Bubbles and Unemployment

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Disclaimer

- Usual disclaimer: I am not speaking for others in the Federal Reserve or on the Federal Open Market Committee.

- But I’ll make an even stronger disclaimer: I’m exploring a new theoretical model ...

- And so the results do not necessarily reflect my thinking about policy.
Lots of Exciting Research on Great Recession

- But relatively little concerns the behavior of unemployment.
  - Nice exception: Farmer (2011)

- I will describe a (SIMPLE!) model that connects:
  - a bubble collapse
  - insufficiently accommodative monetary policy
  - elevated unemployment
Basic Modeling Approach

- Take a rational bubble model (in this case, OG).

- “Glue” a Diamond-Mortensen-Pissarides (DMP) model onto it.

- One key element: Ignore DMP job creation margin.
  - jobs are created as needed to satisfy demand
Basic Structure of Equilibria

- Continuum of bubbly equilibria
  - the size of the bubble varies across equilibria
  - zero real interest rate in all equilibria

- Continuum of non-bubbly equilibria
  - indexed by the real interest rate \( \leq 0 \)
  - no bubble in any of them
Result 1

- Take any bubbly equilibrium.

- There exists a non-bubbly equilibrium *with same labor market outcomes.*
  - it has a negative real interest rate

- Interpretation: Bubble collapses don’t affect labor market if real interest rate falls enough.
Result 2

- Take any non-bubbly equilibrium with a negative real interest rate.

- The non-bubbly equilibrium with a zero real interest rate has:
  - higher unemployment
  - more slack in the labor market

- Interpretation: If monetary policy is not sufficiently accommodative after a bubble collapse, the economy will have high unemployment.
Similar Ideas to ...

• Hall (2011) and Krugman (1998)
  – ZLB disrupts adjustment of real interest rate
  – creates labor market disequilibrium

• Farmer (2011)
  – continuum of steady-state unemployment rates indexed by beliefs
Outline

1. Sketch of the DMP Model
2. Some Empirics
3. DMP - Meet OG
4. Structure of Equilibria
5. Results
6. Decline in Matching Efficiency
7. Conclusions
1. Sketch of the DMP Model

- Firms create jobs at exogenous cost $k$.

- Get matched with qualified worker with probability $f(\theta)$.
  - $\theta = v/u$ is endogenous

- (Nash) bargain over wages.
Exogenous Parameters

- $A$ is worker output in job
- $z$ is unemployed worker output
- $\beta$ is worker bargaining power
- $s$ is separation rate
- $\phi$ is matching efficiency
Endogenous Parameters

- $u$ is unemployment rate
- $v$ is vacancy rate
- $\theta \equiv v/u$ is market tightness
Steady-State in DMP Model

\[ k = \frac{(1 - \beta)(A - z)}{\beta \theta} \quad \text{(approx. job creation)} \]

\[ u = \frac{s}{s + \phi f(\theta)} \quad \text{(Beveridge curve)} \]
2. Some Empirics

- Job creation wedge has grown in past three years:

\[
\frac{(1 - \beta)(A - z)}{\beta \theta} - k
\]

- \( \theta \) has fallen by 65% from December 2007 to December 2010.
  
  - BLS data on unemployment and job openings
• The matching efficiency parameter has also fallen ...

•

\[ \phi = \frac{s(1 - u)}{uf(\theta)} \]

• \( \phi \) has fallen between 32% and 44% over the past three years
  – as elasticity of \( f \) ranges between 0.5 and 0.3
3. DMP - Meet OG

- Consider a standard OG model, with 2-period lived households.

- Households have *apple* endowments \((e^y, e^o)\).

- They have utility functions \(U(c^y) + U(c^o + h)\) over *banana* consumption.
  - \(h\) is a small positive parameter
  - \(U\) has non-decreasing relative risk aversion
A Bubbly Asset

- Initial old each have one unit of intrinsically useless asset (land).

- Assume: $e^y > e^o + h$.

- This creates possibility of bubbly equilibria (usual OG).
DMP Part of the Model

- Distinct equal population of infinitely lived workers.
  - Matched workers/firms create \( A \) bananas.
  - Unmatched workers create \( z \) bananas, \( z < A \).

- Worker and firm owners have linear utility over apples

- They can’t participate in asset markets.
Two Novel Features of Model

• Firms create jobs as needed to satisfy banana demand.
  – no job creation condition in equilibrium.

• Central bank picks real interest rate.
4. Structure of Equilibria

- Define bubbly equilibria

- Define non-bubbly equilibria

- Apples (household endowment) are numeraire.
• Given a land price $P^L$, $(c^y_{bub}, c^o_{bub}, P^B_{bub}, u_{bub}, \theta_{bub})$ is a bubbly equilibrium iff:

\[ U'(c^y_{bub}) = U'(c^o_{bub} + h) \]

\[ P^B_{bub} c^y_{bub} = e^y - P^L \]

\[ P^B_{bub} c^o_{bub} = e^o + P_L \]

\[ u_{bub} z + (1 - u_{bub}) A = c^y_{bub} + c^o_{bub} \]

\[ u_{bub} = \frac{s}{s + \phi f(\theta_{bub})} \]
Properties

- The bubbly equilibria are indexed by $P^L$; $r^* = 0$ in all equilibria

- Given a specification for $P^L$:

$$P^B_{bub} = \frac{e^y - e^o - 2P^L}{h}$$

$$[u_{bub}z + (1 - u_{bub})A] = \frac{(e^y + e^o)h}{(e^y - e^o - 2P^L)}$$
• Big bubbles imply low banana prices, high agg. demand, and low unemployment.

