Employment Effects and Welfare Consequences of Short-Time Work Programs

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Motivation

Short-time work

- Subsidy for hour reductions to firms experiencing temporary shocks

- Twofold objective:
  - Insure workers against income fluctuations due to variations in employment at intensive margin
  - Prevent potentially excessive layoffs in response to shocks and the resulting increase in unemployment

- Policy tool widely used in OECD countries during the crisis
  - 3-6% of the workforce and 0.1-0.3% of GDP in 2009
  - Expenditure on UI was 0.7% and 1.1% of GDP in 2007 and 2009

- Little knowledge about the effect of STW on firms and workers
  - Limited evidence due to lack of good-quality data and credible identifying variation
  - Lack of conceptual framework to evaluate welfare effects
### Average monthly take-up rate in 2007 and 2009

<table>
<thead>
<tr>
<th>Country</th>
<th>2007</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRT</td>
<td></td>
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<tr>
<td>USA</td>
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<td>TUR</td>
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<tr>
<td>BEL</td>
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</tr>
</tbody>
</table>

Source: Hijzen and Venn (2010), OECD data
Introduction

Research question

STW programs are public schemes intended to preserve jobs at firms experiencing temporary shocks

- Is there an effect of STW programs on employment?
- What are the long-term consequences of STW on individuals and firms?

In a labor market with frictions, shocks to firms may induce inefficient layoffs (Hall and Lazear, 1984) and layoffs may respond to the subsidy

- Are layoffs inefficiently high? Is reducing layoffs welfare enhancing?
- What is the optimal design of STW as a tool to prevent excessive layoffs in a frictional labor market?
Following earlier cross-country empirical analyses (Abraham and Houseman, 1993), renewed interest in STW at the onset of the crisis:

- Cross-country studies find evidence of a positive effect of STW on employment and a negative one on average hours worked (Hijzen and Venn, 2010; Boeri and Bruecker, 2011; Cahuc and Carcillo, 2011; Hijzen and Martin, 2013)
- Analysis at firm-level remains scarce and inconclusive due to limited data availability and credible exogenous variation (Boeri and Bruecker, 2011; Brenke et al., 2013; Calavrezo et al., 2009)

Early theoretical literature shows that STW reduces layoffs compared to UI, but generates distortions at the intensive margin leading to underemployment (Burdett and Wright, 1989)

Recent theoretical work shows that, by preventing increases in unemployment during a recession, STW decreases allocative efficiency due to a reduction in the vacancy filling rate (Cooper et al., 2017)
Unique administrative data on STW at the individual and firm level from Italian Social Security records

Matched with balance-sheet data at firm level

Credible sources of quasi-experimental variation in Italian policy rules to identify causal effects of STW on:

- Employment at the intensive and extensive margins
- Long-term individual and firm outcomes

Twofold empirical strategy

- Baseline triple difference to identify short-run effects
- Triple difference à la Cellini et al. (2010) to identify dynamic effects

Use empirical evidence to analyze the welfare consequences of STW programs as policy tools to limit potentially excessive layoffs
Outline

1. Institutional background and data
2. The effects of STW during the Great Recession
3. Dynamic effects
4. Selection and heterogeneity
5. Discussion
Institutional features of the Italian STW program

- Subsidy for hour reductions - either partial or full-time - available to workers in the private sector and administered by the Social Security
- Replaces about 80% of foregone earnings due to hours not worked
- Firms intending to use the program must file an application to the Social Security or the Ministry of Labor
  - Provide justification of economic need
  - Develop a recovery plan
- Weak conditionality requirements
  - No compulsory training
  - No prohibition of dismissal
  - No job-search requirement for employee
- Cost to employer is a fixed percentage of subsidized hours (with exemptions)
Institutional background and data

## Three pillars of Cassa Integrazione Guadagni

<table>
<thead>
<tr>
<th>Target</th>
<th>Duration</th>
<th>Avg spell</th>
<th>Industry</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CIGO</strong></td>
<td>Transitory, exogenous shocks</td>
<td>13 weeks</td>
<td>2 weeks</td>
<td>Manufact Construct Transport</td>
</tr>
<tr>
<td><strong>CIGS</strong></td>
<td>Crisis Restructuring Insolvency</td>
<td>2 years</td>
<td>3.5 months</td>
<td>Manufact Construct Retail Transport</td>
</tr>
<tr>
<td><strong>CIGD</strong></td>
<td>Extend coverage or duration of CIGO/CIGS</td>
<td>By decree</td>
<td>3.5 months</td>
<td>Sectors and regions set by decree</td>
</tr>
</tbody>
</table>
Administrative data from Italian Social Security Archives

