Low Passthrough from Inflation Expectations to Income Growth Expectations: Why People Dislike Inflation

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\textsuperscript{1}Federal Reserve Bank of Cleveland  \textsuperscript{2}Morning Consult  \textsuperscript{3}Brandeis University

September 29, 2022

The randomized control trial is registered at the AER RCT Registry (\#AEARCTR-0009062). The views expressed herein are those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of Cleveland or the Federal Reserve System.
Inflation Expectations and Income Growth Expectations

How do inflation expectations and income growth expectations interact and what is the nature of the causality?
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- Relevance in current economic environment:
  - Persistently high inflation and tight labor markets.
  - Wage-price spiral discussions have resurfaced.

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- Relevance in current economic environment:
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  - Wage-price spiral discussions have resurfaced.

- Surveys find that consumers dislike inflation
  - Private agents associate higher inflation with worse economic outcomes.
    - Firms: Coibion et al. (2020, QJE), Savignac et al. (2022).
Role of Inflation Expectations

- Empirical work finds causal link from inflation expectations to firms’ and consumers’ decisions.
  - Coibion et al. (2020, QJE), Coibion et al. (2022)

- Could inflation expectations management be used as a policy tool? Depends on how people perceive it (supply, demand, other?).
  - Coibion et al. (2020, IJE)
Role of Inflation Expectations

- Empirical work finds *causal* link from inflation expectations to firms’ and consumers’ decisions.
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- Could inflation expectations management be used as a policy tool? Depends on how people perceive it (supply, demand, other?).
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- What are the channels through which consumers dislike inflation?
  - Labor markets?
    - Little evidence on the role of inflation expectations on labor market decisions.
      - Bostanci et al. (2020), Jain et al. (2022).
  - Do nominal wage rigidities matter for how households perceive inflation?
This Paper

1. Uses a representative sample of the US population to
   - simultaneously measure both of inflation expectations and income growth expectations.
   - implement a novel experimental setup to assess the causal link between them.

2. Incorporates empirical findings into a New Keynesian model with nominal wage rigidity & search-and-matching frictions to
   - assess their macro implications.
   - understand the mechanism behind why consumers dislike inflation.
Main Empirical Findings

1. Causal, but moderate, relationship from inflation expectations to income growth expectations.
   - 1 ppt increase in inflation expectations results in 0.20 ppt increase in income growth expectations.
   - ⇒ current nominal wage rigidities feeding into expectations.

2. Heterogeneity in passthrough across socio-demographic factors such as income or gender.
   - Insignificant passthrough for women and low-income respondents.
   - 34% (27%) passthrough for high-income (male) consumers.

3. Inflation expectations exert small causal impact on labor market actions.
   - 1 ppt increase in inflation expectations results in 0.11 ppt increase in likelihood to apply for another job.
Main Takeaways from Model Application

1. Relative to a counterfactual unit passthrough, the estimated passthrough:
   - Demand-side $\pi$ shock: lower utility due to longer work hours at lower real wages.
   - Supply-side $\pi$ shock: amplified (-) link between output and inflation.

2. Higher nominal wage rigidity: less positive or more negative association b/n inflation & utility expectations.

3. No macroeconomic effects from the passthrough of inflation expectations into labor market actions.
   - Efforts exerted to increase wages due to higher inflation expectations yields no changes in the average consumer’s real wages, consumption, utility, etc.
Experimental Setup: Overview

0) Pilot in January 2022
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1) Inflation Expectations and Income Growth Expectations Pre-treatment

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   **February 2022: 6.7K respondents.** August 2022: 8K respondents.

2) Control group + 5 Information Treatment Groups
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4) Labor Market Actions
Prior Questions: Inflation Expectations

- Indirect Consumer Inflation Expectations (ICIE)
  - Morning Consult & Cleveland Fed project (Hajdini et al. (2022))
  - Weekly measure of inflation expectations for 20,000 respondents
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  - Weekly measure of inflation expectations for 20,000 respondents

“Next we are asking you to think about changes in prices during the next 12 months in relation to your income. Given your expectations about developments in prices of goods and services during the next 12 months, how would your income have to change to make you equally well-off relative to your current situation, such that you can buy the same amount of goods and services as today? (For example, if you consider prices will fall by 2% over the next 12 months, you may still be able to buy the same goods and services if your income also decreases by 2%). To make me equally well off, my income would have to...

- Increase by %;
- Stay about the same;
- Decrease by %.
Prior Questions: Inflation Expectations

Indirect Consumer Inflation Expectations (ICIE)

Notes: Weekly trimmed mean and the 95% confidence interval based on 1,000 bootstrapped samples.
Prior Questions: Income Growth Expectations

- Do you expect your income to increase, decrease, or stay about the same over the next 12 months?
  - Increase by %;
  - Stay about the same;
  - Decrease by %.

