Aggregate Nominal Wage Adjustments: New Evidence from Administrative Payroll Data

John Grigsby, Erik Hurst and Ahu Yildirmaz
July 2018

Paper is Preliminary and Evolving
Motivation

- Little movement in aggregate nominal wages during 2009 Recession
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- Little movement in aggregate nominal wages during 2009 Recession
- Possible explanation: Downward Nominal Wage Rigidity
- Little work measuring nominal wage adjustments and their response to economic conditions.
- Large and influential literature using micro data to measure output price stickiness.

- Reason: Existing data sets not ideal to measure wage adjustment.
  - Household data sets: Measurement error in both hours and earnings.
  - Administrative data sets: No measure of hours (and hard to measure hours of salaried individuals).
This Paper

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- Three principal contributions:
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  2. High quality **measurement** of wage adjustment
     - Job-stayers
     - Job-changers
     - Aggregate
       - Majority of downward adjustments come from job-changers
       - Compare our findings with other measures in the literature
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  3. Evidence of **state dependence** in wage setting
     - Business cycle, cross-industry, cross-region, and cross-firm variation
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- Caveat: only discussing realized adjustment, not structural parameters
Part 1: Data
New Data

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- Monthly aggregates of paycheck information

- Contain information on all aspects of HR/paycheck
  - Hours
  - Earnings by type (wage, benefits, bonus, etc.)
  - Worker status (hourly/salaried, monthly vs weekly paid, etc.)
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  - Firm 6-digit NAICS, firm location, firm size
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- Can track individuals across firms (if migrate to another ADP firm)
Sample Representativeness

- ADP has two data products:
  - One marketed to “firms” with > 50 employees
  - One marketed to “firms” with < 50 employees

- We have access to the data product for “firms” with > 50 employees.

- As a result, our data underrepresents small firms.
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- Restrict sample to 21-60 year olds (inclusive)

- Draw random sample of 1 million workers for tractability
<table>
<thead>
<tr>
<th></th>
<th>ADP Employee Sample</th>
<th>BDS Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Employees</td>
<td>1,000,000</td>
<td></td>
</tr>
<tr>
<td>Number of Firms</td>
<td>91,577</td>
<td></td>
</tr>
<tr>
<td>Number of Observations</td>
<td>24,831,244</td>
<td></td>
</tr>
<tr>
<td>% Firm Size: 50-499</td>
<td>37.8</td>
<td>29.5</td>
</tr>
<tr>
<td>% Firm Size: 500-999</td>
<td>13.6</td>
<td>7.3</td>
</tr>
<tr>
<td>% Firm Size: 1000-4999</td>
<td>25.1</td>
<td>17.5</td>
</tr>
<tr>
<td>% Firm Size: 5000+</td>
<td>19.7</td>
<td>45.6</td>
</tr>
</tbody>
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Note: We reweight ADP data so it is representative of BDS industry-size distribution by year. (Industry distribution is pretty representative).
Sample Description, Part 2

- The demographic composition of ADP sample similar to CPS
- About 2/3 of ADP sample report being hourly workers
- 57% of CPS respondents report being hourly
Sample Description, Part 2

- The **demographic composition** of ADP sample similar to CPS

- About **2/3 of ADP sample** report being **hourly workers**

- **57% of CPS** respondents report being **hourly**

- Differences stem from two sources:
  - Our ADP sample **excludes small firms**
  - Some ADP firms classify workers as “hourly” although they behave as “salaried” in many respects.
Administrative Measure of “Nominal Wage”

- Nominal wage measure: **contracted per-period payment rate**
  - Administratively reported (separate field for all employees)
  - Contracted hourly wage for hourly workers (2/3 of sample)
  - Contracted weekly/bi-weekly/monthly pay rate for salaried workers (~1/3 of sample)
  - Very little missing data
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  - Very little missing data

- All data is pre-tax and nominal.

