage to *all* workers. The benefit level under the basic plan is low and unrelated to pre-displacement earnings. Between 2005 and 2007, unemployed workers covered by the basic plan received a daily allowance of 320 SEK ($\approx$ 35 USD).[7] To get a sense of the magnitude, this corresponds to a replacement rate of approximately 20% for the median wage earner.

The second part of the UI system is voluntary. In particular, workers can opt for comprehensive UI coverage by paying a monthly premium to UI funds. Workers are free to opt in and out of comprehensive UI at any time, but need to have paid the premium for at least 12 consecutive months to be eligible for comprehensive UI. Moreover, to qualify for either insurance plan, workers have to fulfil a labor market attachment criterion. During the past 12 months prior to displacement, workers need to have had at least a part-time job for 6 months.

Comprehensive UI replaces 80% of pre-unemployment earnings up to a cap. In 2007, the daily allowance was capped at 680 SEK ($\approx$ 75 USD). Moreover, the ceiling is fairly low, and approximately 70% of *unemployed* workers have pre-unemployment earnings above the ceiling. Still, the UI benefit level for most workers is more than twice as high if they are covered by comprehensive UI. The benefit level is the only difference between

[7]Benefits are paid out 5 days per week, which means that 320 SEK per day translated into a monthly income of 6400 SEK ($\approx$ 700 USD).

the insurance plans.[8] Benefit duration was capped at 300 days in 2007.

The voluntary part of the UI system is administrated through several UI funds. In 2007, there were 36 UI funds, tied to different industries/occupations.[9] For instance, there is one UI fund restricted to those who are employed in the teaching profession.

The government heavily subsidizes the UI funds, and more than 90% of their expenditures on UI are covered by subsidies from the state. Furthermore, the generosity of UI and the monthly insurance premium are entirely determined by government policy.

The 2007 reform

Following the September 2006 general election, the Social Democratic government was ousted and replaced by the right-wing coalition. The Swedish parliament subsequently decided to sharply increase the premium for UI fund membership, a decision taken on December 21, 2006.

This was achieved by introducing an additional fee that the UI funds had to pay to the government each month. The fee was determined through a formula written into UI law. In addition to a general increase, UI funds with higher expenditures on benefits had to pay a larger fee to the government each month. The motivation behind the reform was partly to make UI actuarially fair, and to incentivise the UI funds to tighten monitoring of benefit recipients. The reform was implemented on January 1, 2007, and all UI funds immediately decided to sharply increase their membership premiums.

As visible in *Figure 2*, the average monthly premia rose from around 100 SEK to 320 SEK. The surge in pricing also lead to a sharp decline in the take up rate of supplement UI. In 2007, the share of workers covered by comprehensive UI was reduced from 90% to 80%.[10]

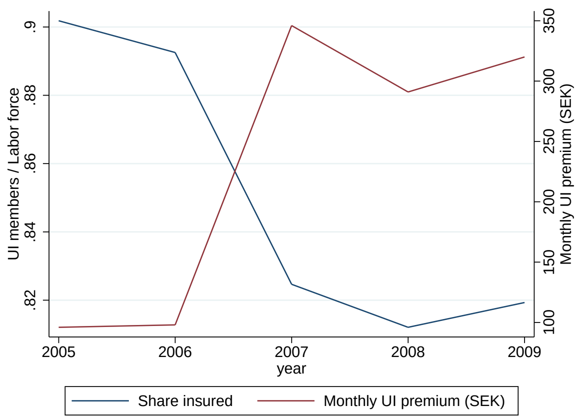
---

[8] The replacement rate under comprehensive UI is reduced from 80% to 70% after 200 days of unemployment. However, this will only affect the UI benefit level for workers who have pre-displacement earnings *below* the cap. The benefit ceiling is however binding for most workers so I will ignore this feature of the UI system.

[9] There is also one UI fund called "Alfa kassan" that provide coverage to *all* workers, regardless of which industry they are employed in.

[10] The reform also lead to a significant decline the share of unionized workers. This is because some unions demand that their members buy supplement UI. However, the reduction in UI-coverage was much more significant. In 2007, 380,000 workers opted out of supplement UI, but only 180,000 terminated their union membership (Kjellberg, 2009). I will therefore focus on the decline in UI-coverage.

Figure 2: Monthly UI fund premium and the take-up rate of supplement UI



Wage setting

Sweden is heavily unionized and almost all workers (91%) are covered by collective bargaining agreements. These take place at the sectoral (or occupational) level and typically impose lower bounds on workers' wages. Bargaining occurs at three levels. First, unions and employer organizations set the frame for wage formation through central agreements. Once negotiations at the central level are complete, bargaining at the local (establishment) level occurs. Here, the local union and firm representatives curtail the central agreement to the establishment level. Finally, wages at the individual level are set in negations between the manager and the worker.

In 2007, an unusually large number of central agreements expired and were subject to renegotiations (Medlingsinstitutet, 2007). This was the largest round of revisions since 1993, and the majority of unions and employer organizations signed new agreements. Negotiations at the central level were initiated in spring 2007.

The impact of the premia hike on the take-up rate of supplement UI was immediate. By February 2007, more than 100,000 workers had already opted out of supplement UI. Hence, the sharp decline in the take-up rate of supplement UI coincided with a period when wages were fairly flexible.

Moreover, the wage data used in this paper is collected by Statistics Sweden during the fall each year. The timing of measurement is explicitly motivated by the desire to include new wage-agreements. Hence, there should be plenty of time for any potential wage adjustments to occur before the data was collected.

4 Data sources and descriptive statistics

In this section, I introduce the data sources used in the empirical analysis, describe the construction of the cost of comprehensive UI variable and provide basic descriptive statistics.

Data

This paper uses data from several Swedish administrative registries. The first registry contains UI fund membership information for the entire population (ages 16 - 64) between 2005 - 2009. This data was compiled by Statistics Sweden using the UI funds membership registries. The dataset contains indicators for if the individuals are buying supplement UI as of December each year.

The UI fund membership data are combined with survey data on wages and industry of occupation from Statistics Sweden's wage statistics. The survey is conducted annually during the fall and covers all workers in the public sector and larger private firms, as well as a random sample of workers in small firms (altogether, approximately 50% of private sector workers are covered). Moreover, wages are recorded as monthly full-time equivalent wages and are not derived from some measure of earnings and hours worked.

The industry classification codes were used to divide the labor market into industries. The codes consist of 5 digits and indicates at an increasingly detailed level (2 digits being the least and 5 the most detailed) the type of industry in which an individual is employed. I used the first 3 digits to divide the labor market into industries.

My empirical analysis focuses on the UI-premia hike that was implemented in 2007. The industry classification codes used by Statistics Sweden at the time were introduced in 2002, which therefore defines the starting point for my sample. To avoid potentially confounding effects of the Great Recession, I end the sample in 2007. The sample is further restricted to one employment spell per worker each year. If an individual had several employment spells in a given year, I restrict attention to the spell with the highest wage. Furthermore, some industries are very small and are not observed in the wage statistics every year. I exclude these and restrict the sample to industries which employed at least 500 workers in 2002, and were observed every year between 2002 and 2007.