Baseline Exercise: January 2022
Information Treatments

- Control (N=1,075)
Information Treatments

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- The Federal Reserve targets an inflation rate of 2% per year in the long run. (1,155)
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- The Federal Reserve targets an inflation rate of 2% per year in the long run. (1,155)
- A recent survey from The Conference Board found that wages were expected to rise 3.9% in 2022. (1,093)
Information Treatments

- Control (N=1,075)

- The Federal Reserve targets an inflation rate of 2% per year in the long run. (1,155)

- A recent survey from The Conference Board found that wages were expected to rise 3.9% in 2022. (1,093)

- Between January 2021 and January 2022, the Consumer Price Index (CPI), which measures the average change in prices over time that consumers pay for goods and services, showed the inflation rate in the U.S. was 7.5%. (1,112)
Information Treatments

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- Between January 2021 and January 2022, the Consumer Price Index (CPI), which measures the average change in prices over time that consumers pay for goods and services, showed the inflation rate in the U.S. was 7.5%. (1,112)

- According to the Survey of Professional Forecasters, the Consumer Price Index (CPI), which measures the average change in prices over time that consumers pay for goods and services, showed the inflation rate will be 3.7% by the end of 2022. (1,074)
Information Treatments

- Control (N=1,075)
- The Federal Reserve targets an inflation rate of 2% per year in the long run. (1,155)
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- Between January 2021 and January 2022, the Consumer Price Index (CPI), which measures the average change in prices over time that consumers pay for goods and services, showed the inflation rate in the U.S. was 7.5%. (1,112)
- According to the Survey of Professional Forecasters, the Consumer Price Index (CPI), which measures the average change in prices over time that consumers pay for goods and services, showed the inflation rate will be 3.7% by the end of 2022. (1,074)
- According to the U.S. Census Bureau, the United States population was 332,402,978 as of December 31, 2021 (1,120)
Posterior Questions

1. **Inflation Expectations: Michigan Survey of Consumers type of question**
   - In the next year, do you think prices in general will increase, decrease, or stay about the same?
     * Increase by %;
     * Stay about the same;
     * Decrease by %.

2. **Income growth expectations: move the annual forecast horizon forward by 3 quarters**
   - Between December 2022 and December 2023, do you expect your income to increase, decrease, or stay about the same?
     * Increase by %;
     * Stay about the same;
     * Decrease by %.
Labor Market Actions

How likely are you to do the following to increase your income over the next three months?

- Apply for a job(s) that pays more
- Work longer hours
- Ask for a raise
  - Very likely – 4
  - Somewhat likely – 3
  - Somewhat unlikely – 2
  - Very unlikely – 1
- Other: (description)
Treatments Affecting Expectations

\[ \mathbb{E}_i \left( \pi^\text{Prices} \right) = \alpha + \beta \mathbb{E}_i \left( \pi^\text{ICIE} \right) + \sum_{j=2}^{6} \gamma_{\pi j} \times T_{ij} + \sum_{j=2}^{6} \theta_{\pi j} \times T_{ij} \times \mathbb{E}_i \left( \pi^\text{ICIE} \right) + \varepsilon_i \quad (1) \]

- \( T_{ij} = \begin{cases} 1 & \text{if consumer } i \text{ receives treatment } j \\ 0 & \text{otherwise} \end{cases} \)
- \( \gamma_{\pi j} \) - change in inflation expectations level post-treatment \( j \)
- \( \theta_{\pi j} \) - change in relation b/n inflation expectations pre- vs. post-treatment \( j \)
Treatments Affecting Expectations

\[ \mathbb{E}_i \left( \pi^{Prices} \right) = \alpha + \beta \mathbb{E}_i \left( \pi^{ICIE} \right) + \sum_{j=2}^{6} \gamma_{\pi j} \times T_{ij} + \sum_{j=2}^{6} \theta_{\pi j} \times T_{ij} \times \mathbb{E}_i \left( \pi^{ICIE} \right) + \varepsilon_i \tag{1} \]

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\[ \mathbb{E}_i \left( \pi^{Income,2y} \right) = \alpha + \beta \mathbb{E}_i \left( \pi^{Income,1y} \right) + \sum_{j=2}^{6} \gamma_{ij} \times T_{ij} + \sum_{j=2}^{6} \theta_{ij} \times T_{ij} \times \mathbb{E}_i \left( \pi^{Income,1y} \right) + \varepsilon_i \tag{2} \]
# Treatments Affecting Expectations

