The Capitalists, the Workers, the Bread, and the Galleons

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VERY PRELIMINARY
Overview of the Model

Tractable and equilibrium model with

- Unemployment
- Price and wage rigidity
- Aggregate demand
- Social inequality
Modeling Price and Wage Rigidity

- Use price indeterminacy with *bilateral monopoly*
  - labor market: long-term employment relationship
  - bread market: customer relationship

- Decouple price/wage rigidity from rest of model
  - could explain rigidity with social norms, behavioral factors, bounded rationality, etc.

- Business cycle: quantity movements, rigid prices
Modeling Aggregate Demand

One good \textit{in fixed supply} & one \textit{rigid price}:

- money & menu cost [Blanchard and Kyotaki, 1987]
- unproduced good & monopoly price [Hart, 1982]
- money & rigid price [Barro and Grossman, 1971]
- asset & rigid price [Farmer, 2011]
- steady-state consumption & zero lower bound
Modeling Social Inequality

**Capitalists** differ from **workers**:

- lower preference over consumption
- higher share of profits per capita
- only two types of villagers: no distributions
The Bread and the Galleons
Equilibrium Unemployment & Aggregate Demand

- Three goods:
  - labor
  - bread (produced by labor)
  - galleons (unproduced, numeraire)

- Three markets:
  - galleon market: perfectly competitive
  - labor market: matching frictions, rigid wage
  - bread market: matching frictions, rigid price
Galleon Market

- Village endowment = $\mu$ galleons
- Perfectly competitive market
- Price = 1
- No production, no depreciation
One-Period Labor Market

$1-u$ incumbents

$u$ unemployed
One-Period Labor Market

1-u incumbents  

job-finding probability: 1  

1-u employees  

u unemployed
One-Period Labor Market

job-finding probability: \( f(\theta) \)

- 1-u incumbents
- u unemployed

n=1-u+u \( f(\theta) \) employees
Formation of Worker-Bakery Match

- Bakery posts $o$ vacancies

- Number of new matches: $h = \omega_h \cdot u^\eta \cdot o^{1-\eta}$

- **Labor market tightness:** $\theta \equiv o/u$

- Vacancy-filling probability: $q(\theta) \equiv h/o = \omega_h \cdot \theta^{-\eta}$

- Job-finding probability: $f(\theta) \equiv h/u = \omega_h \cdot \theta^{1-\eta}$

- **Hiring cost:** $r/q(\theta)$ breads
One-Period Bread Market

\[ \text{customers} \quad \text{shoppers} \]
One-Period Bread Market

\[ \kappa \text{ customers} \quad \text{buying probability: 1} \quad \kappa \text{ breads} \]

\[ \sigma \text{ shoppers} \]
One-Period Bread Market

\[ c = \kappa + s \cdot F(x) \text{ breads} \]
Formation of Customer-Bakery Match

- Bakery posts $O$ bread samples
- Number of matches: $H = \omega_H \cdot s^\nu \cdot O^{1-\nu}$
- **Bread market tightness:** $x \equiv O/s$
- Selling probability: $Q(x) \equiv H/O = \omega_H \cdot x^{-\nu}$
- Buying probability: $F(x) \equiv H/s = \omega_H \cdot x^{1-\nu}$
- *Advertizing cost:* $R/Q(x)$ breads
Rigid Wage and Rigid Price

$\theta$ acts like a **wage** and $1/x$ acts like a **price**

- $\theta$ equilibrates labor market
- $x$ equilibrates bread market
- Workers like $x$ and like $\theta$
- Firms dislike $x$ and dislike $\theta$
- Bread wage $w$ and bread price $1/p$ are **parameters**
The Bakery

- Production: \( y = a \cdot n^\alpha - \frac{r \cdot a}{q(\theta)} \cdot [n - (1 - u)] \)

- Bread demand: \( y = \kappa + (c - \kappa) \cdot \left[1 + \frac{R}{Q(x)}\right] \)

- Production necessary for each marginal sale:

\[
\frac{y - \kappa}{c - \kappa} = 1 + \frac{R}{Q(x)}
\]
Bakery’s Employment Decision

■ The bakery maximizes bread profits:

\[ \pi = \kappa \text{ customers} + \frac{a \cdot n^\alpha - \frac{r \cdot a}{q(\theta)} \cdot [n - (1 - u)] - \kappa}{1 + \frac{R}{Q(x)}} - w \cdot n \]

■ First-order condition:

\[ \alpha \cdot n^{\alpha - 1} = \frac{r}{q(\theta)} + \left[ 1 + \frac{R}{Q(x)} \right] \cdot \frac{w}{a}. \]
The Household

- CES utility for bread $c$ and galleon $m$:

$$v(c, m) = \frac{1}{1 + \beta^{1/\epsilon}} \cdot \frac{\epsilon}{\epsilon - 1} \cdot \left[ c^{(\epsilon-1)/\epsilon} + \beta^{1/\epsilon} \cdot m^{(\epsilon-1)/\epsilon} \right]$$

- Budget constraint in terms of breads:

$$p \cdot m + c = p \cdot \mu + \pi + n \cdot w.$$
Household’s Consumption Decision

- Desired bread consumption $c$: 
  \[ c = \frac{1}{1 + \beta \cdot p^{1-\epsilon}} \cdot [p \cdot \mu + \pi + n \cdot w] \]