- Universe of matched employer-employee data for the private sector
- Information on workers and firms
  - Demographics
  - Working histories
  - Social insurance and social assistance program participation
  - Firm characteristics (size, sector)
- Information on CIG eligibility, applications, authorizations, duration and payment for the years 2005-2015
- Matching with firm-level balance-sheet data (approx. 50%)
Identification of STW effects

- We use the Great Recession as our main source of shock
- Identification exploits variations in eligibility for CIG Straordinaria based on:
  - **Size**: having employed more than 15 employees in full-time equivalent in six months prior to application
  - **Industry**: mostly industries in manufacturing and construction
- Compare the difference in outcomes around the 15-threshold in eligible and non-eligible industries, before and after the start of the Great Recession
  - Industry variation in eligibility for STW allows controlling for the confounding effect of employment protection legislation
Empirical strategy

Reduced-form graphical representation

- Plot the difference in outcomes between firms above and below the 15-threshold, and in eligible and non-eligible industries relative to 2007

Structural-form regression-based estimation

- Instrument the probability of receiving CIGS using the interaction between a 15-threshold dummy, industry and calendar year
- Structural form

\[ y_{ist} = \beta_0 + \beta_1 T_{ist} + u_{ist} \]

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Empirical strategy (cont.)

First stage

\[ T_{ist} = \gamma_0 + \sum_{j \neq 2007} \gamma_1^j \mathbb{1}[s \in elig] \times \mathbb{1}[\text{size} > 15] \times \mathbb{1}[j = t] \]

\[ + \sum_{j \neq 2007} \sum_k \gamma_2^{jk} \mathbb{1}[k = s] \times \mathbb{1}[j = t] \]

\[ + \sum_{j \neq 2007} \gamma_3^j \mathbb{1}[\text{size} > 15] \times \mathbb{1}[j = t] \]

\[ + \sum_k \gamma_4^k \mathbb{1}[k = s] \times \mathbb{1}[\text{size} > 15] \]

\[ + \sum_k \gamma_5^k \mathbb{1}[k = s] \times \sum_{j \neq 2007} \gamma_6^j \mathbb{1}[j = t] \]

\[ + \gamma_7 \mathbb{1}[\text{size} > 15] + v_{ist} \]

where \( i \) is firm, \( s \) industry at 5-digit level and \( t \) calendar year.
Empirical implementation

- Annual data from 2000 to 2015
- Panel of all ever-active firms and of their workers (in eligible job positions)
- Eligibility status is defined dynamically based on maximum 6-month average firm size and industry in each year
  - Select firms with 6-month full-time equivalent firm size $\in (5; 25]$  
- Definition of a STW event
  - Any month in which a CIG episode is reported, which is also authorized according to the authorization data
  - When aggregating at the annual level, an event is defined as having at least one CIG episode during the year
The effects of STW during the Great Recession

Probability of receiving CIGS

Eligible sectors

Source: INPS.
The effects of STW during the Great Recession

Probability of receiving CIGS

Non-eligible sectors

Source: INPS.
The effects of STW during the Great Recession

Probability of receiving CIGS

Triple difference

Source: INPS.

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The effects of STW during the Great Recession

Probability of ever receiving CIGS in the past 5 years

Triple difference

Source: INPS.

Other programs

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The effects of STW during the Great Recession

Intensive-margin response

Log annual weeks worked per employee

Triple difference

Note: IV estimate -0.486 (s.e. 0.033).
Source: INPS.
The effects of STW during the Great Recession

Log annual wage bill per employee

Triple difference

Note: IV estimate -0.585 (s.e. 0.044).
Source: INPS.
The effects of STW during the Great Recession

Extensive-margin response

Log firm size headcount (March)

Triple difference

Note: IV estimate 0.380 (s.e. 0.036).
Source: INPS.
The effects of STW during the Great Recession

Log open-ended contracts (March)

Triple difference

Note: IV estimate 0.616 (s.e. 0.043).
Source: INPS.