## Table: Effects of Treatment on Expectations

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E_i(\pi^{Prices})$</td>
<td>0.262***</td>
<td>0.505***</td>
<td>0.775***</td>
<td>0.604***</td>
</tr>
<tr>
<td>$E_i(\pi^{Prices})$</td>
<td>(0.026)</td>
<td>(0.007)</td>
<td>(0.048)</td>
<td>(0.074)</td>
</tr>
<tr>
<td>$E_i(\pi^{Income,2y})$</td>
<td>0.002</td>
<td>-0.023***</td>
<td>-0.127*</td>
<td>-0.094</td>
</tr>
<tr>
<td>$E_i(\pi^{Income,2y})$</td>
<td>(0.036)</td>
<td>(0.008)</td>
<td>(0.072)</td>
<td>(0.117)</td>
</tr>
<tr>
<td>$E_i(\pi^{Income,2y})$</td>
<td>-0.003</td>
<td>-0.213***</td>
<td>-0.047</td>
<td>-0.210*</td>
</tr>
<tr>
<td>$E_i(\pi^{Income,2y})$</td>
<td>(0.035)</td>
<td>(0.013)</td>
<td>(0.071)</td>
<td>(0.101)</td>
</tr>
<tr>
<td>$E_i(\pi^{Income,2y})$</td>
<td>-0.015</td>
<td>-0.258***</td>
<td>-0.114</td>
<td>0.084</td>
</tr>
<tr>
<td>$E_i(\pi^{Income,2y})$</td>
<td>(0.035)</td>
<td>(0.011)</td>
<td>(0.074)</td>
<td>(0.112)</td>
</tr>
<tr>
<td>$E_i(\pi^{Income,2y})$</td>
<td>-0.025</td>
<td>-0.281***</td>
<td>-0.039</td>
<td>-0.091</td>
</tr>
<tr>
<td>$E_i(\pi^{Income,2y})$</td>
<td>(0.036)</td>
<td>(0.011)</td>
<td>(0.071)</td>
<td>(0.111)</td>
</tr>
<tr>
<td>$E_i(\pi^{Income,2y})$</td>
<td>0.047</td>
<td>-0.008</td>
<td>-0.078</td>
<td>0.001</td>
</tr>
<tr>
<td>$E_i(\pi^{Income,2y})$</td>
<td>(0.035)</td>
<td>(0.008)</td>
<td>(0.074)</td>
<td>(0.131)</td>
</tr>
</tbody>
</table>

**Sample**
- All
- All
- All
- Trimmed

**Regression**
- OLS
- Huber
- OLS
- OLS

**Observations**
- 6,620
- 5,892
- 6,622
- 5,753
Low Passthrough from Inflation to Income Growth Expectations

\[
E_i (\pi^{Income,2y}) = \alpha + \beta E_i (\pi^{Prices}) + \psi E_i (\pi^{Income,1y}) + \varepsilon_i
\]  

(3)
Low Passthrough from Inflation to Income Growth Expectations

\[ \mathbb{E}_i (\pi^{Income,2y}) = \alpha + \beta \mathbb{E}_i (\pi^{Prices}) + \psi \mathbb{E}_i (\pi^{Income,1y}) + \varepsilon_i \]  

(3)

IV: \[ \mathbb{E}_i (\pi^{Prices}) = \begin{cases} \sum_{j=2}^{6} \hat{\gamma}_j \pi_j \times T_{ij} + \sum_{j=2}^{6} \hat{\theta}_j \pi_j \times T_{ij} \times \mathbb{E}_i (\pi^{ICIE}) & \text{if } j \in \{2, 4, 5\} \\ 0 & \text{if } j \in \{1, 6\} \end{cases} \]  

(4)

**Exogenous** variation in inflation expectations due to treatments (Coibion et al., 2022).
Low Passthrough from Inflation to Income Growth Expectations

$$\mathbb{E}_i (\pi^{Income,2y}) = \alpha + \beta \mathbb{E}_i (\pi^{Prices}) + \psi \mathbb{E}_i (\pi^{Income,1y}) + \varepsilon_i$$ (3)

$IV$: $\mathbb{E}_i (\pi^{Prices}) = \begin{cases} \sum_{j=2}^{6} \hat{\gamma}_j \times T_{ij} + \sum_{j=2}^{6} \hat{\theta}_j \times T_{ij} \times \mathbb{E}_i (\pi^{ICIE}) & \text{if } j \in \{2, 4, 5\} \\ 0 & \text{if } j \in \{1, 6\} \end{cases}$ (4)

Exogenous variation in inflation expectations due to treatments (Coibion et al., 2022).

$$\mathbb{E}_i (\pi^{Prices}) = \alpha + \beta \mathbb{E}_i (\pi^{Income,2y}) + \psi \mathbb{E}_i (\pi^{ICIE}) + \varepsilon_i$$ (5)

$IV$: $\mathbb{E}_i (\pi^{Income}) = \begin{cases} \hat{\gamma}_{l3} \times T_{i3} + \hat{\theta}_{l3} \times T_{i3} \times \mathbb{E}_i (\pi^{Income,1y}) & \text{if } j = 3 \\ 0 & \text{if } j \in \{1, 6\} \end{cases}$ (6)
## Low Passthrough from Inflation to Income Growth Expectations

