The views expressed in this paper are those of the author(s) and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.
Counter-cyclical DI take up

○ Economic conditions play an important role for DI take up.
  - Autor et al. 2013; Autor & Duggan 2003; Black, Daniel & Sanders 2002; Michaud & Wiczer 2018

○ SSDI applications and awards accelerate during recessions.
  - Autor & Duggan 2003; Maestas, Mullen & Strand 2018

○ SSDI is costly: the present value of a single award around $300,000.
  - Awardees rarely return to work (Autor & Duggan 2006).
  - Access to Medicare after 2 years on SSDI.

○ Potential hysteresis effects and fiscal consequences of recessions.
COUNTER-CYCLICAL UI BENEFIT DURATIONS

○ UI durations are regularly extended during recessions.
  - From 26 to a potential maximum of 99 weeks during Great Recession.

○ Potential benefits:
  - Consumption insurance (Ganong & Noel 2019)
  - Aggregate demand effects (Mc Kay & Reis 2017; Kekre 2019)
  - Housing stabilizer (Hsu, Matsa & Melzer 2018)
  - Productivity gains (Acemoglu & Shimer 1999)
Counter-cyclical UI benefit durations

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  - Aggregate demand effects (Mc Kay & Reis 2017; Kekre 2019)
  - Housing stabilizer (Hsu, Matsa & Melzer 2018)
  - Productivity gains (Acemoglu & Shimer 1999)

○ Potential costs:
  - Disincentive effects on labor supply (Rothstein 2011; Farber, Rothstein & Valletta 2015; Johnston & Mas 2018)
  - Search externalities (Lalive, Landais & Zweimuller 2015)
  - Equilibrium effects on labor demand (Hagedorn, Karahan, Manovskii & Mitman 20XX; Chodorow-Reich, Coglianese & Karabarbounis 2019)
More generous UI policies keep those that would o/w go on DI in the labor force.

Questions:
More generous UI policies keep those that would o/w go on DI in the labor force.

Questions:
1. Does UI take up rise during recessions? **YES, increasingly with age.**
More generous UI policies keep those that would o/w go on DI in the labor force.

Questions:
1. Does UI take up rise during recessions? **YES, increasingly with age.**
2. Does extending UI durations during downturns reduce DI take up? **YES**
More generous UI policies keep those that would o/w go on DI in the labor force.

Questions:
1. Does UI take up rise during recessions? **YES, increasingly with age.**
2. Does extending UI durations during downturns reduce DI take up? **YES**
3. What are the effects of UI extensions in recessions given program substitution?
More generous UI policies keep those that would o/w go on DI in the labor force.

Questions:
1. Does UI take up rise during recessions? **YES, increasingly with age.**
2. Does extending UI durations during downturns reduce DI take up? **YES**
3. What are the effects of UI extensions in recessions given program substitution?

New analysis to measure interactions between UI and DI programs
- Complementary to Lindner & Nichols 2012; Muller, Rothstein & von Wachter 2016; Rutledge 2012
WHAT WE DO

Empirically,

1. Show that DI take up rise in recessions.

2. Exploit variation in UI duration during the Great Recession to show:
   - DI applications decline as UI durations get extended (state level).
   - DI applications rise in response to unanticipated UI cuts (Missouri).
   - DI take up decreases with UI durations (border county design).

Using a quantitative model:

1. Rationalize the empirical findings.

2. Study the effects of counter-cyclical UI policies on DI take up and the labor market.
Road Map

Empirical Analysis

Model

Quantitative Analysis
Data

○ Cohort analysis: SIPP


○ UI durations constructed from weekly trigger reports from the Department of Labor.

○ Monthly DI applications at the state level from SSA

○ Annual number of beneficiaries at the county level from SSA

○ Other state and county level data from BLS LAUS, Census population estimates, etc.
Cyclicality of DI Take Up

○ Once on DI, return to work is rare.

○ If take up is counter cyclical, cohorts exposed to more recessions would have higher shares on DI at any given age.
  - inspired by Storesletten, Telmer & Yaron 2004 (cyclicality of income risk).