- Refer to the per-period contract rate as a workers “**base wage**” or “**contract wage**”

- **Hourly wage matches CPS** in levels and trends
Base Pay vs. Gross Earnings

- Additionally observe **administrative gross earnings**
Base Pay vs. Gross Earnings

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- Construct Base Pay = Pay Rate x \{Hours, # of Paychecks\}
Base Pay vs. Gross Earnings

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- Define Residual Earnings = Gross Earnings – Base Pay
  - Bonuses
  - Overtime
  - Commissions
  - Signing bonus/Severance pay
  - Cashed out vacation days
  - Other (e.g. tips, contracted performance pay, reimbursements, measurement error)
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- **Define bonus to be residual earnings that:**
  
  - Arrives in December, January, February, or March
  - Is at least 1% of annual earnings
  - Paid out 1-3 times per year (Narrow definition: once per year)
### Share of Earnings in Base Pay

<table>
<thead>
<tr>
<th>Share Base pay out of Earnings</th>
<th>All Monthly</th>
<th>Full-Year Employees Monthly</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>10\textsuperscript{th} Percentile</td>
<td>78.6%</td>
<td>78.3%</td>
<td>80.3%</td>
</tr>
<tr>
<td>25\textsuperscript{th} Percentile</td>
<td>93.7%</td>
<td>93.6%</td>
<td>90.1%</td>
</tr>
<tr>
<td>Median</td>
<td>100%</td>
<td>100%</td>
<td>96.2%</td>
</tr>
<tr>
<td>75\textsuperscript{th} Percentile</td>
<td>100%</td>
<td>100%</td>
<td>99.4%</td>
</tr>
<tr>
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- Majority of earnings are in base pay
- Mass of workers receiving commissions, tips, etc. as large share
- 25-35% of workers receive annual bonus, about 3% of earnings.
Part 2:
Nominal Wage Adjustment for Job-Stayers
Wage Setting on-the-Job

- Why focus on job-stayers?
  
  (1) Comparison with literature (mostly job-stayers)

  (2) Provide set of moments to use when relevant measure is on-the-job adjustments
Wage Setting on-the-Job

- Why focus on job-stayers?
  1. Comparison with literature (mostly job-stayers)
  2. Provide set of moments to use when relevant measure is on-the-job adjustments

- Provide summary measures of nominal wage adjustments on-the-job.

- Evidence of time dependence in wage adjustment

- Show differences by industry and firm size (in paper)
Part 2a:
Distribution of Wage Changes for Job-Stayers
Distribution of 12 month Wage Change, Job Stayers

Hourly (hourly wage)  Salaried (per period earnings)
Distribution of 12 month Wage Change, Job Stayers

Hourly (hourly wage)  
Salaried (per period earnings)

- Note: Large mass at zero – ~35% of hourly and salaried unchanged
- Note: Hardly any wage cuts – ~2% of hourly and salaried
Distribution of 12 month Wage Change, Job Stayers

- Hourly (hourly wage)
- Salaried (per period earnings)

- Note: Large mass at zero – ~35% of hourly and salaried unchanged
- Note: Hardly any wage cuts – ~2% of hourly and salaried
- Note: Very few small positive wage changes:
  - 8.6% of workers received a wage change of 0-2%
  - 27.1% of workers received a wage change of 2-4%
## Job-Stayer Adjustment Moments, 2008-2016

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Part 2b:
Time Dependence in Wage Changes
Hazard is essentially flat in most months.

Spikes at 1 year and 2 year (and smaller spikes at 6 months).

On-cycle wage changes tend to be smaller.
Seasonality of Wage Changes, Job-Stayers

**Panel A: \( \Pr\{\text{Change}\} \)**
- Monthly seasonality in wage setting.
- Little quarterly seasonality.

**Panel B: Mean Change Size**
Summary – Wage Setting on the Job and When to Use Job-Stayer Rigidity

- Clear time dependence in data
  - Hazards spike at 12 months
  - Monthly, but not quarterly seasonality
  - Taylor style contracting

- Strong asymmetry for job-stayers
  - 66.3% receive wage change; just 2.4% is downward

- Other results (in paper)
  - Large firms more likely to adjust wages
  - Manufacturing firms more likely to adjust wages
  - Firms synchronize their wage changes
Part 3: Aggregate Nominal Wage Rigidity
Building an Aggregate Measure of Rigidity

- Many macro models do not have clear notion of a *job*
  - Supply labor to a labor aggregating firm (e.g. CEE, 2005)

- Much wage growth may come from job switching
  - Posted wage rigidity (Hazell and Taska, 2018)

- Challenge is to *combine job-stayers and job-switchers* into one macro-economic wage adjustment measure
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  1. Present wage change distribution for job-changers
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- Key takeaway: wages much more flexible for job-changers, and thus in aggregate, than inferred from studies of job-stayers.
Part 3a: Nominal Wage Adjustment for Job-Changers
Vast majority of job-changers receive wage change.