- Desired galleon consumption $m$: 
  \[ m = \beta \cdot p^{-\epsilon} \cdot c. \]
Bread Market Equilibrium

- Bread supply: \( c^S = \pi + w \cdot n \)

- Bread demand:

\[
c^D = \frac{1}{1 + \beta \cdot p^{1-\epsilon}} \cdot [p \cdot \mu + c^S]\]

- Equilibrium condition:

\[
c^D = c^S\]
Consumption Cross: \( c = p^\epsilon \cdot \mu / \beta \)
Labor Market Equilibrium: $n^d(\theta) = n^s(\theta)$

- Labor supply: $n^s(\theta) = (1 - u) + u \cdot f(\theta)$
- Labor demand $n^d(\theta)$:
  - start from bakery’s first-order condition
  - write $1 + R/Q(x)$ as function of $(n, w)$ by defining a function $G(n, a)$ with $G_n > 0$ and $G_a > 0$
  - define $n^d(\theta)$ implicitly

\[
\alpha \cdot n^{\alpha-1} = \frac{G(n, a)}{[(c - \kappa)/w] + (1 - u) - n} + \frac{r}{q(\theta)}
\]
Labor Market Equilibrium Representation

Equilibrium \((n, \theta)\)

- Labor supply
- Labor demand

UNEMPLOYMENT
Positive Short-Run Technology Shock: $a \uparrow$

\[
\alpha \cdot n^{\alpha-1} = \frac{G(n, a^+)}{[\frac{(c - \kappa)}{w}] + (1 - u) - n} + \frac{r}{q(\theta)}
\]

- lower $n^d(\theta)$, same $n^s(\theta)$
- lower labor market tightness: $\theta \downarrow$, $n \downarrow$, $u \uparrow$
- higher bread market tightness: $x \uparrow$, $c \rightarrow$, $y \uparrow$
- Contractionary technology shock: Pareto, Gali
Negative Demand Shock: $\mu \downarrow$ or $\beta \uparrow$

$$\alpha \cdot n^{\alpha-1} = \frac{G(n, a)}{(c - \kappa)/w + (1 - u) - n} + \frac{r}{q(\theta)}$$

- lower $n^d(\theta)$, same $n^s(\theta)$
- lower labor market tightness: $\theta \downarrow$, $n \downarrow$, $u \uparrow$
- higher bread market tightness: $x \uparrow$, $c \downarrow$, $y \downarrow$
- Keynesian unemployment
Positive Bread-Wage Shock: \( w \uparrow \)

\[
\alpha \cdot n^{\alpha-1} = \frac{G(n, a)}{(c - \kappa)/w + (1 - u) - n} + \frac{r}{q(\theta)}
\]

- lower \( n^d(\theta) \), same \( n^s(\theta) \)
- lower labor market tightness: \( \theta \downarrow, n \downarrow, u \uparrow \)
- lower bread market tightness: \( x \downarrow, c \to, y \downarrow \)
- Classical unemployment
The Capitalists and the Workers
The Capitalists

- Capitalists like galleons more: $\beta^C > \beta^W$
  - lower marginal propensity to consume

- Income:
  - $\phi^P$ of bakery’s profits
  - $\phi^E$ of $\mu$ galleons
  - $\phi^N \cdot (w \cdot n)$

- Capitalists receive more profits: $\phi^P > \phi^N$
Galleon Market-Clearing Condition

\[ c = p \cdot \mu \cdot \frac{X(\phi^E)}{1 - X(\phi^P)} + \frac{\phi^P - \phi^N}{1 - X(\phi^P)} \cdot (B^W - B^S) \cdot w \cdot n. \]

- \( B^W > B^C \) because \( \beta^W < \beta^C \)
- \( \phi^P > \phi^N \) because capitalists receive more profits
- Social inequality: if \( w \uparrow \), then \( c \uparrow \)
Labor Market Equilibrium: \( n^d(\theta) = n^s(\theta) \)

- Labor supply: \( n^s(\theta) = (1 - u) + u \cdot f(\theta) \)
- Labor demand \( n^d(\theta) \):

\[
\alpha \cdot n^{\alpha - 1} = \frac{r}{q(\theta)} + \frac{G(n, a)}{[(c - \kappa)/w] + (1 - u) - n}
\]
Labor Market Equilibrium: $n^d(\theta) = n^s(\theta)$

- Labor supply: $n^s(\theta) = (1 - u) + u \cdot f(\theta)$

- Labor demand $n^d(\theta)$:

$$\alpha \cdot n^{\alpha - 1} = \frac{r}{q(\theta)} + \frac{G(n, a)}{\frac{1}{w} \left[ p \mu \frac{X(\phi^E)}{1 - X(\phi^P)} - \kappa \right] + (1 - u) - \left[ 1 - \frac{\phi^P - \phi^N}{1 - X(\phi^P)} (B^W - B^S) \right] n}$$
Trickle Up

- If \( p \cdot \mu \cdot \frac{X(\phi^E)}{1-X(\phi^P)} < \kappa \)

- **Then when wage \( \uparrow \), unemployment \( \downarrow \)**

- Higher consumption dominates higher labor cost

- **Note:** requires \( \beta^W < \beta^C \) and \( \phi^P > \phi^N \)
Extensions
● Dynamic model with saving/capital
● Social insurance and redistribution
● Tax policy
● Government spending