○ Compare share on DI across cohorts with same age but different histories.

○ The share of DI recipients of a cohort at age $a$ is given by $\text{DI}_a = 1 - \prod_{i=1}^{a}(1 - f_a)$
  - $f_a$: share of individuals that go on DI at age $a$. Recessions: $f_a^r = f_a(1 + \chi_a^r)$
  - Assume DI is a completely permanent state.
Conceptual Illustration

![Graph showing the share of DI (%) over age with a line labeled "Cohort w. 0 downturns". The x-axis represents age from 25 to 60, and the y-axis represents the share of DI (%) from 0 to 12. The graph shows an upward trend as age increases.]
Conceptual Illustration

Graph showing the share of DI (%) against age for different cohorts with varying downturns.
CONCEPTUAL ILLUSTRATION
Conceptual Illustration

Graph showing the share on DL (%) over age for different cohorts with 0 to 4 downturns.
Conceptual Illustration
○ Controlling for age, \( \text{cov}(\#\text{recessions}, \text{DI share}) \) is informative of cyclicality.
○ Strength of covariance at difference ages reveals sensitivity at different ages.
Cohort Analysis using SIPP Data

- Pool 1996–2008 SIPP panels, ages 25 to 60.

- For each cohort (c) and age (a) cell, compute the share on disability, \( DI_{ca} \).

- Residualize \( DI_{ca} \) by removing age effects.

- Plot residualized \( DI_{ca} \) against the share of working life in expansionary years.

- A year is expansionary if real GNP growth is above its long-run average.
Cyclicality of DI Take Up

- Recessions increase DI take up.

- Slope for 30–39: -0.014
- Slope for 40–49: -0.039
- Slope for 50+: -0.114

DI take up is cyclically sensitive - more so for older individuals.
Recessions increase DI take up.

Slope for 30–39: -0.014
**Cyclicalality of DI Take Up**

- Recessions increase DI take up.
- Slope for 30–39: -0.014
- Slope for 40–49: -0.039

![Graph showing the relationship between share on DI and share of working life in expansion.](image-url)
Cyclicality of DI Take Up

○ Recessions increase DI take up.
○ Slope for 30–39: -0.014
○ Slope for 40–49: -0.039
○ Slope for 50+: -0.114
Cyclicality of DI Take Up

- Recessions increase DI take up.
- Slope for 30–39: -0.014
- Slope for 40–49: -0.039
- Slope for 50+: -0.114
- DI take up is cyclically sensitive
  - more so for older individuals
Measuring the Effect of UI Durations on DI

- DI is a costly way of insuring business cycle shocks.

- Can more targeted insurance programs, such as UI, affect this behavior?
  - Use variation across states in UI durations during the Great Recession.

- UI is partly state administered. During the Great Recession:
  - Regular, Extended Benefits (EB), Emergency Unemployment Compensation (EUC).
  - 26 weeks to as long as 99 weeks of UI.
  - Duration contingent on state labor market cdts. ⇒ variation across space and time.

- DI is fully federally administered. No geographical variation in generosity.
UI Duration During the Great Recession
3 pieces of evidence to show longer UI durations lead to fewer DI applications and take up:

1. State-level monthly DI applications.

2. Large UI cut in Missouri in April 2011.

3. Border design on county-level annual DI take up.
**State-level DI Applications**

\[
\log(\text{DI Applications}_{st}) = \alpha_s + \gamma_t + \beta \log(\text{UI Duration}_{st}) + X'_{st} \eta + \varepsilon_{st}
\]

<table>
<thead>
<tr>
<th>Variables</th>
<th>\log(\text{DI Applications})</th>
</tr>
</thead>
<tbody>
<tr>
<td>\log(\text{UI Duration})</td>
<td>-.082**</td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
</tr>
<tr>
<td>Unemployment rate</td>
<td>0.020***</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
</tr>
</tbody>
</table>

| \(N\)                      | 4896                          |
| Time FE                    | ✓                             |
| State FE                   | ✓                             |
**LARGE UNANTICIPATED UI CUT IN MISSOURI**

- Missouri State House passed a law to extend EB to 20 weeks for federal funds.

