Explaining the Unemployment Fluctuations in Taiwan

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Motivation

- Unemployment: Different Regime before and after 1990s
- Vacancy in Taiwan
  - Series begins from 1997
  - Semi-Annual: Low frequency data cannot represent the high mobility in the labor market
Research Question

- Sources of Unemployment Fluctuations
  - Matching Frictions: Frictional Unemployment
  - Job Rationing (Michaillat 2012): Rationing Unemployment
- Is Labor Search-and-Matching Model a good Model for Taiwan?
- Analyze the Labor Market after 1997
  - Different unemployment pattern
  - Data Availability & Quality
Policy Implication

- Extended Unemployment Insurance (UI)
  - Nakajima (2012): UI → Unemployed workers’ search effort ↓
  - Job Rationing as the main source
    - More Generous UI during recessions (Michaillat 2012)
  - Matching Frictions as the main source: Different Suggestion

- Search Assistance or Fiscal (or monetary) policies
  - Job Rationing: Fiscal (or monetary) policies
  - Matching Frictions: Search Assistance
Analysis Approach & Findings

- Job Rationing Model based on Michaillat (2012)
- Calibrate the Parameters based on Taiwan’s Data
- I did not use estimation because I want to examine model performance

Main Findings

- Matching Frictions: Main Source for Unemployment during Normal Time (80%)
- Job Rationing: Main Source for Unemployment during Bad Time (80% during the Great Recession)
Model Equations

\[ h_t = \mu u_t^{\xi} v_t^{1-\xi} \Rightarrow \text{Matching Function (Hires)} \]

\[ f_t = h_t / u_t \Rightarrow \text{Job Finding Rate} \]

\[ q_t = h_t / v_t \Rightarrow \text{Vacancy Filling Rate} \]

\[ u_t = 1 - (1 - s)n_{t-1} \Rightarrow \text{Job Seekers (Unemployment)} \]

\[ n_{t+1} = (1 - s)n_t + h_t \Rightarrow \text{Employment Transition} \]

\[ J_t = \alpha a_t n_t^{\alpha-1} - w_t + E_t (1 - s)J_{t+1} \Rightarrow \text{Job Creation Conditions} \]

\[ J_t = \frac{a_t c^\gamma}{q_t} \Rightarrow \text{Free Entry} \]

\[ w_t^R = \omega a_t^\gamma \Rightarrow \text{Rigid Wage (Source of Job Rationing)} \]

\[ \ln a_t = \rho^a \ln a_{t-1} + \epsilon_t^a \Rightarrow \text{Tech. Shock} \]

\[ \epsilon_t^a \sim N(0, \sigma^a) \]
Model Equations

\[ h_t = \mu u_t^\xi v_t^{1-\xi} \Rightarrow \text{Matching Function (Hires)} \]

- \( h_t \): Hires
- \( u_t \): Unemployed Workers (Job Seekers)
- \( v_t \): Vacancy
- \( \xi \): Matching Elasticity
- \( \xi \): Matching Elasticity
Model Equations

\[ f_t = \frac{h_t}{u_t} \Rightarrow \text{Job Finding Rate} \]
\[ q_t = \frac{h_t}{v_t} \Rightarrow \text{Vacancy Filling Rate} \]
Model Equations

\[ u_t = 1 - (1 - s)n_{t-1} \Rightarrow \text{Job Seekers (Unemployment)} \]

\[ n_{t+1} = (1 - s)n_t + h_t \Rightarrow \text{Employment Transition} \]

- Transition for Unemployment and Employment
- \( s \): Separation Rate
Model Equations

\[ y_t = a_t n_t^\alpha \Rightarrow \text{Production Conditions} \]
\[ J_t = \alpha a_t n_t^{(\alpha - 1)} - w_t + E_t(1 - s)J_{t+1} \Rightarrow \text{Job Creation Conditions} \]
\[ J_t = \frac{a_t c^v}{q_t} \Rightarrow \text{Free Entry} \]

- \( J_t \): Value of hiring a worker (filling a vacancy)
- \( c^v \): Vacancy Cost
Model Equations

\[ w_t^R = \omega a_t^\gamma \implies \text{Rigid Wage (Source of Job Rationing)} \]

\[ \ln a_t = \rho^a \ln a_{t-1} + \epsilon_t^a \implies \text{Tech. Shock} \]

\[ \epsilon_t^a \sim N(0, \sigma^a) \]