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E_i (\pi_{\text{Income},2y})$</td>
<td>0.085***</td>
<td>0.203***</td>
<td>0.403***</td>
<td>0.325</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.069)</td>
<td>(0.074)</td>
<td>(0.381)</td>
</tr>
<tr>
<td>$E_i (\pi_{\text{Income},1y})$</td>
<td>0.674***</td>
<td>0.636***</td>
<td>0.269***</td>
<td>0.269***</td>
</tr>
<tr>
<td></td>
<td>(0.025)</td>
<td>(0.033)</td>
<td>(0.017)</td>
<td>(0.018)</td>
</tr>
<tr>
<td>$E_i (\pi_{\text{ICIE}})$</td>
<td>0.269***</td>
<td>0.269***</td>
<td>0.459***</td>
<td>0.633***</td>
</tr>
<tr>
<td>Constant</td>
<td>0.109</td>
<td>-0.805</td>
<td>4.593***</td>
<td>4.633***</td>
</tr>
<tr>
<td></td>
<td>(0.101)</td>
<td>(0.521)</td>
<td>(0.185)</td>
<td>(0.451)</td>
</tr>
<tr>
<td>Regression</td>
<td>OLS</td>
<td>IV</td>
<td>OLS</td>
<td>IV</td>
</tr>
<tr>
<td>F-test</td>
<td>-</td>
<td>120.584</td>
<td>-</td>
<td>51.202</td>
</tr>
<tr>
<td>Observations</td>
<td>5,525</td>
<td>5,525</td>
<td>2,975</td>
<td>2,910</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.558</td>
<td>0.539</td>
<td>0.262</td>
<td>0.257</td>
</tr>
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</table>
Heterogeneous Passthrough Across Demographic Groups

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Male</th>
<th>Female</th>
<th>&lt;50k</th>
<th>50k-100k</th>
<th>&gt;100k</th>
</tr>
</thead>
<tbody>
<tr>
<td>$E_i (\pi^{Income,2y})$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$E_i (\pi^{Prices})$</td>
<td>0.201***</td>
<td>0.267***</td>
<td>0.156</td>
<td>0.129</td>
<td>0.309*</td>
<td>0.336***</td>
</tr>
<tr>
<td></td>
<td>(0.070)</td>
<td>(0.103)</td>
<td>(0.097)</td>
<td>(0.091)</td>
<td>(0.171)</td>
<td>(0.122)</td>
</tr>
<tr>
<td>$E_i (\pi^{Income,1y})$</td>
<td>0.637***</td>
<td>0.621***</td>
<td>0.634***</td>
<td>0.656***</td>
<td>0.579***</td>
<td>0.589***</td>
</tr>
<tr>
<td></td>
<td>(0.034)</td>
<td>(0.054)</td>
<td>(0.045)</td>
<td>(0.041)</td>
<td>(0.067)</td>
<td>(0.102)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.792</td>
<td>-1.079</td>
<td>-0.534</td>
<td>-0.314</td>
<td>-1.562</td>
<td>-1.503**</td>
</tr>
<tr>
<td></td>
<td>(0.530)</td>
<td>(0.660)</td>
<td>(0.843)</td>
<td>(0.741)</td>
<td>(1.278)</td>
<td>(0.766)</td>
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<tr>
<td>F-test</td>
<td>117.408</td>
<td>51.174</td>
<td>61.95</td>
<td>64.121</td>
<td>27.205</td>
<td>42.654</td>
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<tr>
<td>Observations</td>
<td>5,525</td>
<td>2,724</td>
<td>2,801</td>
<td>2,503</td>
<td>1,894</td>
<td>1,128</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.540</td>
<td>0.600</td>
<td>0.483</td>
<td>0.528</td>
<td>0.452</td>
<td>0.657</td>
</tr>
</tbody>
</table>
Inflation Expectations Modestly Affect Labor Market Actions

\[ y_{ij} = \alpha_j + \beta_j E_i \left( \pi^{Prices} \right) + \varepsilon_{ij} \]  

(7)

Table: Effect of Inflation Expectations on Actions to Increase Income

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( E_i \left( \pi^{Prices} \right) )</td>
<td>0.005***</td>
<td>0.030***</td>
<td>0.004**</td>
<td>0.009</td>
<td>-0.002</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.006)</td>
<td>(0.002)</td>
<td>(0.005)</td>
<td>(0.002)</td>
<td>(0.006)</td>
</tr>
<tr>
<td>Constant</td>
<td>2.231***</td>
<td>2.013***</td>
<td>2.263***</td>
<td>2.216***</td>
<td>2.111***</td>
<td>2.072***</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.053)</td>
<td>(0.022)</td>
<td>(0.050)</td>
<td>(0.022)</td>
<td>(0.051)</td>
</tr>
<tr>
<td>( \frac{dy}{dx} )</td>
<td>0.019</td>
<td>0.114</td>
<td>0.015</td>
<td>0.034</td>
<td>-0.009</td>
<td>0.011</td>
</tr>
<tr>
<td>( \bar{X} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \bar{Y} )</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regression</td>
<td>OLS</td>
<td>IV</td>
<td>OLS</td>
<td>IV</td>
<td>OLS</td>
<td>IV</td>
</tr>
<tr>
<td>F-Test</td>
<td>-</td>
<td>143.3</td>
<td>-</td>
<td>149.8</td>
<td>-</td>
<td>143.3</td>
</tr>
<tr>
<td>Observations</td>
<td>4,651</td>
<td>4,651</td>
<td>4,573</td>
<td>4,573</td>
<td>4,409</td>
<td>4,409</td>
</tr>
</tbody>
</table>

Effects across different demographic groups
Second Wave of the Experiment Confirms the Low Passthrough

August 2022; 8K respondents.