• They also imply small wedges in job creation first-order condition because

$$\frac{(A - z)(1 - \beta)}{\beta \theta_{bub}} - \frac{k}{P_{bub}}$$

is small.
Non-Bubbly Equilibria

- Given an interest rate $r^*$, $(c_{nb}^y, c_{nb}^o, P_{nb}^B, u_{nb}, \theta_{nb})$ is a non-bubbly equilibrium iff:

\[
U'(c_{nb}^y) = (1 + r^*)U'(c_{nb}^o + h)
\]

\[
P_{nb}^B c_{nb}^y = e^y
\]

\[
P_{nb}^B c_{nb}^o = e^o
\]

\[
u_{nb}z + (1 - u_{nb})A = c_{nb}^y + c_{nb}^o
\]

\[
u_{nb} = \frac{s}{s + \phi f(\theta_{nb})}
\]
4. Results

Result 1

• Suppose \((c^y, c^o, P^B, u^*, \theta^*)\) is a bubbly equilibrium given \(P^L\).

• Then: There exists \((c'^y, c'^o, r^*)\) such that:

• \((c'^y, c'^o, P^B, u^*, \theta^*)\) is a non-bubbly equilibrium given \(r^*\).
• Pick \((c^y, c^o, r^*)\) so that:

\[
c^y = \frac{e^y}{e^y + e^o}(c^y* + c^o*)
\]

\[
c^o = \frac{e^o}{e^y + e^o}(c^y* + c^o*)
\]

\[
(1 + r^*) = \frac{U'(c^y)}{U'(c^o + h)}
\]

• Simple intuition: Divide the aggregate bananas so that young don’t save.
Interpretation

- Note: $r^* < 0$.

- Given appropriate monetary policy, a bubble collapse has no impact on labor market outcomes.

- Bubble collapse does mean that households are worse off (lower $r^*$).
Result 2

- Suppose \((c^{y'}, c^{o'}, P^{B*}, u^*, \theta^*)\) is a non-bubbly equilibrium given \(r^* < 0\).

- Suppose \((c^{y''}, c^{o''}, P^{B''}, u'', \theta'')\) is a non-bubbly equilibrium given \(r' = 0\).

- Then:

\[ u'' > u^* \text{ and } \theta'' < \theta^* \]
Mechanics

• Equilibrium banana price $P_{nb}^B$ satisfies Euler equation:

$$U'(\frac{e^y}{P_{nb}^B}) = (1 + r^*)U'(\frac{e^o}{P_{nb}^B} + h)$$

• Comparative statics:

$$\frac{d(1/P_{nb}^B)}{dr} = \frac{P_{nb}^B(1 + r^*)}{-CARR(e^y/P_{nb}^B) + CARR(e^o/P_{nb}^B + h)(\frac{e^o/P_{nb}^B}{e^o/P_{nb}^B + h})}$$

$$< 0$$
• Denominator is negative because $U$ has non-decreasing RRA.

• As $r^*$ rises, $P^B_{nb}$ rises, and so $u_{nb}$ rises.
Intuition

• Think of there being three goods - apples, bananas, and banana bonds.

• Young households demand banana bonds that pay off when they are old.
  – that drives up the price of banana bonds in terms of apples

• But - with the fixed real interest rate - the price of bananas has to go up.

• Conclusion: all households demand fewer bananas.
Interpretation

- Bubble collapse implies no effect on unemployment if $r^*$ is lowered enough.

- BUT: ZLB + sticky inflation expectations imply lower bound on $r^*$.

- If $r^*$ doesn’t fall enough, then we get an increase in unemployment.
Increase in Labor Market Wedge

- As $r^*$ rises, $u$ rises, $P_B^{nb}$ rises, and $\theta$ falls.

- Hence, the firm’s job creation wedge:

$$
(1 - \beta)(A - z) - \frac{k}{\beta \theta_{nb}} - \frac{PB}{PB_{nb}}
$$

rises.

- As noted: over past three years, wedge has increased by 65% in US data.
6. Decline in Matching Efficiency

- We have seen that US labor market matching efficiency has declined since 2007.

- What’s the impact of such a decline in the model, assuming:
  
  - $r^*$ is fixed
  
  - no bubbles
No Effect on Unemployment Rate

• Given \( r^*, (c_{nb}^y, c_{nb}^o, P^B_{nb}) \) satisfy:

\[
U'(c_{nb}^y) = (1 + r^*)U'(c_{nb}^o + h)
\]

\[
c_{nb}^y = \frac{e^y}{P^B_{nb}}
\]

\[
c_{nb}^o = \frac{e^o}{P^B_{nb}}
\]

• Then, \( u_{nb} \) is pinned down by aggregate demand:

\[
u_{nb}z + (1 - u_{nb})A = c_{nb}^y + c_{nb}^o
\]

• Decline in \( \phi \) has no effect on the unemployment rate.
Increased Job Openings Rate

• With fixed $u_{nb}$, fall in $\phi$ implies that $\theta_{nb}$ rises:

$$u_{nb} = \frac{s}{s + \phi f(\theta_{nb})}$$

• Hence, with fixed $r^*$, fall in $\phi$ results generates vertical upward shift in Beveridge curve.

• Intuition: need more job openings to replace separations.
7. Conclusions

• Kocherlakota (2011) considers a wide class of rational bubble models.

• That paper describes how a bubble collapse can generate a fall in labor supply.
  – Loss of wealth leads to increase in labor supply.
  – Fall in real interest rate leads to decrease in labor supply.
  – Aggregate effect is ambiguous but can be negative.
• In this paper: unemployment rate is wholly determined by demand.
  – labor supply is irrelevant

• Bubble collapse generates a fall in demand ...

• and unemployment rises if ZLB prevents accommodative monetary policy.

• It would be useful to extend results to a wider class of rational bubble models.