The instrumental variable approach exploits the differential increase in the premia for supplement UI. Unfortunately, the UI-fund membership data only reveals if an individual buys supplement UI, but not from *which* UI fund. To link industries to UI-funds, I add data on unemployment from the Swedish public employment office. It covers the universe of unemployment spells between 1990 and 2015. This data is combined with the registry ASTAT, which contains detailed information on the universe of UI benefit spells from 1999 onwards. Importantly, ASTAT ties *all* payments to UI funds.

To link industries to UI funds, I combine the wage survey from 2005 with unemployment outcomes from 2006.[11] Specifically, I link workers who became displaced in 2006 to the industries they were employed in 2005. I then use the empirical distribution of payments from different UI funds to estimate the share of workers in an industry that buy insurance from a particular fund.[12]

Information about the monthly premia each UI fund charge from 2004 onwards are publicly available on the IAF's web page. I downloaded these and computed the average monthly premia in 2007. These were then combined with the estimates of the share of workers in each industry that buy supplement UI from a particular fund to construct an estimate of the cost of insurance for each industry in 2007.[13]

I further define industry level unemployment in year t as the share of workers employed in the industry in year t - 1, who were unemployed in year t. I complement this data with an additional population wide registry Louise, which contains information about earnings and background characteristics such as educational attainment.

Before turning to the main empirical analysis, I briefly analyse the characteristics of

[11] I define an unemployment spell as en episode that starts with "open" unemployment, during which the individual claim income related UI benefits.

[12] Let n_j denote the number of workers who were employed in industry j in 2005, and who became unemployed in 2006. Moreover, let f_j denote the number of unemployed workers from industry j, who claimed UI benefits from fund f. I then compute the fraction $x_{jf} = \frac{f_j}{n_j}$, and assume that x_{jf} represents the share of workers from industry j who buys insurance from fund f.

[13] Let p_f denote the average monthly premia charged by UI fund f in 2007. Let c_j denote the cost of insurance for industry j in 2007. We then have that $c_j = \sum_{f=1}^{36} x_{jf} * p_f$. Recall that there were 36 UI funds in January, 2007.

those who left supplementary UI as a response to the premia increase. *Figure A1* and *Figure A2* in the appendix show that workers above 60 years of age and those who held part-time employment opt out of UI to a much greater extent. There are several reasons for this. Older workers have typically attained high job tenure and are subsequently unlikely to be displaced. In addition, UI fund memberships are automatically dissolved once the workers turn 65 and become eligible for retirement benefits. Hence, it is unlikely that older workers will ever claim UI benefits.

Recall from section 3 that workers have to fulfill a labor market attachment criterion to qualify for any type of UI. Part-time workers are at the boundary for fulfilling this criterion. Hence, if they work slightly less for a few months and then become displaced, they will fail to fulfil the labor market attachment criterion and will not qualify for supplement UI, even if they are members of a UI fund. In addition, part-time workers have low earnings. Any given UI-premia increase will therefore constitute a large share of their total income. For these two reasons, one would expected part-time workers to be more sensitive to changes in the price of UI.

Furthermore, Landais et al. (2017) use the same reform and document that displacement risk is a strong predictor of UI choices. In particular, workers with a higher risk of unemployment are more likely to stay in the UI system after the premia hike.

Altogether, this suggests that UI-coverage should decline more in industries that employ a greater share of workers close to retirement, have low displacement risk and employ a large share of part-time workers.[14]

Appendix *Table A1* shows the cross-industry relationship between the decline in UI-coverage between 2006-2007 and a variety of industry-level characteristics.[15] There is a strong positive correlation between the decline in UI-coverage and the price of supplement UI in 2007, the share of workers that are close to retirement and the share of part-time

[14]Following the sharp decline in UI-coverage, the government mandated the Swedish Unemployment Insurance Board (IAF) to investigate the effect of the premia increase. These reports (IAF, 2007, 2008) also show that those who opt out were primarily older workers, individual that work part-time and those who have low unemployment risk. In addition, there was a group of workers that simply thought UI became to expensive after the reform.

[15]The wage data is collected by Statistics Sweden through 5 different surveys. I always control for the share of observation in each industry that comes from each survey.

workers. In particular, the share of part-time employment seams to be a much stronger predictor of the decline in UI-coverage compared to the share of workers that are above 60 years of age.

Table 2 collects some additional descriptive statistics of the available sample.[16] The table reports the mean and standard deviation of selected covariates for the three groups in 2005, 2006 and 2007. I focus on this period because the UI-fund-membership data starts in 2005.

Industries with a larger decline in UI-coverage employ slightly older workers who earn relatively low wages. UI coverage prior to the reform was also lower in those industries. However, educational attainment does not vary systemically across industries with small, medium and large changes in UI-coverage. Also, note that UI-coverage is almost unaffected in industries with low reductions, while UI-coverage decline by more than 10% in the most affected industries.

[16] The industries have been divided into three groups with a large, medium and small reduction in UI-coverage between 2006 - 2007, corresponding to below 3, between and 3 and 5.4 and above 5.4 percentage points. The thresholds were set so that 33% of the industries experienced a change in UI-coverage that was classified as "small", "medium" and "large" respectively.

Table 2: Characteristics of industries with small, medium and large reduction in UI-coverage.

	2005				2006				2007			
	All	Large	Medium	Small	All	Large	Medium	Small	All	Large	Medium	Small
Share who buy UI insurance	0.905	0.885	0.922	0.956	0.895	0.875	0.912	0.950	0.827	0.788	0.864	0.927
	(0.293)	(0.319)	(0.269)	(0.205)	(0.306)	(0.331)	(0.283)	(0.219)	(0.378)	(0.409)	(0.343)	(0.259)
Age	43.16	43.38	43.11	42.25	43.18	43.40	43.16	42.25	43.23	43.34	43.40	42.33
	(11.88)	(12.16)	(11.58)	(11.23)	(12.01)	(12.30)	(11.71)	(11.31)	(12.08)	(12.42)	(11.66)	(11.33)
Log monthly wage	10.05	10.03	10.06	10.16	10.08	10.06	10.09	10.19	10.11	10.08	10.13	10.22
	(0.298)	(0.274)	(0.327)	(0.312)	(0.300)	(0.276)	(0.330)	(0.310)	(0.305)	(0.280)	(0.338)	(0.306)
Years of schooling	13.18	13.27	13.34	12.41	13.24	13.34	13.38	12.48	13.30	13.39	13.46	12.54
	(2.813)	(2.851)	(2.758)	(2.637)	(2.803)	(2.840)	(2.747)	(2.631)	(2.794)	(2.826)	(2.747)	(2.623)

Mean and standard deviation of selected covariates.

