Bubbles and Unemployment*

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1 Introduction

The purpose of this paper is to investigate how the collapse of a bubble affects the long-run behavior of unemployment in a simple theoretical framework. I blend two canonical models together: the overlapping generations model of Samuelson (1958) and the Diamond-Mortensen-Pissarides (DMP) model of unemployment. A key feature of my modeling approach is that I do not require equilibrium outcomes to satisfy the job creation condition of the DMP model. In this loose sense, and as in Farmer (2011), output is "demand-determined".

*Preliminary. The views expressed herein are not necessarily those of my colleagues on the Federal Open Market Committee or anyone else in the Federal Reserve System. Indeed, the paper should be viewed only as an exploration of the properties of a new economic model and, as such, containing no information about my own thinking about current policy. I thank Robert Hall for comments.

I allow for the possibility of a bubble in the price of an asset in fixed supply (that I term land). I show that the unemployment rate is the same in an equilibrium with a bubble as it is in an equilibrium without a bubble, as long as the interest rate is sufficiently low in the latter. In this sense, labor market outcomes are unaffected by a bubble collapse, as long as monetary policy is sufficiently accommodative.

I then impose a lower bound on the real interest rate (motivated, as in Krugman (1998) and Hall (2011), by sticky inflationary expectations and the zero lower bound on the nominal interest rate). This lower bound on the real interest rate creates slack in the labor market that manifests itself as an expanded wedge in the job creation first-order condition of firms. I document that this kind of wedge has developed in U.S. data over the past three years.

In the model, the collapse of a bubble, combined with insufficiently accommodative monetary policy[1], moves the economy downward along a fixed Beveridge curve. In the past three years, the Beveridge curve has shifted in the United States in a way that suggests that labor market matching efficiency has declined. In the theoretical model, the unemployment rate is demand-determined, and is unaffected by labor market matching efficiency. A decline in labor market matching efficiency means that firms need to create more vacancies to fill positions created by separations. The economy moves

[1] Over the past two years, many central banks - including the Federal Reserve - have supplemented conventional monetary policy tools with the use of large-scale asset purchases. This model in this paper is insufficiently rich to allow for an analysis of these alternative tools.

upward and vertically off the original Beveridge curve.

The remainder of the paper is organized as follows. In section 2, I review some basic elements of the DMP model. In section 3, I use the model to analyze changes in the United States labor market in the past three years. In section 4, I set forth my simple "OG-DMP" model. In section 5, I show how non-accommodative monetary policy can generate high unemployment and labor market slack. In section 6, I discuss some some other policy implications, and Section 7 concludes.

2 Basic DMP Framework

In this section, I sketch the basic DMP framework - see Shimer (2005) (among many other possible references) for more details.

Let u represent the unemployment rate and v represent the vacancy (or job openings) rate. Define $\theta = v/u$ to be market tightness. The DMP model treats worker productivity A, the worker's benefits z from not working, the cost k of creating a job, the discount rate r, the job separation rate s, the constant-returns-to-scale matching function m, and the worker's bargaining power β (in the Nash bargain) as exogenous. I will let ϕ be a multiplicative shifter to the matching function m.

Given those exogenous elements of the model, I can write the (steady-state) equilibrium equations as follows:

$$k = (1-\beta)\phi q(\theta)V \tag{1}$$

$$V = \frac{(A-z)}{r+s+\beta\phi f(\theta)} \tag{2}$$

$$u = \frac{s}{s+\phi f(\theta)} \tag{3}$$

where:

$$\phi f(\theta) \equiv \phi m(1,\theta) \tag{4}$$

$$\phi q(\theta) \equiv \phi m(1/\theta, 1) \tag{5}$$

Here, f and q represent the job-finding and worker-finding rates. V is the joint surplus (to the worker and firm) of a match.

For standard parameterizations (Shimer (2005)), I can treat r and s as small relative to $\beta\phi f(\theta)$. Hence, I can rewrite (1)-(3) as two equations in the two unknowns u and θ:

$$k = \frac{(A-z)(1-\beta)}{\beta\theta} \tag{6}$$

$$u = \frac{s}{s+\phi f(\theta)} \tag{7}$$

I will refer to the first equation (6) as the job creation condition and the latter equation (7) as the Beveridge curve. The level of market tightness is determined by the job creation condition. Then, given the equilibrium level of market tightness, the unemployment rate is determined by the Beveridge curve.

3 Some Empirics

In this section, I'll discuss two changes in the United States labor market over the past three years, as viewed through the lens of the job creation condition (6) and the Beveridge curve (7). First, I'll describe how a wedge in the job creation equation seems to have developed (assuming no changes in A, z, β or k). Second, I'll describe how the labor market matching efficiency parameter ϕ has changed.

In my discussion, I use the following observations from Bureau of Labor Statistics (BLS) data.[2] In December 2007 in the United States, the unemployment rate, the separation rate, and the job openings rate were:

$$\begin{aligned} u_{2007} &= 0.05 \\ s_{2007} &= 0.035 \\ v_{2007} &= 0.031 \end{aligned}$$

[2] These numbers differ from those in Kocherlakota (2011b) because of data revisions by the BLS.

In December 2010, these variables had changed to become:

$$\begin{aligned} u_{2010} &= 0.094 \\ s_{2010} &= 0.029 \\ v_{2010} &= 0.021 \end{aligned}$$

3.1 A Wedge in the Job Creation Condition

The job creation condition (6) says that:

$$k = \frac{(1-\beta)(A-z)}{\beta\theta} \tag{8}$$

In December 2007, $\theta = 0.031/0.05 = 0.62$. In December 2010, $\theta = 0.021/0.094 = 0.22$. Market tightness has fallen by approximately 65% in the past three years. This points to a wedge in the job creation condition in December 2010, relative to December 2007. I have argued elsewhere (Kocherlakota (2011b)) that there may well have been changes in A and z in the past three years, but it seems unlikely that these changes are sufficiently large to completely offset the fall in market tightness.