- Passthrough from inflation expectations to income growth expectations: 16.6%.
- Higher passthrough for male (22.0%) and high household income respondents (30.6%).
- Higher inflation expectations increase the probability of applying for another job (0.14***) and working longer hours (0.07***).
- No significant effect on the probability of asking for a raise (0.01).
New Keynesian Model: Overview

General equilibrium model similar to Christoffel and Kuester (2008), Christoffel et al. (2009).

- Search-and-matching in labor markets as in Mortensen and Pissarides (1994).
- Price stickiness as in Calvo (1983).
- Monetary policy responds to inflation deviations from the target and output growth.

Information treatments (public information) affect inflation expectations:

\[
\hat{\pi}_t + 1 = (1 - \lambda) \hat{\pi}_t + 1 + \lambda \hat{\pi}_{t-1} + 1 \quad (8)
\]

Use treatment information, pre- and post-treatment inflation expectations to estimate \( \lambda \).

Details \( \lambda = 0 \).
New Keynesian Model: Overview

General equilibrium model similar to Christoffel and Kuester (2008), Christoffel et al. (2009).

- Search-and-matching in labor markets as in Mortensen and Pissarides (1994).
- Price stickiness as in Calvo (1983).
- Monetary policy responds to inflation deviations from the target and output growth.
- Information treatments (public information) affect inflation expectations:
  - Information stickiness in inflation expectations, similar to Mankiw and Reis (2002):
    \[
    \tilde{E}_t \hat{\pi}_{t+1} = (1 - \lambda)E_t \hat{\pi}_{t+1} + \lambda E_{t-1} \hat{\pi}_{t+1}
    \]  
    (8)
    - use treatment information, pre- and post-treatment inflation expectations to estimate \( \lambda \).
    \[
    \lambda = 0.285
    \]
Matching Fact 1

- Nominal wage rigidity:
  - in any given period, firms and workers cannot renegotiate nominal wages w/ prob. $\gamma$.
  - if no renegotiation, nominal wages adjust to past inflation by $0 \leq \zeta_{w} \leq 1$.
  - $\gamma, \zeta_{w}$ - key parameters to match the estimated passthrough.

Value of employment/unemployment
Matching Fact 1

- Nominal wage rigidity:
  - in any given period, firms and workers cannot renegotiate nominal wages w/ prob. $\gamma$.
  - if no renegotiation, nominal wages adjust to past inflation by $0 \leq \zeta_w \leq 1$.
  - $\gamma$, $\zeta_w$ - key parameters to match the estimated passthrough.

Compute the response of expected nominal wage growth to inflation expectations:

$$
\frac{\partial \tilde{E}_t(\hat{W}_{t+7} - \hat{W}_{t+3})}{\partial \tilde{E}_t \hat{\pi}_{t+4}} = f(\Theta, \gamma, \zeta_w)
$$

Fix all model’s parameters $\Theta$, except $\gamma$ and $\zeta_w$.

$$(\gamma, \zeta_w) = \begin{cases} 
(0.875, 0.675) & \text{passthrough across all respondents} \\
(0.65, 0.306) & \text{counterfactual unit passthrough}
\end{cases}$$
Matching Fact 3

If a worker, who cannot renegotiate, applies for another job due to higher inflation expectations,

- generates an outside offer w/ certainty
- uses that to put some upward pressure on the current nominal wage
Matching Fact 3

If a worker, who cannot renegotiate, applies for another job due to higher inflation expectations,

- generates an outside offer w/ certainty
- uses that to put some upward pressure on the current nominal wage

\[ \hat{W}_t - \hat{W}_{t-1} = \zeta_w \hat{\pi}_{t-1} + e_t^w \]

new: wage-push factor

(11)

\[ e_t^w = \rho_w e_{t-1}^w + \bar{e}_\pi \hat{\pi}_t \hat{\pi}_{t+1} \]

(12)
Matching Fact 3

If a worker, who cannot renegotiate, applies for another job due to higher inflation expectations,

- generates an outside offer with certainty
- uses that to put some upward pressure on the current nominal wage

\[ \hat{W}_t - \hat{W}_{t-1} = \zeta_w \hat{\pi}_{t-1} + e_t^w \]  \hspace{1cm} (11)

\[ e_t^w = \rho_w e_{t-1}^w + \bar{e}_\pi \hat{\pi}_t \hat{\pi}_{t+1} \]  \hspace{1cm} (12)

\[ \bar{e}_\pi = \text{passthrough} \times \text{elasticity of job applications w.r.t. inflation expectations} \]  \hspace{1cm} (13)

\[ \bar{e}_\pi = \begin{cases} 
0.0228 & \text{passthrough across all respondents} \\
0.114 & \text{counterfactual unit passthrough} 
\end{cases} \]  \hspace{1cm} (14)
Demand Shock: Lower Passthrough Lowers Consumers’ Utility

Output

Inflation

Fed funds rate

< Unit pass-through
Unit pass-through

Consumption

Real wage

Nominal wage growth

Hours

Unemployment

Utility
Supply Shock: Lower Passthrough Strengthens (-) Inflation - Output Link
Inflation Expectations and Expected Period Utility

- Generate IRFs to demand and cost-push shocks for 50 periods
  - for many pairs of non-renegotiation prob., $\gamma$, and adjustment to past inflation, $\zeta_w$.