5 The impact of UI benefits on wages

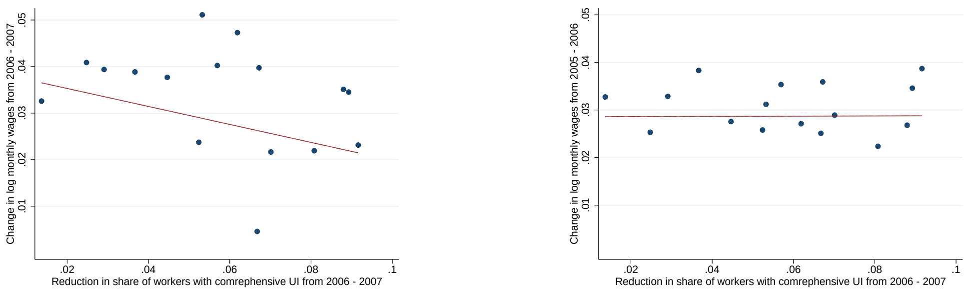
In this section, I present the main empirical results on the impact of industry-level UI coverage on equilibrium wages. I begin by presenting a transparent difference-in-differences design, that exploits the differential impact of the premia hike in 2007 on the take-up rate of supplement UI. I complement the analysis with a series of placebo exercises to test the "common trends" assumption in the pre-reform period. I argue that any potential bias associated with the difference-in-difference design should lead to an underestimation of the true UI wage effect. The final subsection attempts address the downward bias using an IV-approach.

Difference-in-Difference estimates

Figure 3 presents plots of the change in wages against the reduction in industry level UI-coverage. The industries have been grouped into 17 equally sized bins, based on the decline in industry level UI-coverage following the 2007 premia reform.

There is a clear negative association between wage growth and the reduction in industry level UI-coverage. Furthermore, the right-hand side panel in *Figure 3* plots the growth in wages between 2005 - 2006 against the change in UI-coverage between 2006 - 2007. There are no signs of differential trends prior to the reform.

Figure 3: Changes in UI-coverage and wage growth



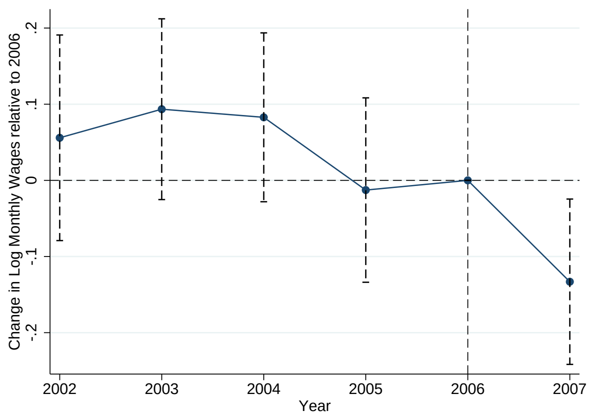
Although suggestive, the results in *Figure 3* do not entail any formal tests for statistical significance. To investigate this further, I pool data from 2002 - 2007 and estimate the following regression model:

$$y_{ist} = \delta_s + \alpha_1 t_{2002} + ... + \alpha_5 t_{2007} + X'_{ist}\beta_t + \phi_1 t_{2002} d_s + ... + \phi_5 t_{2007} d_s + \varepsilon_{ist} \qquad (8)$$

Where y_{ist} is the log monthly wage of workers i, employed in industry s in year t, δ_s is an industry-level fixed effect, $t_{2002}, ..., t_{2007}$ are year fixed effects, X_{ist} denotes individual-level controls for age, gender, and education, interacted with the year fixed effects. d_s is the reduction in the share of workers covered by supplement UI in industry s between 2006 - 2007.[17] The coefficients of interest are $\phi_1, ..., \phi_5$. These interaction terms measure whether industries with a larger decline in UI-coverage between 2006 and 2007 experienced weaker wage growth, and if there is any evidence of diverging wage trends in the pre-reform period. I omit year 2006 so that the interaction terms measures differences in wage growth relative to the year prior to the reform.

Figure 4 plots the point estimates together with 95% confidence intervals from the baseline specification without covariates. Standard errors are clustered at the industry level.

Figure 4: Difference-in-Differences estimates of the impact of UI-coverage on wages.



The figure shows that wage growth declines significantly in industries that experienced a sharper reduction in UI-coverage. Moreover, there is no evidence of diverging trends

[17] $d_s = \frac{I_{s,2006}}{N_{s,2006}} - \frac{I_{s,2007}}{N_{s,2007}}$, where $I_{s,2006}$ and $I_{s,2007}$ are the number of workers in industry s covered by supplement UI in 2006 and 2007 respectively. $N_{s,2006}$ and $N_{s,2007}$ are the total number of workers employed in industry s in 2006 and 2007 respectively.

in the pre-treatment period. Importantly, *Figure 4* shows that, if anything, industries that experienced a sharper decline in UI-coverage had *stronger* wage growth prior to the reform.

Note that the pre-treatment years include a period of increasing (2002 - 2005) and decreasing (2005 - 2006) unemployment (see appendix *Figure A3*). Still, there were no significant differences in wage growth at any point during the pre-treatment period. This suggest that aggregated macroeconomic conditions exert the same effect on wage growth across industries. Moreover, the unemployment rate was smoothly decreasing when the UI-premia reform was implemented. Hence, it is unlikely that the difference-in-difference estimates are confounded by changes in macroeconomic conditions.

Table 3 presents the results from specification (8). The first column represents the most parsimonious specification without controls. In column 2, I add individual-level controls for age, gender and education. Column (3) and (4) show that the results are robust to excluding workers above 60 years of age. This is important since those who are above 60 opt out of UI to a much greater extent. Moreover, as workers start to approach retirement, labor supply and subsequent wages could potentially start to stagnate. Column (3) and (4) show that this does not drive the results. Quantitatively, the results suggest that a 10 percentage point reduction in industry level UI-coverage reduces wages by around 1.3 percent.

Although encouraging, this analysis is not completely satisfactory since opting out of UI *is* a choice. Moreover, this decision should clearly depend on factors such as perceived displacement risk. Lay-off risks should therefore, on average, be lower in industries where a greater share of workers opted out of comprehensive UI. Moreover, the unemployment risk will typically be lower in sectors of the economy that are booming. Hence, industries where a greater share of workers opted out of supplement UI should, if anything, have experienced *stronger* wage growth in the absence of the reform. Moreover, the placebo checks supports this conjunction since industries most effected by the reform experienced slightly stronger, but not statistically significant, growth in wages during the pre-treatment period. Altogether this suggests that the difference-in-difference estimates should be interpreted as a lower bound on the true UI-wage effect.

Table 3: Difference-in-difference estimates of the impact of UI-coverage on wages

VARIABLES	(1)	(2)	(3)	(4)
Reduction in share with UI*2002	0.056	0.024	0.068	0.023
	(0.069)	(0.053)	(0.071)	(0.054)
Reduction in share with UI*2003	0.093	0.065	0.105	0.066
	(0.061)	(0.065)	(0.064)	(0.068)
Reduction in share with UI*2004	0.083	0.053	0.096	0.058
	(0.057)	(0.055)	(0.058)	(0.058)
Reduction in share with UI*2005	-0.013	-0.019	-0.008	-0.017
	(0.062)	(0.060)	(0.063)	(0.062)
Reduction in share with UI*2007	-0.133**	-0.078*	-0.140**	-0.080*
	(0.055)	(0.046)	(0.056)	(0.046)
Observations	13,198,919	13,147,594	12,381,284	12,341,938
Clustered standard errors	✓	✓	✓	✓
Controls		✓		✓
Excludes workers above 60			✓	✓

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: Standard errors (in parentheses) accounts for clustering at the industry level. The vector of controls include gender, age and educational dummies (primary school, high school and more than high school).