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The effects of STW during the Great Recession

Log fixed-term contracts (March)

Triple difference

Note: IV estimate -0.403 (s.e. 0.117).
Source: INPS.
The effects of STW during the Great Recession

Probability of firm survival in t+1

Triple difference

Note: IV estimate -0.017 (s.e. 0.022).
Source: INPS.
### Balance-sheet outcomes

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</thead>
<tbody>
<tr>
<td>CIGS</td>
<td>690.458</td>
<td>52.638</td>
<td>1.644</td>
<td>701.563**</td>
<td>-210.891</td>
<td>-227.865</td>
</tr>
<tr>
<td></td>
<td>(2873.104)</td>
<td>(602.295)</td>
<td>(1.710)</td>
<td>(337.087)</td>
<td>(525.144)</td>
<td>(481.722)</td>
</tr>
<tr>
<td>Obs.</td>
<td>10950</td>
<td>10950</td>
<td>10950</td>
<td>10950</td>
<td>10950</td>
<td>10950</td>
</tr>
</tbody>
</table>
Total labor earnings for hours worked

Log annual labor earnings

Note: IV estimate -0.324 (s.e. 0.093).
Source: INPS.

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The effects of STW during the Great Recession

Insurance role of STW compensation

Log annual labor earnings including STW

Triple difference

Note: IV estimate 0.337 (s.e. 0.091).
Source: INPS.
The effects of STW during the Great Recession

Probability of employment in t+1
Triple difference

Note: IV estimate 0.062 (s.e. 0.021).
Source: INPS.

Difference in discontinuities

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The previous analysis captures the contemporaneous effects of STW on outcomes.

We are also interested in long-term effects:

- On firms
- On workers, to capture longer term insurance value of STW

A challenge in the identification of long-term effects is the possibility of dynamic treatment.

In order to isolate the effect of treatment in $t - k$ on outcomes in $t$ controlling for treatment between $t - k$ and $t$, we adopt an empirical strategy similar to Cellini et al. (2010)

Preliminary evidence suggests that effects dissipate quickly over time.
**Treatment effects with dynamic treatment**

We can write $y_{i,t}$ as a function of the full history of treatment:

$$y_{i,t} = \sum_{t=0}^{T} T_{i,t-k} \beta_k$$

**Effect of treatment on the treated (TOT):** The effect of treatment in $t - k$ on outcome in $t$, absent any additional treatment between $t - k$ and $t$

$$\beta_{k}^{TOT} = \frac{\partial y_{i,t}}{\partial T_{i,t-k}} = \beta_k$$

**Intention-to-treat effect (ITT):** The effect of treatment in $t - k$ on outcome in $t$, allowing for the possibility of additional treatment between $t - k$ and $t$

$$\beta_{k}^{ITT} = \frac{d y_{i,t}}{d T_{i,t-k}} = \frac{\partial y_{i,t}}{\partial T_{i,t-k}} + \sum_{j=1}^{k} \frac{\partial y_{i,t}}{\partial T_{i,t-k+j}} * \frac{d T_{i,t-k+j}}{d T_{i,t-k}}$$

$$= \beta_{k}^{TOT} + \sum_{j=1}^{k} \beta_{k-j}^{TOT} * \pi_j$$
Identification of dynamic treatment effects

1. Estimate $\hat{\pi}_k$ instrumenting $T_{i,t}$ using the interaction between size, industry and calendar year

$$T_{i,t+k} = \pi_0 + \pi_k T_{i,t} + \varepsilon_{i,t+k}$$

2. Estimate $\hat{\beta}_{ITT}^k$ instrumenting $T_{i,t}$ using the interaction between size, industry and calendar year

$$y_{i,t+k} = \beta_0 + \beta_{ITT}^k T_{i,t} + \eta_{i,t+k}$$

3. Retrieve $\beta_{TOT}^k$ recursively and estimate standard errors via bootstrapping

$$\beta_{TOT}^0 = \beta_{ITT}^0$$

$$\ldots$$

$$\beta_{TOT}^k = \beta_{ITT}^k - \sum_{h=1}^{k-1} \pi_h \beta_{TOT}^{k-h}$$
Log open-ended contracts (March)

Source: INPS.
Dynamic effects

Log fixed-term contracts (March)

Source: INPS.
Firm survival

Source: INPS.

