Motivation
Motivation

<table>
<thead>
<tr>
<th>Year</th>
<th>Unemployment Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1974</td>
<td>3%</td>
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<tr>
<td>1984</td>
<td>5%</td>
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<tr>
<td>1994</td>
<td>7%</td>
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<tr>
<td>2004</td>
<td>9%</td>
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<tr>
<td>2014</td>
<td>11%</td>
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</tbody>
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Potential Causes:
- Technology?
- Aggregate demand?
- Mismatch?
- Low job search?
- Low participation?
Motivation

- 1974
- 1984
- 1994
- 2004
- 2014

Unemployment rate

- Technology?
- Aggregate demand?
- Mismatch?
- Low job search?
- Low participation?
- Monetary policy?
- Unemployment insurance?
- Payroll tax?
- Nothing?
- Transfers?
The available models

1. matching model of the labor market
   - tractable
   - but no aggregate demand

2. ?

3. New Keynesian DSGE model
   - many shocks
   - but greater complexity
The general disequilibrium model?

- vast literature after Barro & Grossman [1971]
- recent revival after Great Recession
  - Mankiw & Weinzierl [2011]
  - Caballero & Farhi [2014]
- captures important intuitions
- but difficult to analyze
This model

equilibrium version of the Barro-Grossman model, with matching frictions on product + labor markets:

- graphical representation of GE and welfare
- frictional + classical + Keynesian unemployment
Basic model (no labor market)
Setup

- static model
- measure 1 of identical households
- production takes place within households
- households cannot consume own production
- households trade production on frictional market
Matching function and tightness

\[ k \text{ units of produced good} \]

\[ \nu \text{ visits} \]
Matching function and tightness

- Visits $v$
- Capacity $k$
- Sales
- Purchases
- CRS matching function $h(k,v)$
Matching function and tightness

sales = \( k \cdot h(1, x) = k \cdot f(x) \)

output: \( y = h(k, \nu) \)

purchases = \( \nu \cdot h\left(\frac{1}{x}, 1\right) = \nu \cdot q(x) \)

visits \( \nu \)

capacity \( k \)

tightness: \( x = \nu / k \)
Low product market tightness
High product market tightness
Matching cost: $\rho$ goods per visit

- output $= \left[1 + \tau(x)\right] \cdot \text{consumption}$

- proof:

\[
\begin{align*}
y & = c + \rho \cdot \frac{y}{q(x)} \\
\Rightarrow y \cdot \left[1 - \frac{\rho}{q(x)}\right] & = c \\
\Rightarrow y & = \left[1 + \frac{\rho}{q(x) - \rho}\right] \cdot c \equiv \left[1 + \tau(x)\right] \cdot c
\end{align*}
\]
Tightness and aggregate supply

product market tightness $x$

capacity: $k$

quantity of produced good
Tightness and aggregate supply

\[ y = f(x) \]

output: \( y = f(x) \) k

product market tightness \( x \)

quantity of produced good

capacity \( k \)
Tightness and aggregate supply

\[ c = \frac{f(x) \cdot k}{1 + \tau(x)} = [f(x) - \rho \cdot x] \cdot k \]
Tightness and aggregate supply

tightness of the product market $x$

aggregate supply $c$

output $y$

capacity $k$

consumption

trading cost

idle time

quantity of produced good

$T$ightness and aggregate supply

$C_1$onsumption

$C_2$ommodity $C_1$

$C_3$apacity $C_1$
Nonproduced good

■ valued by consumers
■ in fixed supply
■ traded on a perfectly competitive market
■ examples: real money, land, gold, fixed capital
■ as in Barro & Grossman [1971], Hart [1982], and Blanchard & Kiyotaki [1987]
Households

- take price $p$ and tightness $x$ as given
- choose $c$, $m$ to maximize utility

$$\left( \frac{\chi}{1 + \chi} \cdot \frac{\varepsilon - 1}{\varepsilon} + \frac{1}{1 + \chi} \cdot \frac{\varepsilon - 1}{\varepsilon} \right)$$

subject to budget constraint

$$m \underbrace{+ p \cdot (1 + \tau(x)) \cdot c = \mu + f(x) \cdot p \cdot k}_{\text{numeraire, produced good, endowment, labor income}}$$
Optimal consumption decision

■ first-order condition

\[
\left(1 + \tau(x)\right) \cdot p \cdot \frac{1}{1 + \chi} \cdot m^{-\frac{1}{\varepsilon}} = \frac{\chi}{1 + \chi} \cdot c^{-\frac{1}{\varepsilon}}
\]

■ aggregate demand (as \(m = \mu\)):

\[
c^d(x, p) = \frac{\chi^\varepsilon \cdot \mu}{\left(1 + \tau(x)\right)^\varepsilon \cdot p^\varepsilon}
\]
Tightness and aggregate demand

\[ c^d(x, p) = \frac{\chi^\epsilon \cdot \mu}{(1 + \tau(x))^\epsilon \cdot p^\epsilon} \]
Definition of equilibrium