- Rigid Wage: \( w_t^R \)
- \( \gamma \): Tech Elasticity for Wage
Calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\beta): Discount Factor</td>
<td>0.999</td>
<td>Convention</td>
</tr>
<tr>
<td>(\alpha): Labor Elasticity</td>
<td>0.462</td>
<td>Labor Share</td>
</tr>
<tr>
<td>(\xi): Matching Elasticity</td>
<td>0.28</td>
<td>Observed Hires, Vacancy and Unemployment</td>
</tr>
<tr>
<td>(\mu): Matching Efficiency</td>
<td>0.69</td>
<td>Observed Hires, Vacancy and Unemployment</td>
</tr>
<tr>
<td>(s): Separation Rate</td>
<td>0.023</td>
<td>Entry and Exit Data</td>
</tr>
<tr>
<td>(c^v): Vacancy Cost</td>
<td>0.12</td>
<td>Vacancy Cost-Wage Ratio = 0.25</td>
</tr>
<tr>
<td>(\gamma): Tech Elasticity</td>
<td>0.7</td>
<td>Pissarides (2009)</td>
</tr>
</tbody>
</table>
\[\rho^a\]
\[\sigma^a\]

- Parameters are calibrated based on Monthly or Quarterly Frequency. For simulation exercise, I transform them into weekly frequency.
Calibration Procedure I

\[ h_t = \mu u_t^\xi v_t^{1-\xi} \Rightarrow \text{Matching Function (Hires)} \]

\[ \min \ln h_t - \ln \mu - \xi \ln u_t - (1 - \xi) \ln v_t \]

- Given hiring, unemployment and vacancy data, we can estimate \( \mu \) and \( \xi \).
Calibration Procedure II

\[ J_t = \alpha a_t n_t^{\alpha - 1} - w_t + E_t(1 - s)J_{t+1} \Rightarrow \text{Job Creation Conditions} \]

\[ J_t = \frac{a_t c^v}{q_t} \Rightarrow \text{Free Entry} \]

So, the Steady-State Equation is

\[ \frac{c^v}{w q} = \alpha \frac{y}{n \cdot w} - 1 + (1 - s) \frac{c^v}{w q} \]

- Given labor share and vacancy cost-to-wage ratio, we can determine \( \alpha \)
Model Performance & Dynamics

- Compare Simulated Moments and Observed Moments
- Compare Smoothed Variables and Observed Variables (Use Tech Shock From Data)
- Impulse Response Functions
### Observed Moment

<table>
<thead>
<tr>
<th></th>
<th>$u$</th>
<th>$v$</th>
<th>$h$</th>
<th>$y$</th>
<th>$a$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>0.101</td>
<td>0.083</td>
<td>0.0787</td>
<td>0.022</td>
<td>0.020</td>
</tr>
<tr>
<td><strong>Autocorrelation</strong></td>
<td>0.906</td>
<td>0.870</td>
<td>0.7647</td>
<td>0.766</td>
<td>0.739</td>
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<tr>
<td><strong>Correlation</strong></td>
<td>1.000</td>
<td>-0.585</td>
<td>-0.5427</td>
<td>-0.692</td>
<td>-0.621</td>
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<tr>
<td></td>
<td>-0.585</td>
<td>1.000</td>
<td>0.6347</td>
<td>0.788</td>
<td>0.786</td>
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<tr>
<td></td>
<td>-0.542</td>
<td>0.634</td>
<td>1.0007</td>
<td>0.722</td>
<td>0.723</td>
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<tr>
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<td>-0.692</td>
<td>0.788</td>
<td>0.7227</td>
<td>1.000</td>
<td>0.995</td>
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<tr>
<td></td>
<td>-0.621</td>
<td>0.786</td>
<td>0.7237</td>
<td>0.995</td>
<td>1.000</td>
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</table>
## Simulated Moment