- Republicans at the State Senate argued this would increase fiscal deficit.

- Following a filibuster in the State Senate, a compromise was reached.
  
  **State** regular weeks cut from 26 weeks to 20 weeks.

  **Federal** EUC depends on regular benefits, implying additional 10 week cut.

  ⇒ UI cut from 73 weeks to 57 weeks in April 2011.

- Largely unanticipated: First news on April 8, law passed on April 13.
Missouri Natural Experiment

- Compare Missouri to a synthetic control constructed from other US states following Johnston and Mas (2018)

- Match states based on:
  - disability applications
  - unemployment rate
  - UI duration
  - employment shares by NAICS–1 sectors

before the April 2011 cut.
April 2011: Missouri cuts UI
MISSOURI NATURAL EXPERIMENT
Missouri Natural Experiment

![Graph showing beneficiaries per 1,000 pop. in 20-64 (MO-control) over years from 2000 to 2014. The graph shows a general increase in beneficiaries over time.]
Border Discontinuity

- Extensions tied to state-level conditions.
- Compare two neighboring counties on different sides of state borders.
**Border Discontinuity**

\[
\Delta_p \log(\text{DI Stock}_{c(p)t}) = \alpha_p + \beta \Delta_p \log(\text{UI Duration}_{c(p)t}) + \Delta_p X'_{c(p)t}\eta + \varepsilon_{pt}
\]

<table>
<thead>
<tr>
<th>Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
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</thead>
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<tr>
<td>log(DI Stock)</td>
<td>-0.039***</td>
<td>-0.038***</td>
<td>-0.040***</td>
</tr>
<tr>
<td>(\Delta_p \log(\text{UI Duration}))</td>
<td>(0.012)</td>
<td>(0.011)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>(\Delta_p \log(\text{Pop}_{20-64}))</td>
<td>0.391***</td>
<td>0.396***</td>
<td>0.468***</td>
</tr>
<tr>
<td>(\Delta_p \log(\text{Unemployed}))</td>
<td>(0.095)</td>
<td>(0.099)</td>
<td></td>
</tr>
<tr>
<td>(\Delta_p \log(\text{Employed}))</td>
<td></td>
<td></td>
<td>-0.109**</td>
</tr>
<tr>
<td>(N)</td>
<td>10534</td>
<td>10534</td>
<td>10534</td>
</tr>
<tr>
<td>County Pair FE</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
Road Map

Empirical Analysis

Model

Quantitative Analysis
Environment

- Equilibrium search model:
  + worker heterogeneity in health and skill
  + stochastic UI and DI eligibility
  + DI applications

- Unit mass of workers and large mass of potential firms.

- Random search and free entry.
  - Matching function \( M(S, v) \), labor market tightness \( \theta = v/S \).
  - Worker contact rate \( f(\theta) = M/S \), firm contact rate \( q(\theta) = M/v \).
  - Search subject to convex cost \( c(\cdot) \).

- Exogenous match destruction rate \( \delta \).

- Wages determined according to Nash Bargaining.
Worker Heterogeneity

Labor market states:
- Employed and UI eligible/ ineligible.
- Unemployed and UI and DI eligible/ineligible.
- Apply for DI benefits.
- Receive DI benefits (probabilistic).

Health $h$:
- improve with $\lambda^a(h)$, worsen with $\lambda^d(h)$
- mortality rate $\nu$
- disutility from work $v(h)$, $v'(h) < 0$.

Skill $s$:
- appreciate when employed with $\pi^a$
- depreciate when non-employed with $\pi^d$. 
Government Programs

○ UI and DI payments: $b$ and $d$.

DI eligibility:
- Non-employed become long-term unemployed and eligible to apply for DI at rate $\omega$.
- Applicants are admitted with probability $p(\theta, h, s); p_h < 0$.

UI eligibility:
- Ineligible employed re-entitled for UI at rate $r$.
- Eligible unemployed exhausts UI at rate $e$.
- DI applicants become ineligible automatically.