Instrumental variable estimates

To break the potential endogeneity of UI-coverage in the DID design, I propose an instrumental variable approach. The monthly premia for supplement UI rose differentially across UI funds. In particular, the increase was dictated by a formula written into UI law, which mandated that UI funds with higher unemployment rates increased their premium further. However, the UI funds typically provide insurance to workers from several different industries. Hence, two industries with identical unemployment rates can experience differential premia hikes, if they share UI funds with other industries that have differential unemployment rates.

By controlling for industry level unemployment, I can thus isolate variation in the UI premia that is driven by the unemployment rate in *other* industries. This part of the premia should clearly affect UI-coverage, while the unemployment rates in other industries that buy UI from the same fund are unlikely to directly affect wage growth.

As explained in section 3, the UI premia increase was implemented by introducing an additional fee that the UI-funds had to pay to the government each month. This fee was determined through the following formula:

$$A = 240 + (K - G) * 0.0348 \tag{9}$$

where A is the fee per employed member (in SEK), K corresponds to the average monthly UI benefit payments per member from the period June - July the preceding year. G is simply the average of K across all (36) UI funds. Hence, the formula mandated that UI funds with higher expenditures on UI pay a larger fee to the government each month. Moreover, the UI funds increased their premiums by an amount that was close to identical to the monthly payments mandated by the formula (IAF, 2007).

This suggests that the price of UI in 2007 should be higher in industries with more unemployment. To confirm this, appendix *Figure A4* plots the price of UI in 2007 against industry-level unemployment in 2006. There is a strong positive relationship between industry-level unemployment and the price of UI.

Appendix *Figure A5* shows the distribution of prices for supplement UI across industries in 2007. The variation is fairly small, and most workers face monthly premias between 320 (≈ 40 USD) and 360 SEK (≈ 45 USD). Furthermore, the premia difference between any given industries never exceeds 100 SEK (≈ 13 USD). It is worth pointing out that the reform increased monthly UI-premiums by 220 SEK (≈ 27 USD) on average. This reduced the take-up rate of supplement UI by approximately 10 percentage points. Hence, the price elasticity of demand for UI is very high, which implies that small premia-differences could potentially be used in an IV-strategy.

There are many potential instruments for the reduction in industry level UI-coverage. The most obvious one is the premia for supplement UI in 2007, after controlling for industry-level unemployment in 2006. Alternatively, one could replace the actual price with a predicted price, based on the price of UI in 2006 and the formula in equation (9).

Finally, one could ignore the UI-premia differentiation, and simply leverage the distribution of price-sensitive groups across industries. Section 4 showed that workers who hold part-time employment are particularly sensitive to changes in the price of UI. An additional approach is therefore to instrument changes in UI-coverage with the share of workers that held part-time employment the year prior to the reform. This instrument will be stronger and have higher precision, which could be important since the UI-premia variation is fairly small. On the other hand, the exclusion restriction becomes harder to justify. I will therefore consider three instruments for the reduction in industry level UI-coverage:

- $IV_{1,s}$: Price of UI in 2007 for workers in industry s
- $IV_{2,s}$: Predicted price of UI in 2007 for workers in industry s
- $IV_{3,s}$: Share of workers part-time employed in industry s in 2006

I construct the predicted price of UI in 2007 as follows:

$$\text{IV}_{2,\text{s}} = \text{P}_{2006,\text{s}} + \text{F}_\text{s} \tag{10}$$

where $\text{P}_{2006,\text{s}}$ is the price of UI workers in industry s faced in 2006, F_s is the price increase mandated by the formula in equation 9.[18] The government agency IAF was responsible for determining the fees that the UI-funds had to pay to the government each month. The fees were determined on a yearly basis and are publicly available. I use the fees computed by the IAF to construct F_s.

To implement the instrumental variable strategy, consider the following regression specification:

$$y_{ist} = \delta_s + \alpha \times d_{2007} + X_s' \times \beta + \phi \times d_{2007} \times d_s + \varepsilon_{ist} \tag{11}$$

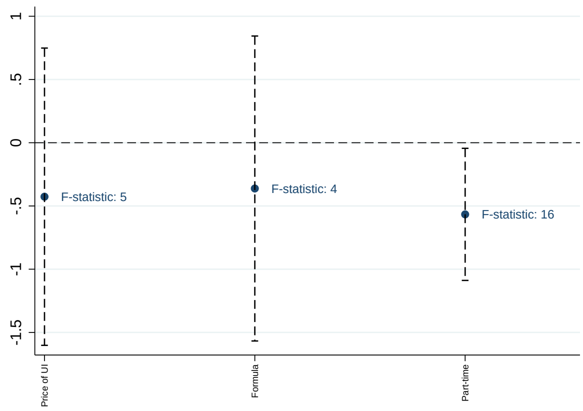
Where y_{ist} is the log monthly wage of worker i, employed in industry s in year t, δ_s is an industry-level fixed effect, d_{2007} is a dummy variable for 2007, X_s is a vector of industry-level controls, such as the unemployment rate. Importantly, all covariates in X_s are measured in 2006. The variable d_s corresponds to the reduction in the share of workers covered by supplement UI in industry s between 2006 - 2007.[19] The potentially endogenous variable of interest is $d_{2007} \times d_s$. This interaction term measure whether industries with a sharper reduction in UI-coverage experienced weaker wage growth between 2006 and 2007.

I pool data from 2006-2007 and estimate equation (11) with two stage least squares (2SLS), using one of my three instruments at a time. The 2SLS estimates of the impact of industry level UI-coverage on wages are shown together with 95% confidence intervals in *Figure 5*. First stage F-statistics are reported together with the point estimates. Standard errors are clustered at the industry level.

[18] As usual, I weight the mandated price increase with the estimates of the share of workers in any given industry that buy UI from a particular fund.

[19] $d_s = \frac{I_{s,2006}}{N_{s,2006}} - \frac{I_{s,2007}}{N_{s,2007}}$, where $I_{s,2006}$ and $I_{s,2007}$ are the number of workers in industry s covered by supplement UI in 2006 and 2007 respectively. $N_{s,2006}$ and $N_{s,2007}$ are the total number of workers employed in industry s in 2006 and 2007 respectively.

Figure 5: IV estimates of the impact of UI-coverage on wages



Note: I always control for the share of workers employed by the county council, government and municipality, share of white and blue collar workers in the private sector and the share of workers above 60 years of age. All controls are measured in 2006 and interacted with a 2007 dummy. The specifications that exploit the predicted and actual UI-premia as instruments control for industry-level unemployment and the share of workers that work part time or less. The excluded instruments are always standardized and interacted with a 2007 dummy.

Two things are immediately clear from *Figure 5*. First, the estimated UI-wage effects are unilaterally larger than those obtained from the DID strategy. Indeed, the IV estimates oscillates around -0.5. By contrast, the DID estimates were about -0.1. This supports the conjecture that DID estimates should be interpreted as a lower bound on the true UI-wage effect.

Second, the specification that exploit the actual and predicted price of UI are similar. However, these estimates are not statistically significant. This is clearly the result of a fairly weak first stage relationship between the instruments and industry level UI-coverage. From *Figure 5*, it is clear that this results in low precision. Instrumenting changes in UI-coverage with the share of workers that held part-time employment in 2006 substantially strengthens the first stage relationship and provides large gains in precision. Furthermore, the UI-wage effect is statistically significant at conventional levels in this specification.