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With heterogenous firms and workers, it is key to understand which firms and workers are taking up STW (selection) and how treatment effects vary across different firms (heterogeneity)

**Productivity**: STW subsidizes low-productivity matches and may prevent the efficient reallocation of workers in the labor market, as suggested by the long term effects of STW

**Liquidity/financial constraints**: STW may provide liquidity to financially constrained firms and prevent excess layoff sensitivity to productivity shocks (Schoefer, 2016)
Selection into STW

- Explore heterogeneity in **take-up** across different firm characteristics.
- Use balance sheet data to construct measures of heterogeneity:
  - Liquidity (proportion of liquid assets out of total assets)
  - Labor productivity (value added per employee)
- For each of these dimensions, rank firms by their pre-crisis level of liquidity/credit constraints/labor productivity, conditional on 2-digit industry.
- Compare take-up for firms in the top and bottom quartiles of their industry-specific ranking.
Probability of receiving CIGS

Source: INPS.
Probability of receiving CIGS

Source: INPS.
Summary of empirical results

- Exploit richness of administrative data on STW and exogenous variation in Italian STW regulations to assess the impact of STW on firms and workers.
- Document large increase in STW take-up by eligible firms during the Great Recession.
- Find sharp reduction of employment at the intensive margin and positive effects on the extensive margin, but entirely to the benefit of open-ended contracts.
- No significant effect on firm survival.
- Matching with firm-level balance-sheet data allows exploring selection and heterogeneous effects by firm-level characteristics and types of shocks.
- Some initial evidence of heterogeneity in take-up by degree of liquidity and labor productivity.
Theoretical framework for welfare analysis

- Develop a general-equilibrium framework to analyze the welfare effects of STW as a policy tool to prevent layoffs in the presence of frictions and a dual labor market
- Characterize the optimal design of the subsidy
- Use empirical estimates to assess the optimality of the current system and inform policy choices
Additional slides
Distribution of firms by firm size

All sectors
2000-2014

Note: McCrary test -0.009 (s.e. 0.005).
Source: INPS.

Back
Note: McCrary test -0.024 (s.e. 0.008).
Source: INPS.
Distribution of firms by firm size

Non-eligible sectors

2000-2014

Note: McCrary test 0.003 (s.e. 0.007).
Source: INPS.

Density

Firm size

0 0.05 0.1 0.15 0.2 0.25

5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
McCrary Test

All sectors

Source: INPS.
McCrery Test
Eligible sectors

Source: INPS.
McCrory Test
Non-eligible sectors

Source: INPS.
Probability of receiving any CIG

Triple difference

Source: INPS.
Probability of receiving CIGD

Triple difference

Source: INPS.
Probability of receiving CIGS or CIGD

Triple difference

Source: INPS.
Probability of receiving CIGO

Triple difference

Percentage points

Source: INPS.


**Probability of receiving CIGS**

Triple difference

Percentage points

Source: INPS.
Probability of receiving CIGS
Years 2010-2014

Note: Discontinuity in eligible sectors 1.970 (s.e. 0.077).
Discontinuity in non-eligible sectors -0.020 (s.e. 0.063).
Double-discontinuity estimate 1.990 (s.e. 0.100).
Source: INPS.
Probability of receiving CIGS (Worker)

Years 2010-2014

Note: Discontinuity in eligible sectors 1.383 (s.e. 0.021).
Discontinuity in non-eligible sectors -0.015 (s.e. 0.017).
Double-discontinuity estimate 1.398 (s.e. 0.027).
Source: INPS.
### IV Difference-in-Discontinuity Design - Firm-level outcomes

<table>
<thead>
<tr>
<th></th>
<th>Log wage bill per empl</th>
<th>Log total weeks per empl</th>
<th>Log employment</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIGS</td>
<td>-1.403*** (0.437)</td>
<td>-1.291*** (0.302)</td>
<td>-0.330 (0.273)</td>
</tr>
<tr>
<td>Obs.</td>
<td>1424248</td>
<td>1423439</td>
<td>1424786</td>
</tr>
</tbody>
</table>

*Significance levels: *** p < 0.01, ** p < 0.05, * p < 0.1
### IV Difference-in-Discontinuity Design - Worker-level outcomes

<table>
<thead>
<tr>
<th></th>
<th>Log weeks worked</th>
<th>Log earnings for hours worked</th>
<th>Log earnings including STW</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIGS</td>
<td>-0.672***</td>
<td>-0.464</td>
<td>0.158</td>
</tr>
<tr>
<td></td>
<td>(0.203)</td>
<td>(0.307)</td>
<td>(0.305)</td>
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<tr>
<td>Obs.</td>
<td>14573660</td>
<td>14723369</td>
<td>14723369</td>
</tr>
</tbody>
</table>

*Obs.* refers to the number of observations.
Effect on Pr(CIGS)

Year relative to CIGS

IV 95% CI

Source: INPS.
Log firm size headcount (March)

Source: INPS.
Log open-ended contracts (March)

Source: INPS.
Log fixed-term contracts (March)

Source: INPS.
Firm survival

Source: INPS.

ITT effect

Year relative to CIGS

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