\[ E_t U_{i,t+1} = \alpha_i + \delta_{t+1} + \beta \tilde{E}_t \hat{\pi}_{i,t+1} + \theta (\gamma_i \times \tilde{E}_t \hat{\pi}_{i,t+1}) + \phi (\zeta_{w,i} \times \tilde{E}_t \hat{\pi}_{i,t+1}) + \varepsilon_{i,t} \]

<table>
<thead>
<tr>
<th>Cost-push Shock (1)</th>
<th>Demand Shock (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\tilde{E}<em>t \pi</em>{t+1}$</td>
<td>9.897***</td>
</tr>
<tr>
<td></td>
<td>-0.285</td>
</tr>
<tr>
<td></td>
<td>(1.669)</td>
</tr>
<tr>
<td></td>
<td>(0.183)</td>
</tr>
<tr>
<td>$\gamma \times \tilde{E}<em>t \pi</em>{t+1}$</td>
<td>-10.187***</td>
</tr>
<tr>
<td></td>
<td>-14.486***</td>
</tr>
<tr>
<td></td>
<td>(1.800)</td>
</tr>
<tr>
<td></td>
<td>(0.347)</td>
</tr>
<tr>
<td>$\zeta_w \times \tilde{E}<em>t \pi</em>{t+1}$</td>
<td>-1.305</td>
</tr>
<tr>
<td></td>
<td>1.791***</td>
</tr>
<tr>
<td></td>
<td>(0.842)</td>
</tr>
<tr>
<td></td>
<td>(0.227)</td>
</tr>
<tr>
<td>Observations</td>
<td>5,500</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.204</td>
</tr>
</tbody>
</table>
Demand Shock: No Macro Effects of Wage-push Factor Channel
Concluding Remarks

- Measure inflation expectations and income growth expectations to assess the causal link between them.
  - Low passthrough from inflation expectations to income growth expectations.
  - Heterogeneous effects across socio-demographic factors such as income or gender.
  - Inflation expectations exert small causal impact on labor market actions.

- Explore implications of inflationary shocks in a NK model that matches empirical facts.
  - Demand-side shocks: lower pass through $\Rightarrow$ larger drop in utility.
  - Supply-side shocks: lower pass through $\Rightarrow$ stronger (-) inflation - output link.
  - Higher nominal wage rigidity: less positive or more negative relation b/n inflation & utility expectations.
  - Efforts exerted to increase wages due to higher inflation expectations yields no changes in the average consumer’s real wages, consumption, utility, etc.
Novel Question

1. Indirect utility approach
   - $u(c_t)$ - utility function; increasing and concave in $c_t$.
   - For $u(c_t) = u(c_{t+h})$, it must be that $c_t = c_{t+h}$.
   - $E_t \left( \frac{P_{t+h}}{P_t} \right) = E_t \left( \frac{Y_{t+h}}{Y_t} \right)$

2. Individual experiences: consumers are asked about the anticipated growth of the price index associated with their individual consumption basket.
   - Relatively large and representative pool of respondents is a requirement.
Pilot Exercise: January 2022

- Inflation Expectations: Indirect Consumer Inflation Expectations (ICIE)
- Income growth expectations

Notes: Dashed line shows linear fit b/n ICIE and income growth expectations (20K respondents).
Pilot Exercise: January 2022

Table: Summary Statistics and Relationship between Price and Income Inflation

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1st percentile</td>
<td>-2</td>
<td>-12</td>
<td>-100</td>
</tr>
<tr>
<td>First quartile</td>
<td>0</td>
<td>0</td>
<td>-7</td>
</tr>
<tr>
<td>Median</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Third quartile</td>
<td>10</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>99th percentile</td>
<td>100</td>
<td>100</td>
<td>50</td>
</tr>
<tr>
<td>Mean</td>
<td>12.692</td>
<td>5.523</td>
<td>-7.169</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>24.536</td>
<td>18.822</td>
<td>22.735</td>
</tr>
<tr>
<td>Observations</td>
<td>20,550</td>
<td>20,550</td>
<td>20,550</td>
</tr>
</tbody>
</table>
Estimates of $\gamma_{\pi j}$