○ Programs financed with proportional tax $\tau$ on output.
CALIBRATION

○ Health transitions

<table>
<thead>
<tr>
<th></th>
<th>Severe</th>
<th>Moderate</th>
<th>Good</th>
</tr>
</thead>
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<tr>
<td>Severe</td>
<td>.9712</td>
<td>.0106</td>
<td>.01812</td>
</tr>
<tr>
<td>Moderate</td>
<td>.0205</td>
<td>.9098</td>
<td>.0695</td>
</tr>
<tr>
<td>Good</td>
<td>.0017</td>
<td>.0035</td>
<td>.9946</td>
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</table>

○ Targets

<table>
<thead>
<tr>
<th>Moment</th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unemployment Rate</td>
<td>0.05</td>
<td>0.049</td>
</tr>
<tr>
<td>DI share</td>
<td>0.045</td>
<td>0.045</td>
</tr>
<tr>
<td>EN separation rate</td>
<td>0.015</td>
<td>0.015</td>
</tr>
<tr>
<td>Job Finding Rate Severe</td>
<td>0.0860</td>
<td>0.0862</td>
</tr>
<tr>
<td>Job Finding Rate Moderate</td>
<td>0.2260</td>
<td>0.2255</td>
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<tr>
<td>Job Finding Rate Good</td>
<td>0.2516</td>
<td>0.2501</td>
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</table>
### Model Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A. PREDETERMINED</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\beta$</td>
<td>Discount Factor</td>
<td>0.9967</td>
<td>4% annual interest rate</td>
</tr>
<tr>
<td>$\nu$</td>
<td>Death probability</td>
<td>$1/480$</td>
<td>40-year work life</td>
</tr>
<tr>
<td>$e$</td>
<td>UI expiration rate</td>
<td>$1/5.983$</td>
<td>26-week regular UI benefits</td>
</tr>
<tr>
<td>$r$</td>
<td>UI re-entitlement rate</td>
<td>$1/5.523$</td>
<td>6-month employment</td>
</tr>
<tr>
<td>$\omega$</td>
<td>DI eligibility rate</td>
<td>$1/5$</td>
<td>5-month waiting period</td>
</tr>
<tr>
<td>$\phi$</td>
<td>Worker bargaining share</td>
<td>0.5</td>
<td>–</td>
</tr>
<tr>
<td>$\lambda$</td>
<td>Matching function parameter</td>
<td>0.4</td>
<td>Hagedorn and Manovskii (2008)</td>
</tr>
<tr>
<td>$p(h_1)$</td>
<td>DI admission probability</td>
<td>1/4</td>
<td></td>
</tr>
<tr>
<td>$p(h_2)$</td>
<td></td>
<td>1/12</td>
<td></td>
</tr>
<tr>
<td>$p(h_3)$</td>
<td></td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>$v(h_3)$</td>
<td>No work limitation disutility</td>
<td>0</td>
<td>Normalization</td>
</tr>
<tr>
<td>$\xi$</td>
<td>Home production</td>
<td>0</td>
<td>–</td>
</tr>
<tr>
<td>$\psi$</td>
<td>Search cost shape parameter</td>
<td>1</td>
<td>–</td>
</tr>
<tr>
<td>$\lambda^a$</td>
<td>Skill appreciation probability</td>
<td>0.0137</td>
<td>Returns to tenure</td>
</tr>
<tr>
<td>$\lambda^d$</td>
<td>Skill depreciation probability</td>
<td>0.5464</td>
<td>Earnings loss after job displacement</td>
</tr>
<tr>
<td><strong>B. ESTIMATED</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\kappa$</td>
<td>Vacancy posting cost</td>
<td>0.0063</td>
<td>Unemployment rate</td>
</tr>
<tr>
<td>$d, b$</td>
<td>DI/UI flow benefit level</td>
<td>0.1570</td>
<td>Disability beneficiary share</td>
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<tr>
<td>$\delta$</td>
<td>Exogenous separation rate</td>
<td>0.0089</td>
<td>Average EN rate</td>
</tr>
<tr>
<td>$v(h_1)$</td>
<td>Severe work limitation disutility</td>
<td>0.1628</td>
<td>Job finding rate for $h_1$</td>
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<tr>
<td>$v(h_2)$</td>
<td>Moderate work limitation disutility</td>
<td>0.1061</td>
<td>Job finding rate for $h_2$</td>
</tr>
<tr>
<td>$A$</td>
<td>Search cost scale parameter</td>
<td>0.5</td>
<td>Job finding rate for $h_3$</td>
</tr>
</tbody>
</table>
Road Map