- equilibrium is \((x, p)\) such that supply = demand:

\[ c^s(x) = c^d(x, p) \]

- 1 equation, 2 variables: indeterminacy
- need a price mechanism to select equilibrium
  - fixed price
  - efficient price
Comparative statics

with fixed price and efficient price
Increase in AD with fixed price

product market tightness \( x \)

quantity

output \( y \)

capacity \( k \)

equilibrium

AS

AD
Increase in AD with fixed price

product market tightness $x$

output $y$
capacity $k$

quantity

AS

AD
Increase in AS with fixed price
Comparative statics with fixed price

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<td></td>
<td>output</td>
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<td>aggregate demand</td>
<td>$y$</td>
<td>$+$</td>
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<td>aggregate supply</td>
<td>$+$</td>
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Definition of efficient price

A diagram shows the relationship between product market tightness (x) and consumption (c). The graph includes an AS curve and an AD curve, intersecting at a point labeled as slack equilibrium. An annotation indicates that the price is too high at this point.
Definition of efficient price

product market tightness $x$

consumption $c$

$AS$ $AD$

tight equilibrium

price is too low

$c^*$ $x^*$
Definition of efficient price

Product market tightness $x$ vs. consumption $c$.

- Efficient equilibrium is marked by the intersection of the demand (AD) and supply (AS) curves.
- The price is efficient at this point.

$$c^* \quad x^*$$
Comparative statics with efficient price

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Complete model
Labor market and unemployment

Labor supply $n$  employment $l$  labor force $h$

producers

recruiters

unemployment

labor market tightness $\theta$

number of workers
Firms

- employ producers and recruiters and sell production
- take real wage $w$ and tightnesses $x$ and $\theta$ as given
- choose number of producers $n$ to maximize profits

\[
\begin{align*}
    f(x) \cdot a \cdot n^\alpha - [1 + \hat{\tau}(\theta)] \cdot w \cdot n
\end{align*}
\]

- selling probability
- production
- wage of producers + recruiters
Optimal employment decision

- first-order condition:

\[ f(x) \cdot \alpha \cdot a \cdot n^{\alpha - 1} = \left[ 1 + \hat{\tau}(\theta) \right] \cdot w \]

- selling probability
- MPL
- matching wedge
- real wage

- labor demand: demand for producers

\[ n^d(\theta, x, w) = \left[ \frac{f(x) \cdot a \cdot \alpha}{(1 + \hat{\tau}(\theta)) \cdot w} \right]^{\frac{1}{1 - \alpha}} \]
Partial equilibrium on labor market

- Labor supply
- Employment $l$
- Labor force $h$
- Labor market tightness $\theta$
- Partial equilibrium
- Labor demand

Diagram showing the relationship between labor supply, employment, labor force, labor market tightness, and the number of workers.
General equilibrium \((x, \theta, p, w)\)

- supply = demand on product and labor markets

\[
\begin{align*}
    c^s(x, \theta) &= c^d(x, p) \\
    n^s(\theta) &= n^d(\theta, x, w)
\end{align*}
\]

- 2 equations, 4 variables: indeterminacy

- need price and wage mechanisms
Keynesian, classical, and frictional unemployment

- equilibrium employment:

\[ l = \left( \frac{f(x) \cdot a \cdot \alpha}{w} \right)^{\frac{1}{1-\alpha}} \cdot \left( \frac{1}{1 + \hat{\tau}(\theta)} \right)^{\frac{\alpha}{1-\alpha}} \]

- frictional unemployment from \( \hat{\tau}(\theta) > 0 \)
- classical unemployment from \( w > a \cdot \alpha \)
- Keynesian unemployment from \( f(x) < 1 \)
Comparative statics with fixed prices

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Comparative statics with efficient prices

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Rigid or flexible prices?
Construct proxy for product market tightness from capacity utilization measure in Survey of Plant Capacity:
Fluctuations in product market tightness: rigid price
Fluctuations in labor market tightness: rigid real wage
Effect of labor supply and demand shocks

- labor supply shocks: negative correlation between employment and labor market tightness
- labor demand shocks: positive correlation between employment and labor market tightness
Evidence of labor demand shocks

Labor market tightness (left scale)

Employment (right scale)
Cross-correlogram: labor market tightness and employment
Labor demand shocks:
AD or technology shocks?
Effect of AD and technology shocks

- **AD** shocks: *positive* correlation between output and product market tightness
- **technology** shocks: *negative* correlation between output and product market tightness
Evidence of AD shocks
Cross-correlogram: product market tightness and output
Conclusion

- tractable model of unemployment fluctuations
- empirical series to measure tightness
  - product market tightness
  - labor market tightness
- origins of unemployment fluctuations
  1. importance of price and wage rigidity (not flexibility)
  2. importance of labor demand shocks (not labor supply)
  3. importance of AD shocks (not technology)