Substantially more downward adjustment

Much larger variance
## Stayer vs Changer Comparison, 2008-2016

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Part 3b: Aggregation
Aggregating Job Stayers and Changers

- LEHD Job-to-Job Flows Data shows
  - Quarterly Job Switching Rate: 4.6%
  - Quarterly Job Staying Rate: 88.7%
Aggregating Job Stayers and Changers

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- **Approximate annual flows** by quadrupling quarterly job switching rate
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- **Weight ADP data** so that **job-changers represent 4.8%** = $0.046/(1-0.046)$ of workers quarterly

- Substantially **upweight ADP changers**
  - We only observe switchers **between ADP firms**
### Aggregate Nominal Rigidity, 2008-2016

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<td>Probability of a Wage Cut</td>
<td>0.9%</td>
<td>4.1%</td>
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<tr>
<td><strong>Quarterly</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probability No Change</td>
<td>80.6%</td>
<td>74.1%</td>
</tr>
<tr>
<td>Probability of a Wage Cut</td>
<td>0.9%</td>
<td>4.1%</td>
</tr>
<tr>
<td>Probability of a Wage Increase</td>
<td>18.5%</td>
<td>21.8%</td>
</tr>
<tr>
<td>Std. Dev. of Wage Change</td>
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<td>8.1%</td>
</tr>
<tr>
<td>Conditional Std. Dev.</td>
<td>6.5%</td>
<td>15.3%</td>
</tr>
</tbody>
</table>
## Aggregate Nominal Rigidity, 2008-2016

<table>
<thead>
<tr>
<th></th>
<th>Job Stayers</th>
<th>Aggregate</th>
</tr>
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<tbody>
<tr>
<td><strong>Annual</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probability No Change</td>
<td>33.7%</td>
<td>27.3%</td>
</tr>
<tr>
<td>Probability of a Wage Cut</td>
<td>2.4%</td>
<td>9.9%</td>
</tr>
<tr>
<td>Probability of a Wage Increase</td>
<td>63.9%</td>
<td>62.8%</td>
</tr>
<tr>
<td>Std. Dev. of Wage Change</td>
<td>6.5%</td>
<td>13.6%</td>
</tr>
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Comparing Aggregate vs Job-Stayer Rigidity

- **Job-Changers have much more flexible wages than job stayers**
  - 38.0% receive wage cut in given year (vs 2.4%)
  - 56.8% receive wage increase in given year (vs 56.8%)
  - Standard deviation of 30.4% (vs 6.5%)
Comparing Aggregate vs Job-Stayer Rigidity

- Job-Changers have much more flexible wages than job stayers
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- Aggregate wages see much more downward adjustment than job-stayer wages
  - 9.9% of workers receive wage cut in given year
Comparing Aggregate vs Job-Stayer Rigidity

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- Aggregate wages see much more downward adjustment than job-stayer wages
  - 9.9% of workers receive wage cut in given year

- Aggregate rigidity appropriate in models
  - With no clear notion of job
  - With wage growth both on-the-job and through search

- New Keynesian models should generally use aggregate adjustment
Part 4:
State Dependence in Wage Changes
Time Series of Wage Changes

Panel A: Has Wage Change
Panel B: Has Wage Change: Pos. vs Neg.
# Cyclicality of Job-Stayer and Job-Changer Wages

<table>
<thead>
<tr>
<th></th>
<th>May 2009 To Dec 2010</th>
<th>Jan 2012 To Dec 2016</th>
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</thead>
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<tr>
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<td>Probability No Change</td>
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Distribution of **Annual** Nominal Wage Changes Over Business Cycle, Aggregate