<table>
<thead>
<tr>
<th></th>
<th>$u$</th>
<th>$v$</th>
<th>$h$</th>
<th>$y$</th>
<th>$a$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard Deviation</strong></td>
<td>0.100</td>
<td>0.067</td>
<td>0.040</td>
<td>0.018</td>
<td>0.016</td>
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<tr>
<td></td>
<td>(0.015)</td>
<td>(0.006)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.002)</td>
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<tr>
<td><strong>Autocorrelation</strong></td>
<td>0.781</td>
<td>0.346</td>
<td>0.094</td>
<td>0.736</td>
<td>0.726</td>
</tr>
<tr>
<td></td>
<td>(0.056)</td>
<td>(0.106)</td>
<td>(0.086)</td>
<td>(0.068)</td>
<td>(0.071)</td>
</tr>
<tr>
<td><strong>Correlation</strong></td>
<td>1.000</td>
<td>-0.585</td>
<td>-0.076</td>
<td>-0.958</td>
<td>-0.950</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.060)</td>
<td>(0.030)</td>
<td>(0.012)</td>
<td>(0.014)</td>
</tr>
<tr>
<td></td>
<td>-0.585</td>
<td>1.000</td>
<td>0.851</td>
<td>0.791</td>
<td>0.808</td>
</tr>
<tr>
<td></td>
<td>(0.060)</td>
<td>(0.000)</td>
<td>(0.028)</td>
<td>(0.022)</td>
<td>(0.019)</td>
</tr>
<tr>
<td></td>
<td>-0.076</td>
<td>0.851</td>
<td>1.000</td>
<td>0.355</td>
<td>0.381</td>
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<tr>
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<td>(0.030)</td>
<td>(0.028)</td>
<td>(0.000)</td>
<td>(0.027)</td>
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<tr>
<td></td>
<td>-0.958</td>
<td>0.791</td>
<td>0.355</td>
<td>1.000</td>
<td>1.000</td>
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<td>(0.022)</td>
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<td>(0.000)</td>
</tr>
<tr>
<td></td>
<td>-0.950</td>
<td>0.808</td>
<td>0.381</td>
<td>1.000</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.019)</td>
<td>(0.029)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
</tbody>
</table>
Observed vs Smoothed Variables

Unemployment

Vacancy
Observed vs Smoothed Variables

Hires

Employment
Observed vs Smoothed Variables

Output
IRFs

Hires

Output
IRFs

Rationing Unemployment

Frictional Unemployment
Mechanism of Job Rationing

\[ J_t = \alpha a_t n_t^{\alpha - 1} - w_t + E_t (1 - s) J_{t+1} \Rightarrow \text{Job Creation Conditions} \]

\[ J_t = \frac{a_t c^v}{q_t} \Rightarrow \text{Free Entry} \]

- \( J_t \): Value of hiring a worker (filling a vacancy)
- \( c^v \): Vacancy Cost
- As \( c^v \to 0 \), we have \( \alpha a_t n_t^{\alpha - 1} = w_t \to n_t^R \)
- \( n_t^R \): Rationing Employment
- Rationing Unemployment: \( u_t^R = 1 - n_t^R \)
- Frictional Unemployment: \( u_t^F = u_t - u_t^R \)
Decomposition

![Graph showing the decompositions of frictional and rationing over time from 1996 to 2020. The x-axis represents the years, and the y-axis shows the values ranging from 0.00 to 0.60. The graph is split into two sections: one for Decomposition and another for Fraction. Each section contains a series of lines depicting the changes in values over the years.]
Model Equations for estimation

\[ h_t = \mu_t u_t^\xi v_t^{1-\xi} \quad \Rightarrow \text{Matching Function (Hires)} \]

\[ f_t = h_t / u_t \quad \Rightarrow \text{Job Finding Rate} \]

\[ q_t = h_t / v_t \quad \Rightarrow \text{Vacancy Filling Rate} \]

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\[ \ln a_t = \rho^a \ln a_{t-1} + \epsilon_t^a, \quad \epsilon_t^a \sim N(0, \sigma^a) \quad \Rightarrow \text{Tech. Shock} \]

\[ \ln \mu_t = \rho^\mu \ln \mu_{t-1} + \epsilon_t^\mu, \quad \epsilon_t^\mu \sim N(0, \sigma^\mu) \quad \Rightarrow \text{Matching Efficiency Shock} \]

\[ \ln \omega_t = \rho^\omega \ln \omega_{t-1} + \epsilon_t^\omega, \quad \epsilon_t^\omega \sim N(0, \sigma^\omega) \quad \Rightarrow \text{Wage Shock} \]
## Estimation