Empirical Analysis

Model

Quantitative Analysis
Missouri Natural Experiment Revisited

- Hit the model with one-time unanticipated and persistent UI cut.

\[ e = 1 / 16.8 \rightarrow e = 1 / 12.9 \]

\[ = 73 \text{ weeks} \quad = 56 \text{ weeks} \]

- Study perfect-foresight transition dynamics.
Missouri Natural Experiment Revisited

April 2011: Missouri cuts UI
MISSOURI NATURAL EXPERIMENT REVISITED

Applications per 1,000 pop. in 20-64 (MO-control)

Year

Data
Model
MISSOURI NATURAL EXPERIMENT REVISITED
Recessions and DI take up

- Hit the model with one-time negative productivity shock.
  - No UI extension.
  - Extend UI from 26 weeks to 39 weeks.
  - Extend UI from 26 weeks to 52 weeks.

- To isolate the DI application channel, fix the macro (market tightness) and micro (search effort) responses to the no UI extension benchmark.
DI OUTCOMES

![Graph showing Labor Force Participation, % deviation over time with different UI Extension scenarios.]
Macro effects as a result of UI-DI interactions

When UI is cut, unemployment declines due to several channels

- Unemployed claim DI at higher rates (participation margin)
- Market tightness increases (macro effect) due to a macro effect
  - increased profits (Hagedorn, Karahan, Manovskii and Mitman 20XX)
MACRO EFFECTS AS A RESULT OF UI-DI INTERACTIONS

When UI is cut, unemployment declines due to several channels

○ Unemployed claim DI at higher rates (participation margin)

○ Market tightness increases (macro effect) due to a macro effect
  - increased profits (Hagedorn, Karahan, Manovskii and Mitman 20XX)
  - Composition of the unemployed pool

[decomposition in progress]
Conclusions

- We study the substitutability of two large income replacement programs in the U.S.
- Disability insurance is used by households to deal with lost income during the Great Recession—not the main goal of the program.
- Extending unemployment benefits can mitigate this behavior.
- A model can rationalize the empirical findings and is used to study the effects of counter cyclical UI policies in the presence of this margin.
- A new composition channel. Cutting UI:
  - leads low skill/health workers to drop out of the labor force
  - increases the job finding rate of the rest.
DI Applications are Counter Cyclical

Comovement at bus. cycle frequency (HP-trend, $\alpha = 100$, post-1984 corr=0.8).
**Worker Problem: Disability**

Non-employed worker with UI and DI eligibility status $i \in \{E, I\}$ and $j \in \{ED, ID\}$:

$$\tilde{U}_{i,ED}(h,s) = \max \left\{ U_{i,ED}(h,s), \ D^A(h,s) \right\}$$

Value of applying for DI:

$$D^A(h,s) = \xi + \beta \left[ p(\theta, h, s) \mathbb{E}_n[D^R(h',s')] + (1 - p(\theta, h, s)) \mathbb{E}_n[\tilde{U}^{I,ED}(h',s')] \right]$$

Value of receiving DI:

$$D^R(h,s) = \xi + d + \beta \mathbb{E}_n\left[ \max \left\{ D^R(h',s'), U^{I, ID}(h',s') \right\} \right]$$
Worker Problem: Job Search

