Aggregate Demand, Idle Time, and Unemployment

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November 2014
Motivation
Motivation

Unemployment rate

Technology?
Aggregate demand?
Motivation

- Technology?
- Aggregate demand?
- Mismatch?
- Low job search?
- Low participation?

Unemployment rate

3% 5% 7% 9% 11%
Motivation

Unemployment rate


3%
5%
7%
9%
11%

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 with matching frictions on the labor market
   ▶ many shocks, including aggregate demand 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, especially effect of aggregate demand on unemployment
- but difficult to analyze
This model architecture of the Barro-Grossman model with matching frictions on product + labor markets:

- simple general equilibrium model
- with aggregate demand and unemployment
- comparative statics: aggregate demand, technology, mismatch, labor supply
- graphical representation of GE and welfare
Basic model (no labor market)
Setup

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

\[ k \text{ units of services} \]

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

Capacity $k$

Sales

CRS matching function $h(k, v)$

Purchases

Visits $v$
Matching function and tightness

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

output: $y = h(k, v)$

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

tightness: $x = \frac{v}{k}$

visits $v$

capacity $k$
Low product market tightness
High product market tightness
Matching cost: $\rho \in (0, 1)$ service per visit

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

- proof:

\[
y = \underbrace{c}_{\text{output}} + \underbrace{\rho \cdot v}_{\text{consumption}} = c + \rho \cdot \frac{y}{q(x)}
\]

\[
\Rightarrow y \cdot \left[ 1 - \frac{\rho}{q(x)} \right] = c
\]

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

\[ \text{capacity: } k \]

quantity of services

product market tightness \( x \)
Tightness and aggregate supply

output: \( y = f(x) k \)
Tightness and aggregate supply

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

product market tightness $x$

aggregate supply $c$

output $y$

capacity $k$

consumption

quantity of services

matching cost

idle time
Money

- money in fixed supply $\mu$
- real money balances in households’ utility function
- as in Barro & Grossman [1971]
- and as in Blanchard & Kiyotaki [1987]
Households

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

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

produced good

real money balances

- subject to budget constraint

\[
m + p \cdot (1 + \tau(x)) \cdot c = \mu + f(x) \cdot p \cdot k
\]

numeraire

services

endowment

labor income
Optimal consumption decision

- first-order condition

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

- aggregate demand (as \( m = \mu \)):

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

\[ c^d(x, p) = \left( \frac{\chi}{1 + \tau(x)} \right)^\varepsilon \cdot \frac{\mu}{p} \]
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
  - competitive price in the sense of Moen [1997]
  - also in the paper: Nash bargaining & partially rigid price
Comparative statics
with fixed price
and competitive price
Increase in AD with fixed price
Increase in AD with fixed price
Increase in AS with fixed price
Comparative statics with fixed price

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Definition of competitive price

- Product market tightness $x$ vs. consumption $c$.
- As the price is too high, the market is in a slack equilibrium.

Graph:
- AS (Supply): The supply curve is upward sloping, indicating an increase in the quantity supplied as the price increases.
- AD (Demand): The demand curve is downward sloping, indicating a decrease in the quantity demanded as the price increases.
- The intersection of the AS and AD curves at point $x^*$ and $c^*$ marks the slack equilibrium.
Definition of competitive price

AS

price is too low

AD

tight equilibrium

product market tightness $x$

case$

consumption $c$

case$

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Definition of competitive price

price is competitive

competitive equilibrium

AD

product market tightness \( x \)

consumption \( c \)

\[ x^* \]

\[ c^* \]
Comparative statics with competitive price effect on:

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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

\[
\begin{aligned}
f(x) \cdot a \cdot n^\alpha &- [1 + \hat{\tau}(\theta)] \cdot w \cdot n \\
    \text{selling probability} & \quad \text{production} & \quad \text{wage of producers + recruiters}
\end{aligned}
\]
Optimal employment decision

- **First-order condition:**

\[
\underbrace{f(x)}_{\text{selling probability}} \cdot \alpha \cdot a \cdot n^{\alpha-1} = \underbrace{[1 + \hat{\tau}(\theta)]}_{\text{matching wedge}} \cdot \underbrace{w}_{\text{real wage}}
\]

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

- frictional unemployment from \( \hat{\tau}(\theta) > 0 \)

- classical unemployment from \( w > a \cdot \alpha \)

- Keynesian unemployment from \( f(x) < 1 \)
# Comparative statics, fixed prices

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Comparative statics, fixed prices

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## Comparative statics, competitive 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

![Graph showing fluctuations in log-deviation from HP trend over time from 1974 to 2013.](image)

- Log-deviation from HP trend
- X-axis: Years (1974 to 2013)
- Y-axis: Log-deviation from HP trend

The graph illustrates the fluctuation in product market tightness with rigid prices, showing significant deviations from the HP trend over the years.
Fluctuations in labor market tightness: rigid real wage
Labor demand, labor supply, or mismatch shocks?
Source of labor demand and supply shocks

- labor demand: AD, technology
- labor supply: job search, labor-force participation
Predicted effect of shocks

- **labor supply** and **mismatch** 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
Cross-correlogram: labor market tightness and employment
Labor demand shocks: AD or technology shocks?
Predicted effect of 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

Product market tightness (left scale)
Output (right scale)
Cross-correlogram: product market tightness and output
Conclusion

- tractable model of unemployment fluctuations
- empirical series to measure tightness
  - product market tightness
  - labor market tightness
- source of unemployment fluctuations
  - importance of price and wage rigidity
  - importance of AD shocks