Table 4 presents the results from specification (11). It is interesting to note that the point estimates do not change much when the distribution of part-time employment is used as an instrument.[20] Qualitatively, the only difference is that precision improves and that a zero effect can be ruled out at the 5% level. This is reassuring since the exclusion restriction is easier to justify in specifications that only leverage UI-premia variation (controlling for industry level unemployment). The fact that implied effect sizes are qualitatively the same across specifications lends additional credibility to the part-time employment instrument.

To further validate the use of part-time employment as an instrument, I pool data from 2002 - 2007 and estimate the following regression model:

$$y_{ist} = \delta_s + \alpha_1 t_{2002} + ... + \alpha_5 t_{2007} + \phi_1 t_{2002} z_s + ... + \phi_5 t_{2007} z_s + \varepsilon_{ist} \qquad (12)$$

Where y_{ist} is the log monthly wage of worker i, employed in industry s in year t, δ_s is an industry level fixed effect, $t_{2002},...,t_{2007}$ are year fixed effects, z_s is the share of workers in industry s that held part-time employment in 2006. The coefficients of interest are $\phi_1,...,\phi_5$. These interaction terms measure whether industries that had a greater share of workers with part-time employment in 2006 experienced weaker wage growth between 2006 - 2007, and if there is any evidence of diverging wage trends in the pre-reform period. I omit year 2006 so that the interaction terms measure differences in wage growth relative to the year prior to the reform.

Appendix *Figure A6* plots the point estimates together with 95% confidence intervals. Standard errors are clustered at the industry level. There is no evidence of differential wage trends prior to the reform. However, wage growth declines significantly in industries with more part-time employment between 2006 and 2007.[21] These results further validates using the distribution of part-time employment as an instrument for changes in industry level UI-coverage. Altogether, the IV-strategy suggests that a 10 percentage

[20] Here, I compare the point estimates from the specification that leverages part-time employment as an instrument with the specifications that uses the actual and predicted UI-premia after controlling for industry-level unemployment.

[21] In specification 11, I always control for the share of workers employed by the county council, government and municipality, share of white and blue collar workers in the private sector and the share of workers above 60 years of age. If I include these controls in specification 12, one placebo estimate becomes positive and statically significant.

point reduction in industry level UI-coverage reduce wages by about 5%.

Table 4: IV estimates of the impact of UI coverage on wage formation

	(1)	(2)	(3)	(4)	(5)	(6)
Reduction in share with UI	-0.227	-0.427	-0.175	-0.362	-0.514**	-0.567**
	(0.534)	(0.600)	(0.547)	(0.615)	(0.249)	(0.266)
	First stage coefficients					
Price	0.007**	0.007**				
	(0.003)	(0.003)				
Predicted price			0.007**	0.006**		
			(0.003)	(0.003)		
Part time					0.010***	0.010***
					(0.003)	(0.003)
First stage F-statistic	5.86	4.85	5.13	4.17	16.77	15.74
Control for unemployment		✓		✓		✓

Note: Standard errors (in parentheses) account for clustering at the industry level. Each specification pool data from 2006 and 2007. I always control for the share of workers employed by the county council, government and municipality, share of white and blue collar workers in the private sector and the share of workers above 60 years of age. All controls are measured in 2006 and interacted with a 2007 dummy. The specifications that exploit the predicted and actual UI-premia as instruments control for the share of workers that work part time or less. The excluded instruments are always standardized and interacted with a 2007 dummy.

Direct effect of UI premium

The UI premia reform was intended to make UI actuarially fair and provide incentives for UI funds to tighten monitoring of benefit recipients. However, the reform was also designed to incentivise unions with high unemployment rates to be more restrictive in wage negotiations. Specifically, if they bargained for higher wages and increased unemployment, this would hurt their employed members by driving up the premiums that they had to pay for supplement UI. This is clearly important since such an effect would immediately imply that the UI-premia instrument fails to fulfil the exclusion restriction.

However, several prominent economists pointed out that these potential incentive effects were trivial (Calmfors et al., 2011). They also stressed the fact that one UI fund typically provides UI coverage to *many* industries. The unemployment rate within each industry will therefore have a trivial effect on the overall unemployment rate in the UI fund. Hence, the impact of the unemployment rate within any particular industry on the UI premium will be small. In addition, bargaining at the establishment level is a crucial component of wage formation in Sweden and displacement rates at the firm level will obviously have an even smaller impact on the overall unemployment rate in the UI fund, and thus influence the UI premiums even less. I will therefore assume that any impact of the reform on wages operates through the reduction in supplement UI coverage, and that the introduction of the new premia did not have any direct effect on wages.

6 Interpretation and relation to existing literature

In this section, I interpret my findings through the lens of the DMP model with Nash bargaining. Recall from section 2 that the equilibrium wage is given by:

$$w = (1-\gamma)b + \gamma(y + c\theta(b)) \tag{13}$$

where w is the equilibrium wage, γ represents worker bargaining power, b is unemployment benefits, y is the instantaneous flow of output produced by the worker, c is the vacancy positing cost and θ represents labor market tightness.[22]

In the previous section, I estimated the impact of industry-level UI coverage on wages using a DID and an IV approach. I argued that the difference-in-difference estimate should be interpreted as a lower bound on the true UI-wage effect. Hence, I choose the IV estimates as my preferred specification.

These results indicate that 10 percentage point reduction in industry-level UI coverage reduce wages by about 5 percent. If we are willing to extrapolate, this estimate implies that if all workers are covered by the comprehensive plan, wage are 50% higher compared to the scenario were no one buys supplement UI. Moreover, if we let b_1 and b_0 denote the UI benefits available to workers under the basic and comprehensive plan respectively, equation 13 implies that the associated equilibrium wages can be expressed as:

$$w_0 = (1-\gamma)b_0 + \gamma(y + c\theta(b_0)) \tag{14}$$

$$w_1 = (1-\gamma)b_1 + \gamma(y + c\theta(b_1)) \tag{15}$$

Where w_1 and w_0 are the equilibrium wages associated with the hypothetical scenarios where all or no workers are covered by the comprehensive plan. Now, subtract 14 from 15 and divide through by w_0 and we get:

$$0.5 = (1-\gamma)\frac{b_1 - b_0}{w_0} + \gamma\frac{c}{w_0}(\theta(b_1) - \theta(b_0)) \tag{16}$$

Where I used that my estimate of the UI wage effect imply that $\frac{w_1 - w_0}{w_0} = 0.5$. Furthermore, the DMP model predicts that $\theta(b_1) \leq \theta(b_0)$. This is simply because wages are either completely unresponsive to changes in UI ($\gamma = 1$), in which case $\theta(b_1) - \theta(b_0) = 0$. Otherwise, changes in UI exerts upward pressure on wages, and vacancy creation goes down. In this case, $\theta(b_1) - \theta(b_0) < 0$. There is however no scenario where $\theta(b_1) - \theta(b_0) > 0$. In addition, the range of estimated general equilibrium effects of UI (Chodorow-Reich and Karabarbounis, 2016; Hagedorn et al., 2013; Marinescu, 2017) imply either no effect, or

[22] Recall that labor market tightness is defined as the number of vacancies, v, divided by the number of unemployed workers, u. Hence, $\theta = \frac{v}{u}$.

large negative effects of UI on θ. Hence, it is safe to assume that $\theta(b_1) - \theta(b_0) \leq 0$.