Value of UI-ineligible, DI-ineligible job search:

\[
U_{I, ID}(h, s) = \max_{\sigma} \xi - c(\sigma) + \beta \left[ (1 - \sigma f(\theta)) \left( (1 - \omega) \mathbb{E}_n U_{I, ID}(h', s') + \omega \mathbb{E}_n \tilde{U}_{I, ED}(h', s') \right) + \sigma f(\theta) \mathbb{E}_e W^I(h', s') \right]
\]

Value of UI-ineligible, DI-eligible job search:

\[
U_{I, ED}(h, s) = \max_{\sigma} \xi - c(\sigma) + \beta \left[ (1 - \sigma f(\theta)) \mathbb{E}_n \tilde{U}_{I, ED}(h', s') + \sigma f(\theta) \mathbb{E}_e W^I(h', s') \right]
\]
Worker Problem: Job Search

Value of UI-eligible, DI-ineligible job search:

\[ U^{\text{E,ID}}(h, s) = \max_{\sigma} \xi + b - c(\sigma) + \beta \left[ (1 - \omega)(1 - \sigma f(\theta)) \left( e \mathbb{E}_n U^{\text{I,ID}}(h', s') + (1 - e) \mathbb{E}_n U^{\text{E,ID}}(h', s') \right) ight. \\
\quad + \left. \omega(1 - \sigma f(\theta)) \left( e \mathbb{E}_n \tilde{U}^{\text{I,ED}}(h', s') + (1 - e) \mathbb{E}_n \tilde{U}^{\text{E,ED}}(h', s') \right) + \sigma f(\theta) \mathbb{E}_e W^E(h', s') \right] \]

Value of UI-eligible, DI-eligible job search:

\[ U^{\text{E,ED}}(h, s) = \max_{\sigma} \xi + b - c(\sigma) + \beta \left[ (1 - \sigma f(\theta)) \left( e \mathbb{E}_n \tilde{U}^{\text{I,ED}}(h', s') + (1 - e) \mathbb{E}_n \tilde{U}^{\text{E,ED}}(h', s') \right) ight. \\
\quad + \left. \sigma f(\theta) \mathbb{E}_e W^E(h', s') \right] \]
Worker Problem: Employment

UI-eligible employment value:

\[ W^E(h, s) = w^E(h, s) - v(h) + \beta \left[ \delta \mathbb{E}_n U^E,ID(h', s') + (1 - \delta) \mathbb{E}_e \max \{ W^E(h', s'), U^E,ID(h', s') \} \right] \]

UI-ineligible employment value:

\[ W^I(h, s) = w^I(h, s) - v(h) + \beta \left[ \delta \mathbb{E}_n [U^I,ID(h', s')] + (1 - \delta) \left( r \mathbb{E}_e \left[ \max \{ W^E(h', s'), U^E,ID(h', s') \} \right] + (1 - r) \mathbb{E}_e \left[ \max \{ W^I(h', s'), U^I,ID(h', s') \} \right] \right) \]
**Firm Problem**

Firm with eligible worker:

\[ J^E(h, s) = (1 - \tau) y(h, s) - w^E(h, s) + \beta (1 - \delta) E_e \mathbb{1}\{W^E(h', s') > U^{E,ID}(h', s')\} J^E(h', s') \]

Firm with ineligible worker:

\[ J^I(h, s) = (1 - \tau) y(h, s) - w^I(h, s) + \beta (1 - \delta) \left[ r E_e \mathbb{1}\{W^E(h', s') > U^{E,ID}(h', s')\} J^E(h', s') \right] \\
+ (1 - r) E_e \left[ \mathbb{1}\{W^I(h', s') > U^{I,ID}(h', s')\} J^I(h', s') \right] \]
Equilibrium is a set of value functions, proportional output tax, market tightness, and wages such that:

- Value functions solve the worker and firm Bellman Equations.
- Wages solve the Nash Bargaining problem.
- Worker distribution evolves consistently with worker and firm decisions.
- Market tightness satisfies the firm free-entry condition.
- Output tax balances government budget.

\[ \tau \times \text{Output} = b \times \text{UI Eligible Unemployed} + d \times \text{DI Beneficiaries} \]