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<tr>
<th>Probability of Wage Change</th>
<th>Quarterly</th>
<th>Annual</th>
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<tr>
<td></td>
<td>March 09-Dec. 10</td>
<td>Jan. 12-Dec. 16</td>
</tr>
<tr>
<td>Share Positive Wage Change (%)</td>
<td>17.7</td>
<td>23.5</td>
</tr>
<tr>
<td>Share Negative Wage Change (%)</td>
<td>5.1</td>
<td>3.9</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>Unconditional Size of Wage Change</th>
<th>Quarterly</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>March 09-Dec. 10</td>
<td>Jan. 12-Dec. 16</td>
</tr>
<tr>
<td>Mean Wage Change (%)</td>
<td>0.7</td>
<td>1.6</td>
</tr>
<tr>
<td>Median Wage Change (%)</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Stan. Deviation of Wage Change (%)</td>
<td>8.1</td>
<td>8.2</td>
</tr>
</tbody>
</table>

| Conditional Size of Any Wage Change        | Quarterly          | Annual            |
|                                            | March 09-Dec. 10   | Jan. 12-Dec. 16   | March 09-Dec. 10 | Jan. 12-Dec. 16 |
| Mean Wage Change (%)                       | 3.3                | 6.0               | 4.4              | 6.9             |
| Median Wage Change (%)                     | 3.0                | 3.3               | 3.2              | 3.5             |
| Stan. Deviation of Wage Change (%)         | 16.8               | 15.0              | 15.8             | 16.0            |

- Many more wage cuts in aggregate during recession
- Over 1 in 10 workers received cut year-over-year in recession
Summary of State Dependence

- **Wage adjustment moves** substantively over the **business cycle**, **across regions** during the Great Recession, and in response to **firm level shocks**.

- **Additional source of downward flexibility** during the recession

- New addition to literature
  - One related recent paper: Sigurdsson and Sigurdardottir (2016) who document some state dependence in wage setting in Iceland.

- Mechanism for **state dependence needed** in models of wage adjustments.
  - Asymmetries
  - Menu costs
Part 5: Benefits of Payroll Data
Comparison with Literature – Household Dataset

- Question: How do these results compare with existing literature?
- Answer: Qualitatively similar. Quantitatively very different.

Some recent papers

Daly, Hobijn and Lucking (2012) and Daly and Hobijn (2014) - Use matched CPS data. **Find roughly 85% of job stayers receive an annual wage change over our entire sample period.**
Comparison with Literature – Household Dataset

- Question: How do these results compare with existing literature?
- Answer: Qualitatively similar. Quantitatively very different.

Some recent papers

Barattieri, Basu and Gottschalk (2014) - Use SIPP data. Try to adjust for measurement error using structural breaks.

- Find quarterly frequency of wage adjustment for job stayers of about 15-22% (we get 20%).
- However, they estimate 12% of all quarterly wage changes for job-stayers are cuts. We estimate that 4.6% (0.9/19.4).
- They find no difference across occupations and industries (and no seasonality).
Quarterly Earnings Change, Job Stayers
(akin to some admin data sources)

- Probability of Earnings Cut: 32.2%
- Standard Deviation: 20.0%
Quarterly Earnings Per Hour Change, Job Stayers (akin to some admin data sources with hours data)

Panel A: Hourly
- Probability of No Change: 12-15%
- Probability of Cut: 21.2% (Hourly), 25.3% (Salaried)
- Standard Deviation: 15.9% (Hourly), 19.2% (Salaried)

Panel B: Salaried
Kurmann and McEntarfer (2017)
Two Year Earnings-Per-Hour Change, Washington State, LEHD

Figure 1: Distribution of hourly wage changes of job stayers. Washington State, 1998:2-2013:2
Why the Difference

1. Workers receive many other forms of compensation in their paychecks.
   - Overtime earnings *(formulaically determined)*
   - Commission/tips *(vary with both effort and economic conditions)*
   - Bonuses
   - Cashed out sick and vacation days *(tradeoff with labor supply)*
   - Signing bonus/Severance pay

2. Hours are measured with noise for salaried workers
Quarterly Base Earnings per Base Hour Change, Job Stayers

- Only ~½ of all salaried workers have reported hours worked

- Salaried worker patterns quite different than our main results because hours are mis-measured for those that do report them.

- Standard Deviation for Salaried: 19.7% (vs 6.5%)
Conclusion
Conclusion

- **Exciting new data** that allows a careful measurement of wage adjustments over the last decade.
  
  - Large samples; Administrative data; spans recession and non-recession periods; worker and firm characteristics

- During non-recessionary periods, essentially **no nominal wage cuts for job-stayers**

- **Job-changers have much more wage adjustment**

- Thus **aggregate flexibility higher than amongst stayers**

- **Future Work:**
  - Heterogeneity
  - Fringe Benefits