Moreover, vacancy posting cost (c) and the counterfactual wage (w_0) are clearly positive. We can thus define $\alpha = \frac{c}{w_0}(\theta(b_1) - \theta(b_0))$, where $\alpha \leq 0$. Substitute into 16 and we obtain:

$$0.5 = (1-\gamma)\frac{b_1 - b_0}{w_0} + \alpha\gamma \tag{17}$$

UI benefit duration under the basic and comprehensive plan is capped at 300 days. Moreover, the daily allowance is paid out 5 days per week under both insurance plans. Hence, the only difference between basic and comprehensive UI is the daily benefit level.

Moreover, the vast majority of workers have pre-unemployment earnings that are significantly higher than the benefit ceiling. Recall from section 3 that approximately 70% of displaced workers have pre-unemployment earnings for which the benefit ceiling is binding. Moreover, displaced workers typically earn relatively low wages. The total share of workers (unemployed or employed) with earnings above the ceiling is presumably much higher. I will therefore make the simplifying assumption that all workers receive the maximum daily benefit level if they are covered by supplement UI.

Hence, workers receive daily benefits of 680 SEK ($\approx$ 75 USD) under the comprehensive plan and 320 SEK ($\approx$ 35 USD) under the basic plan. Under the simplifying assumptions discussed above, this is the only difference between the insurance plans. This implies that we can write $b_1 \approx 2.125 b_0$. Worker bargaining power can thus be expressed as:

$$\gamma = \frac{\frac{1.125 b_0}{w_0} - 0.5}{\frac{1.125 b_0}{w_0} - \alpha} \tag{18}$$

I further compute the average wage (25,260 SEK) and the UI coverage rate (90%) for my sample in 2006. We can once again use the estimated UI wage effect to compute the counterfactual wage in 2006, had no worker been covered by the comprehensive plan. This is easily seen to be (1 - 0.45) × 25,260 = 13,893 SEK. Now, unemployed workers covered by basic UI receive 320 SEK per day. These are paid per "working day", which means that there are 5 days of benefits paid per week. Hence, basic UI corresponds to a monthly income of 7,040 SEK. Substitute $w_0 = 13,893$ and use $1.125 b_0 = 7,920$ and we get:

$$\gamma \approx \frac{0.071}{0.57-\alpha} \tag{19}$$

Clearly, the upper bound on γ is obtained by setting $\alpha = 0$, in which case we have $\gamma = 0.12$. Furthermore, as α become arbitrarily large in absoulte terms, γ approaches zero. Hence, $\gamma \in (0, 0.12)$.

Schoefer et al. (2018) argue that estimated rent-sharing elasticities imply that worker bargaining power can be at most 0.2. They further estimate the effect of non-employment values on wages, and argue that their estimates cannot be rationalized by bargaining models with unemployment as the outside option unless one is willing to assume that workers wield almost full bargaining power ($0.95 \leq \gamma$). They conclude that Nash bargaining with unemployment as the outside option for workers is an inappropriate model for wage setting, and that more promising models insulate wages from the value of non-employment.

My results challenge this conclusion. As shown above, my estimates imply an upper bound on worker bargaining power of 0.12. This is clearly lower than the upper bound target by Schoefer et al. (2018). Hence, my result suggests that wage setting protocols should *not* insulate wages from the value of non-employment. It is interesting to consider why my results are so different from the those in Schoefer et al. (2018).

My interpretation is that the results differ because we use variation in UI-benefit entitlement that occurs at different levels. As I mentioned in the introduction, Schoefer et al. (2018) rely on four reforms that changed UI-benefit entitlement for workers in particular parts of the earnings distribution. However, union-affiliation does not map one-to-one with any particular part of the earnings distribution, which implies that treatment does not vary at a level that can capture wage-adjustments that occur through collective bargaining. I rely on variation in UI-entitlement at the industry-level, where collective bargaining occurs, which could potentially explain why I reach different conclusions.

7 Conclusion

Conventional wage setting protocols in macroeconomics and labor economics typically posit a tight relationship between the generosity of UI and wages. In the standard DMP model, the response of unemployment to changes in UI-policy is driven by the UI-wage-pressure channel. Hence, the UI wage effect has important policy implications. There is however surprisingly little credible evidence on this issue, and the sensitivity of wages to changes in UI is largely an unresolved issue.

In this paper, I find strong evidence that UI benefits exert upward pressure on equilibrium wages. I exploit the sudden increase in the premium for supplement UI, following the election of the right-wing coalition. I study the impact of UI-coverage on equilibrium wages using a difference-in-difference approach, and argue that any potential bias should lead to underestimation of the true UI wage effect. In a second step, I validate this conjecture using an IV approach. The results unilaterally suggest that industry level UI-coverage exerts upward pressure on equilibrium wages.

Finally, I use the estimated UI wage effect to derive information bounds on the worker bargaining power parameter in a simple DMP model. My results suggest that it can be at most 0.12. Altogether, this evidence supports wage setting mechanisms that tie wages to the generosity of UI.

References

George A Akerlof and Janet L Yellen. The fair wage-effort hypothesis and unemployment. *The Quarterly Journal of Economics*, 105(2):255–283, 1990.

Pedro Amaral, Jessica Ice, et al. Reassessing the effects of extending unemployment insurance benefits. *Federal Reserve Bank of Cleveland Economic Commentary*, 23, 2014.

Robert Barro. The folly of subsidizing unemployment. *Wall Street Journal*, 30, 2010.

Christopher Boone, Arindrajit Dube, Lucas Goodman, and Ethan Kaplan. Unemployment insurance generosity and aggregate employment. Technical report, IZA Discussion Papers, 2016.

James N Brown and Orley Ashenfelter. Testing the efficiency of employment contracts. *Journal of political economy*, 94(3, Part 2):S40–S87, 1986.

Marco Caliendo, Konstantinos Tatsiramos, and Arne Uhlendorff. Benefit duration, unemployment duration and job match quality: a regression-discontinuity approach. *Journal of Applied Econometrics*, 28(4):604–627, 2013.

Lars Calmfors and John Driffill. Bargaining structure, corporatism and macroeconomic performance. *Economic policy*, 3(6):13–61, 1988.

Lars Calmfors, Torben M Andersen, Michael Bergman, Laura Hartman, Lars Jonung, Helena Svaleryd, Lars Tobisson, and Erik Åsbrink. Svensk finanspolitik: Finanspolitiska rådets rapport 2011. 2011.

David Card and Phillip B. Levine. Extended benefits and the duration of ui spells: evidence from the new jersey extended benefit program. *Journal of public economics*, 78 (1/2):107–138, 2000.

David Card, Raj Chetty, and Andrea Weber. Cash-on-hand and competing models of intertemporal behavior: New evidence from the labor market. *The Quarterly journal of economics*, 122(4):1511–1560, 2007.