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$E_i(\pi^{Prices})$</td>
<td>$E_i(\pi^{Prices})$</td>
<td>$E_i(\pi^{Income,2y})$</td>
<td>$E_i(\pi^{Income,2y})$</td>
</tr>
<tr>
<td>T2: Target</td>
<td>-0.627 0.126</td>
<td>-0.203 0.11</td>
<td>0.011 0.12</td>
<td>0.138 0.15</td>
</tr>
<tr>
<td></td>
<td>(0.460)</td>
<td>(0.468)</td>
<td>(0.248)</td>
<td>(0.127)</td>
</tr>
<tr>
<td>T3: Wages</td>
<td>-0.695 0.771***</td>
<td>-0.208 0.243*</td>
<td>0.243* 0.135</td>
<td>0.135 0.13</td>
</tr>
<tr>
<td></td>
<td>(0.450)</td>
<td>(0.153)</td>
<td>(0.230)</td>
<td>(0.125)</td>
</tr>
<tr>
<td>T4: CPI</td>
<td>-0.825* 0.586***</td>
<td>-0.109 0.200</td>
<td>0.200 0.131</td>
<td>0.131 0.13</td>
</tr>
<tr>
<td></td>
<td>(0.456)</td>
<td>(0.150)</td>
<td>(0.254)</td>
<td>(0.131)</td>
</tr>
<tr>
<td>T5: SPF</td>
<td>-0.749 0.720***</td>
<td>-0.100 0.064</td>
<td>0.064 0.127</td>
<td>0.127 0.13</td>
</tr>
<tr>
<td></td>
<td>(0.465)</td>
<td>(0.149)</td>
<td>(0.247)</td>
<td>(0.127)</td>
</tr>
<tr>
<td>T6: Placebo</td>
<td>0.133 0.498***</td>
<td>-0.373 -0.186</td>
<td>-0.186 -0.127</td>
<td>-0.127 -0.13</td>
</tr>
<tr>
<td></td>
<td>(0.465)</td>
<td>(0.148)</td>
<td>(0.248)</td>
<td>(0.125)</td>
</tr>
<tr>
<td>Constant</td>
<td>5.667*** 1.343***</td>
<td>0.925*** 0.520***</td>
<td>0.520*** 0.520***</td>
<td>0.520*** 0.520***</td>
</tr>
<tr>
<td></td>
<td>(0.337)</td>
<td>(0.098)</td>
<td>(0.185)</td>
<td>(0.131)</td>
</tr>
</tbody>
</table>

Sample | All | All | All | Trimmed |
Regression | OLS | Huber | OLS | OLS |
Observations | 6,620 | 5,892 | 6,622 | 5,753 |
### Effects of Inflation Expectations on Labor Market Actions

<table>
<thead>
<tr>
<th></th>
<th>All</th>
<th>Male</th>
<th>Female</th>
<th>&lt;50k</th>
<th>50k-100k</th>
<th>100k+</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>(2)</td>
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<td>(3)</td>
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<td></td>
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<tr>
<td>(4)</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>(5)</td>
<td></td>
<td></td>
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<td></td>
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<td>(6)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Apply for a Job(s) that Pays More

<table>
<thead>
<tr>
<th>( \frac{dy}{dx} )</th>
<th>All</th>
<th>Male</th>
<th>Female</th>
<th>&lt;50k</th>
<th>50k-100k</th>
<th>100k+</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{\bar{x}}{\bar{y}} )</td>
<td>0.114</td>
<td>0.072</td>
<td>0.184</td>
<td>0.076</td>
<td>0.182</td>
<td>0.094</td>
</tr>
</tbody>
</table>

#### Work Longer Hours

<table>
<thead>
<tr>
<th>( \frac{dy}{dx} )</th>
<th>All</th>
<th>Male</th>
<th>Female</th>
<th>&lt;50k</th>
<th>50k-100k</th>
<th>100k+</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{\bar{x}}{\bar{y}} )</td>
<td>0.034</td>
<td>0.014</td>
<td>0.080</td>
<td>0.003</td>
<td>0.088</td>
<td>0.043</td>
</tr>
</tbody>
</table>

#### Ask for a Raise

<table>
<thead>
<tr>
<th>( \frac{dy}{dx} )</th>
<th>All</th>
<th>Male</th>
<th>Female</th>
<th>&lt;50k</th>
<th>50k-100k</th>
<th>100k+</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \frac{\bar{x}}{\bar{y}} )</td>
<td>0.034</td>
<td>0.014</td>
<td>0.080</td>
<td>0.003</td>
<td>0.088</td>
<td>0.043</td>
</tr>
</tbody>
</table>

**Notes:** We color in red estimates that are significantly different from 0 at at least a 90% significance level.
Calibration of $\lambda$

\[
\left( \hat{E}_t \pi_{t+h} - \hat{E}_{t-1} \pi_{t+1} \right) = (1 - \lambda) \left( E_t \hat{\pi}_{t+h} - E_{t-1} \hat{\pi}_{t+h} \right)
\]

\text{posterior - prior} = \text{new information in period } t

\[
E_i (\pi^{Prices}) - E_i (\pi^{ICIE}) = \alpha + \beta T_i [I_{ij} - E_i (\pi^{ICIE})] + \varepsilon_i
\]

Table: Effect of new information in inflation expectations

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>New information</td>
<td>0.742***</td>
<td>0.711***</td>
<td>0.742***</td>
<td>0.715***</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.014)</td>
<td>(0.012)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Constant</td>
<td>1.581***</td>
<td>-0.678***</td>
<td>1.702***</td>
<td>-0.251</td>
</tr>
<tr>
<td></td>
<td>(0.163)</td>
<td>(0.208)</td>
<td>(0.139)</td>
<td>(0.181)</td>
</tr>
<tr>
<td>Wage Treatment</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Control and Placebo</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Observations</td>
<td>3,338</td>
<td>5,528</td>
<td>4,430</td>
<td>6,620</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.730</td>
<td>0.432</td>
<td>0.735</td>
<td>0.483</td>
</tr>
</tbody>
</table>