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Prior Density/(Mean Std)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\xi$: Matching Elasticity</td>
<td>$B(0.4, 0.1)$</td>
</tr>
<tr>
<td>$\mu$: Matching Efficiency</td>
<td>$G(0.7, 0.15)$</td>
</tr>
<tr>
<td>$c^w$: Vacancy Cost to Wage</td>
<td>$B(0.25, 0.1)$</td>
</tr>
<tr>
<td>$\gamma$: Tech Elasticity in Wage</td>
<td>$B(0.7, 0.1)$</td>
</tr>
<tr>
<td>$\rho^x$</td>
<td>$B(0.5, 0.2)$</td>
</tr>
<tr>
<td>$\sigma^x$</td>
<td>$IG(0.1, \infty)$</td>
</tr>
</tbody>
</table>

- **Calibrated Model:** Only Estimate Shock Process related parameter and $\gamma$
- **Estimated Model:** Estimate All Parameters
## Posterior Density: Calibrated Model

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Posterior Mean</th>
<th>Credible Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\gamma$</td>
<td>0.8356</td>
<td>[0.7907, 0.8847]</td>
</tr>
<tr>
<td>$\rho^a$</td>
<td>0.6745</td>
<td>[0.5716, 0.7869]</td>
</tr>
<tr>
<td>$\rho^\mu$</td>
<td>0.9545</td>
<td>[0.9342, 0.9741]</td>
</tr>
<tr>
<td>$\rho^\omega$</td>
<td>0.8036</td>
<td>[0.7279, 0.8733]</td>
</tr>
<tr>
<td>$e^a$</td>
<td>0.0136</td>
<td>[0.0119, 0.0152]</td>
</tr>
<tr>
<td>$e^\mu$</td>
<td>0.0491</td>
<td>[0.0434, 0.0549]</td>
</tr>
<tr>
<td>$e^\omega$</td>
<td>0.0019</td>
<td>[0.0015, 0.0023]</td>
</tr>
</tbody>
</table>
## Posterior Density: Estimated Model

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Posterior Mean</th>
<th>Credible Set</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\xi)</td>
<td>0.5434</td>
<td>[0.4165, 0.6589]</td>
</tr>
<tr>
<td>(\mu)</td>
<td>0.2568</td>
<td>[0.1001, 0.4058]</td>
</tr>
<tr>
<td>(c^w)</td>
<td>0.4024</td>
<td>[0.2619, 0.5324]</td>
</tr>
<tr>
<td>(\gamma)</td>
<td>0.6762</td>
<td>[0.5554, 0.7959]</td>
</tr>
<tr>
<td>(\rho^a)</td>
<td>0.7239</td>
<td>[0.6298, 0.8126]</td>
</tr>
<tr>
<td>(\rho^H)</td>
<td>0.9724</td>
<td>[0.9492, 0.9963]</td>
</tr>
<tr>
<td>(\rho^{(\omega)})</td>
<td>0.8418</td>
<td>[0.7815, 0.9067]</td>
</tr>
<tr>
<td>(e^a)</td>
<td>0.0134</td>
<td>[0.0118, 0.0150]</td>
</tr>
<tr>
<td>(e^H)</td>
<td>0.0471</td>
<td>[0.0413, 0.0528]</td>
</tr>
<tr>
<td>(e^{(\omega)})</td>
<td>0.0035</td>
<td>[0.0023, 0.0048]</td>
</tr>
</tbody>
</table>
Decomposition: Calibrated Model

Decomposition

Fraction
Decomposition: Estimated Model

Decomposition

Fraction

Frictional Rationing

\( u_F \)

\( u_R \)
Summary

- Job Rationing Model is not perfect for Taiwan but can well match unemployment, vacancy and hiring.
- Based on the decomposition exercise, the job rationing is the main source that determine unemployment fluctuations during a recession period in Taiwan.
- Fiscal or Monetary Policy are important for us to alleviate the increasing in the unemployment in Taiwan.
Conclusion

- Job Rationing is an important source of unemployment fluctuations in Taiwan
- Future studies can
  - incorporate estimation ⇒ Data Issue
  - consider a more complete model (capital, investment, monetary policy and fiscal policy)