Kenneth Carling, Bertil Holmlund, and Altin Vejsiu. Do benefit cuts boost job finding? swedish evidence from the 1990s. *The Economic Journal*, 111(474):766–790, 2001.

Gabriel Chodorow-Reich and Loukas Karabarbounis. The limited macroeconomic effects of unemployment benefit extensions. Technical report, National Bureau of Economic Research, 2016.

Peter A Diamond. Wage determination and efficiency in search equilibrium. *The Review of Economic Studies*, 49(2):217–227, 1982.

Steven Dieterle, Otávio Bartalotti, Quentin Brummet, et al. Revisiting the effects of unemployment insurance extensions on unemployment: A measurement error-corrected regression discontinuity approach. *ESE Discussion Papers*, 268, 2016.

Marcus Hagedorn, Fatih Karahan, Iourii Manovskii, and Kurt Mitman. Unemployment benefits and unemployment in the great recession: the role of macro effects. Technical report, National Bureau of Economic Research, 2013.

IAF. Effekterna av den förhöjda finansieringsavgiften, 2007.

IAF. Effekterna av den förhöjda finansieringsavgiften, rapport 3, 2008.

ILO. Global employment trends: Preventing a deeper job crisis. *Report, ILO: Geneva*, 2012.

Lawrence F Katz. Efficiency wage theories: A partial evaluation. *NBER macroeconomics annual*, 1:235–276, 1986.

Anders Kjellberg. Det fackliga medlemsraset i sverige under 2007 och 2008. *Arbetsmarknad & Arbetsliv*, 15(2):11–28, 2009.

Michael U Krause and Harald Uhlig. Transitions in the german labor market: Structure and crisis. *Journal of Monetary Economics*, 59(1):64–79, 2012.

Alan B Krueger and Lawrence H Summers. Efficiency wages and the inter-industry wage structure. *Econometrica: Journal of the Econometric Society*, pages 259–293, 1988.

Rafael Lalive. Unemployment benefits, unemployment duration, and post-unemployment jobs: A regression discontinuity approach. *The American economic review*, pages 108–112, 2007.

Rafael Lalive, Camille Landais, and Josef Zweimüller. Market externalities of large unemployment insurance extension programs. *The American Economic Review*, 105(12): 3564–3596, 2015.

Camille Landais, Arash Nekoei, Peter Nilsson, David Seim, and Johannes Spinnewijn. Dp12364 risk-based selection in unemployment insurance: Evidence and implications. 2017.

Phillip B Levine. Spillover effects between the insured and uninsured unemployed. *ILR Review*, 47(1):73–86, 1993.

Thomas E MaCurdy and John H Pencavel. Testing between competing models of wage and employment determination in unionized markets. *Journal of Political Economy*, 94 (3, Part 2):S3–S39, 1986.

Ioana Marinescu. The general equilibrium impacts of unemployment insurance: Evidence from a large online job board. *Journal of Public Economics*, 150:14–29, 2017.

Ian M McDonald and Robert M Solow. Wage bargaining and employment. *The American Economic Review*, 71(5):896–908, 1981.

Medlingsinstitutet. Avtalsrörelsen och lönebildningen 2007, 2007.

Stephen P Millard and Dale T Mortensen. The unemployment and welfare effects of labour market policy: a comparison of the usa and the uk. *Unemployment Policy: Government options for the labour market*, pages 545–571, 1997.

Dale T Mortensen and Christopher A Pissarides. Job creation and job destruction in the theory of unemployment. *The review of economic studies*, 61(3):397–415, 1994.

Arash Nekoei and Andrea Weber. Does extending unemployment benefits improve job quality? 2015.

SJ Nickell. A bargaining model of the phillips curve, london school of economics, centre for labour economics. Technical report, Discussion Paper, 1982.

Benjamin Schoefer, Simon Jaeger, Samuel Young, and Josef Zweimueller. Wages and the value of nonemployment. *working paper*, 92(3):684–695, 2018.

Carl Shapiro and Joseph E Stiglitz. Equilibrium unemployment as a worker discipline device. *The American Economic Review*, 74(3):433–444, 1984.

Shouyong Shi and Quan Wen. Labor market search and the dynamic effects of taxes and subsidies. *Journal of Monetary Economics*, 43(2):457–495, 1999.

Lawrence Summers. The economic case for extending unemployment insurance. *The White House Blog, July*, 14:40, 2010.

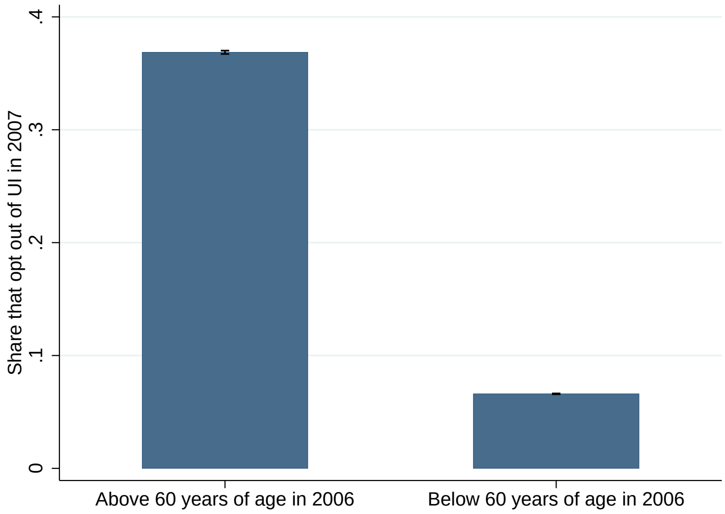
DT Ulph. Unemployment and the pure theory of the trade union. Technical report, Discussion Paper, University College London, 1982.

Jan C Van Ours and Milan Vodopivec. Does reducing unemployment insurance generosity reduce job match quality? *Journal of Public Economics*, 92(3):684–695, 2008.

Andrew Weiss. *Efficiency wages: Models of unemployment, layoffs, and wage dispersion*. Princeton University Press, 2014.

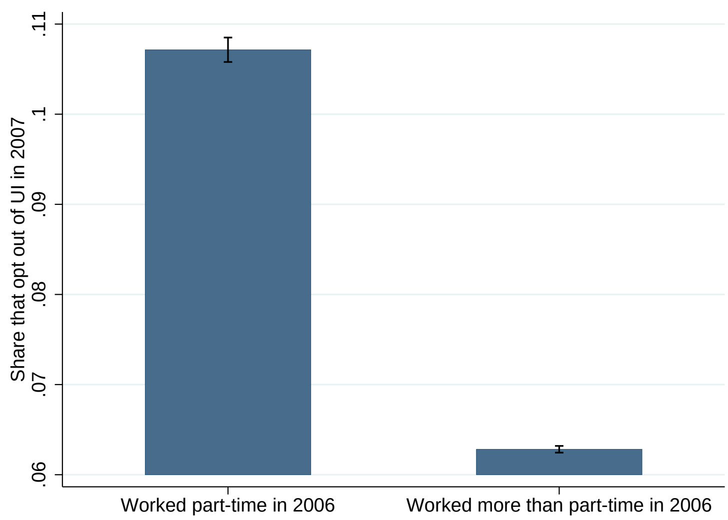
Appendix

Figure A1: Share of workers above and below 60 years of age that opt out of UI in 2007



Note: The figure shows the share of workers that were insured in 2006 but uninsured in 2007 separately for workers that were above or below 60 years of age in 2006.