Back to New Keynesian Model
Value of Employment and Unemployment

\[ \nu^E_t(W_{it}) = \omega_{it} h_{it} - \kappa h_{it}^{1+\varphi}(1+\varphi)\lambda_t \]

labor income-labor disutility

(15)
Value of Employment and Unemployment

\[
\mathcal{V}_t^E(W_{it}) = w_i h_{it} - \kappa h_{it} \frac{h_{it}^{1+\varphi}}{(1+\varphi)\lambda_t} + \mu \mathbb{E}_t \left[ \Gamma_{t+1} \mathcal{V}_{t+1}^U \right],
\]

if unemployed

(16)
Value of Employment and Unemployment

\[ V^E_t(W_{it}) = \underbrace{w_{it} h_{it} - \kappa h \frac{h^{1+\varphi}}{(1 + \varphi)\lambda_t}}_{\text{labor income-labor disutility}} + \underbrace{\mu E_t \left[ \Gamma_{t,t+1} V^U_{t+1} \right]}_{\text{if unemployed}} \]

+ \underbrace{(1 - \mu) E_t \left[ \Gamma_{t,t+1} \left( \gamma V^E_{t+1}(W_{it} e_t^w\pi_t^{\zeta w} \pi_t^{1-\zeta w}) + (1 - \gamma) V^E_{t+1}(W_{t+1}^*) \right) \right]}_{\text{sticky wage}}

+ \underbrace{(1 - \mu) E_t \left[ \Gamma_{t,t+1} \left( \gamma V^E_{t+1}(W_{it} e_t^w\pi_t^{\zeta w} \pi_t^{1-\zeta w}) + (1 - \gamma) V^E_{t+1}(W_{t+1}^*) \right) \right]}_{\text{flexible wage}}

(17)
Value of Employment and Unemployment

\[ V_t^E (W_{it}) = w_{it} h_{it} - \kappa_h \frac{h_{it}^{1+\varphi}}{(1 + \varphi) \lambda_t} + \mu \mathbb{E}_t \left[ \Gamma_{t,t+1} V_{t+1}^U \right] \]

labor income-labor disutility

if unemployed

\[ + (1 - \mu) \mathbb{E}_t \left[ \Gamma_{t,t+1} \left( \gamma V_{t+1}^E (W_{it} (e_{t}^{W} \pi_t^{\zeta_{w}} \pi_t^{1-\zeta_{w}})) + (1 - \gamma) V_{t+1}^E (W_{t+1}^{*}) \right) \right] \]

sticky wage

flexible wage

\[ V_t^U = b \]

unemployment benefits

(18)

(19)
Value of Employment and Unemployment

\[ V_t^E(W_{it}) = w_{it} h_{it} - \kappa_h \frac{h_{it}^{1+\varphi}}{(1 + \varphi) \lambda_t} + \mu E_t \left[ \Gamma_{t,t+1} V_{t+1}^U \right] \]

labor income-labor disutility

\[ + (1 - \mu) E_t \left[ \Gamma_{t,t+1} \left( \gamma V_{t+1}^E(W_{it}(e_t^w \pi_t^w \pi_t^{1-\zeta_w})) + (1 - \gamma) V_{t+1}^E(W_{t+1}^*) \right) \right] \]

if unemployed

\[ V_t^U = b \]

unemployment benefits

\[ + (1 - s_t) E_t \left[ \Gamma_{t,t+1} V_{t+1}^U \right] \]

if unemployed

(21)
Value of Employment and Unemployment

\[ \nu_t^E(W_{it}) = w_{it} h_{it} - \kappa h_{it} \frac{h_{it}^{1+\varphi}}{(1+\varphi)\lambda_t} + \mu E_t \left[ \Gamma_{t,t+1} \nu_{t+1}^U \right] \]

\[ \text{if unemployed} \]

\[ + (1 - \mu) E_t \left[ \Gamma_{t,t+1} \left( \gamma \nu_{t+1}^E(W_{it}(e_t^w \pi_t^{\zeta_w \bar{\pi}_t^{1-\zeta_w}))) + (1 - \gamma) \nu_{t+1}^E(W_{t+1}^*) \right) \right] \]

\[ \nu_t^U = \begin{cases} b & \text{unemployment benefits} \\ + (1 - s_t) E_t \left[ \Gamma_{t,t+1} \nu_{t+1}^U \right] & \text{if unemployed} \end{cases} \]

\[ + s_t E_t \left[ \Gamma_{t,t+1} \left( \gamma \nu_{t+1}^E(W_{it}(e_t^w \pi_t^{\zeta_w \bar{\pi}_t^{1-\zeta_w}))) + (1 - \gamma) \nu_{t+1}^E(W_{t+1}^*) \right) \right] \]

\[ \text{(22)} \]

\[ \text{(23)} \]

Back to Matching Fact 1
Calibration of Some Important Parameters

- Steady-state values set to U.S. realizations in 2021:IV
  - Unemployment rate: 4.2%
  - Job vacancy rate: 7%
  - Job separation rate: 4.1%

- Others
  - Persistence of wage-push factor: 0.9
  - Labor supply elasticity: 0.1 (Trigari, 2006, closer to micro estimates)