Figure A2: Share of part-time and full-time workers that opt out of UI in 2007



Note: *Figure A2* shows the share of workers that were insured in 2006 but uninsured in 2007 separately for worked part-time or more than part-time in 2006. Part-time is defined as working 50% or less.

Table A1: Determinants of the reduction in industry level UI-coverage.

Determinants of the reduction in industry level UI coverage

VARIABLES	(1)	(2)	(3)	(4)
Price of supplement UI in 2007	0.004**	0.003	0.004	0.005**
	(0.002)	(0.002)	(0.003)	(0.002)
Industry-level unemployment rate in 2006		0.216	0.179	0.028
		(0.152)	(0.161)	(0.141)
Share above 55 years of age			0.095	0.159*
			(0.114)	(0.085)
Share who work part time				0.158***
				(0.042)
R-squared	0.938	0.939	0.940	0.952

Note: Standard errors are reported in parentheses. Each column represents a separate regression of the reduction in the share of workers covered by supplement UI on industry-level characteristics in 2006 . All specifications control for the share employed by government, county council, municipality and share of white and blue collar workers in the private sector. The price of supplement UI has been standardized such that the mean is zero and the variance is one.

Figure A3: Unemployment rate

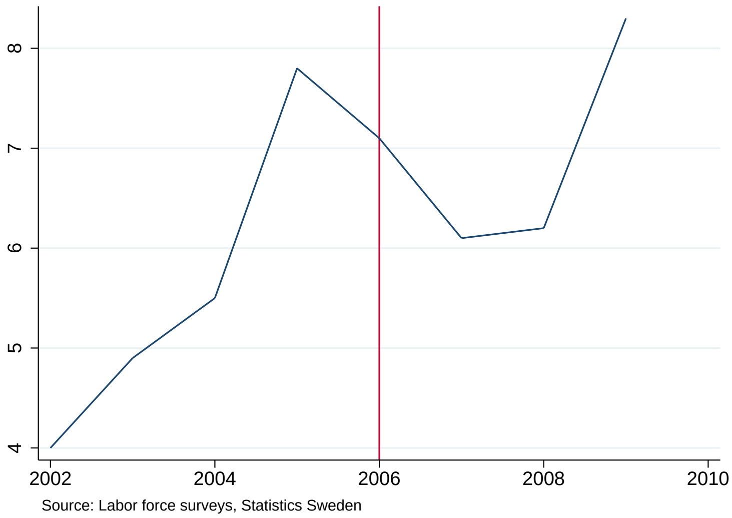
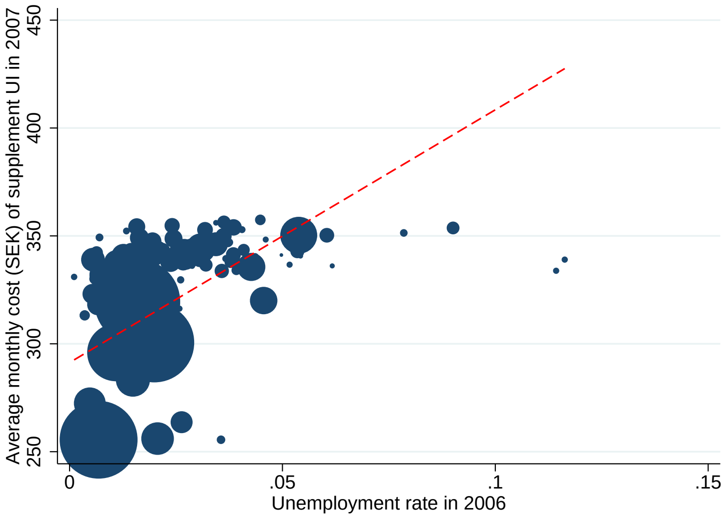
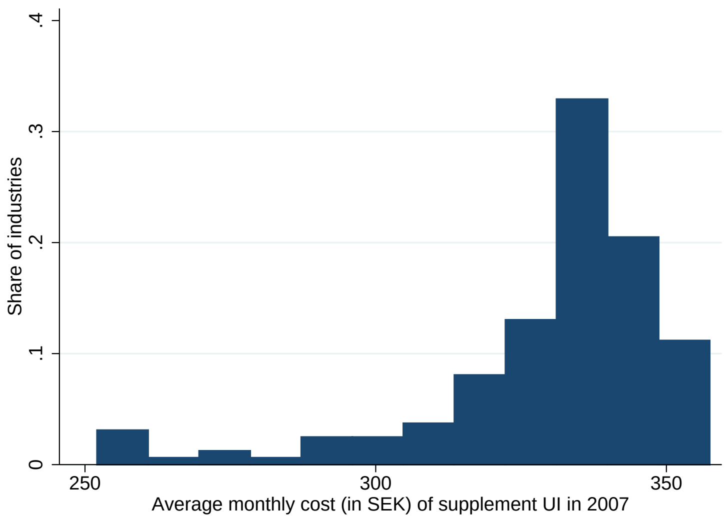


Figure A4: Industry level unemployment and the price of comprehensive UI



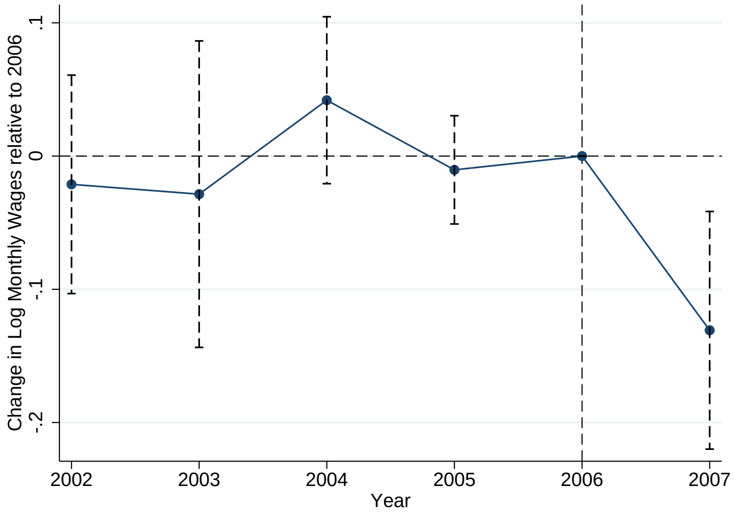
Note: The figure plots the relationship between the average monthly premia for supplement UI in 2007 and industry level unemployment in 2006. The dashed red line shows the regression coefficient from a weighted regression with the number of workers employed in the industry in 2006 as weights.

Figure A5: The distribution of the monthly premia for UI in 2007



Note: *Figure A5* illustrates the distribution of the average monthly cost of UI across industries in 2007.

Figure A6: Wage trends and part-time employment



Note: *Figure A6* shows the difference-in-difference estimates from a model that pools data from 2002 - 2007 and interacts the year fixed effects with the share of workers that held part-time employment in 2006. I omit year 2006 so that the interaction terms measure difference in wage growth relative to the year prior to the reform.