3.2 Decline in Labor Market Matching Efficiency

I now turn to discussing changes in the labor market matching efficiency parameter ϕ. From the Beveridge curve (7), I can write ϕ as:

$$\phi = \frac{s(1-u)}{u}\frac{1}{f(\theta)}$$

Hence:

$$\begin{aligned}\phi_{2010} &= \frac{s_{2010}}{s_{2007}}\frac{(1-u_{2010})}{(1-u_{2007})}\frac{u_{2007}}{u_{2010}}\frac{f(\theta_{2007})}{f(\theta_{2010})} \\ &= \frac{0.029}{0.035}\frac{(1-0.094)}{(1-0.05)}\frac{0.05}{0.094}\frac{f(\frac{0.031}{0.05})}{f(\frac{0.022}{0.094})}\end{aligned}$$

The value of ϕ_{2010} is closely connected to the curvature of f. It is standard to parameterize f as having an elasticity between 0.3 and 0.5 (Petrongolo and Pissarides (2001)). If f has an elasticity of 0.3, then ϕ_{2010} equals 0.563. If f has an elasticity of 0.5, then ϕ_{2010} equals 0.683. Labor market matching efficiency has declined[3] between 32% and 44%.

4 A Model

In this section, I describe a simple model that weds the overlapping generations (OG) model a la Samuelson (1958) to the above DMP framework.

[3] Davis, Faberman, and Haltiwanger (2010) argue that firm search intensity may have declined in the past three years. This decline could help rationalize what appears to be a fall in ϕ.

The goal is to investigate the impact of a bubble collapse on long-run labor market conditions.

Suppose that there is a unit measure of households who live in a standard 2-period overlapping generations setting. The households are endowed with e^y units of apples when young and e^o units of apples when old. The households have utility function:

$$U(c^y) + U(c^o + h)$$

where $U', -U'' > 0$ and U exhibits non-decreasing relative risk aversion. Here, c^y and c^o represent the household's consumptions of a distinct good, bananas. So, the households would like to trade their apples with someone who owns bananas. I will assume that the intercept h in the utility function of the old is small but positive.

The initial old households are also each endowed with a unit of land. Land is intrinsically worthless - it pays no dividend. However, it is in fixed supply. As I will show, land will function much like money in the standard OG framework.

There is also a unit measure of infinitely-lived workers. The workers have the ability to produce z units of bananas on their own. However, if a worker is matched with a firm (productive opportunity), then the worker can produce A units of bananas, where $A > z$. The workers derive utility from consuming apples (the good owned by the households). This introduces the gains for trade between households and workers. The matching between workers and firms proceeds as in the DMP model described above. Workers cannot participate in asset markets.

I make two other changes in this baseline setup. First, I assume that the level of banana production is determined by household demand, and not by firm entry/exit. This assumption implies that the job creation condition (6) will no longer be a condition of equilibrium, and so firms may earn non-zero profits in equilibrium. I assume that firm owners are infinitely-lived people with linear utility over apple consumption who cannot participate in asset markets.

Second, I assume that the central bank has the ability to set the real interest rate r^*. The rough idea behind this assumption is that the central bank successfully "anchors" inflationary expectations, and then varies the nominal interest rate to achieve a desired real interest rate.[4]

I restrict attention to steady-state equilibria. With that restriction, there are two kinds of equilibria in this overlapping generations economy. First, there is a continuum of bubbly equilibria in which land has a positive price and the real interest rate r^* equals zero.[5] Second, there is a continuum of

[4] For technical convenience, I'll analyze steady states. But both of these assumptions (no entry/exit margin and central bank control over the real rate) strike me as better approximations for the short run than the long run. Over time, the existence of positive or negative profits will certainly lead to entry or exit. Entry and exit into job creation will influence the behavior of the real interest rate, regardless of the central bank's policy rule.

[5] The continuum of bubbly equilibria in this model are similar in structure to the continuum of equilibria in Farmer (2011). As in Farmer's model, the equilibrium steady-state unemployment rate is determined by self-fulfilling beliefs. In my paper, the self-fulfilling

non-bubbly equilibria with negative real interest rates and zero land prices. I'll discuss each in turn.

4.1 Equilibrium With Bubbles

In this subsection, I define and discuss a continuum of *bubbly* equilibria. The equilibria are indexed by the price of land P^L in terms of apples, which lies in the open interval $(0, (e^y - e^o)/2)$. Let (c^y_{bub}, c^o_{bub}) denote the consumptions of the young and old households, and let P^B_{bub} be the price of bananas in terms of apples. Then, given any land price P^L, where P^L lies in $[0, (e^y - e^o)/2]$, I define the corresponding equilibrium allocations $(\theta_{bub}, u_{bub}, c^y_{bub}, c^o_{bub})$ and the equilibrium price P^B_{bub} of bananas as a solution to the following five equations:

$$u_{bub} = \frac{s}{s + \phi f(\theta_{bub})} \tag{9}$$

$$P^B_{bub} c^y_{bub} = e^y - P^L \tag{10}$$

$$c^y_{bub} = c^o_{bub} + h \tag{11}$$

$$(c^y_{bub} + c^o_{bub}) P^B_{bub} = e^y + e^o \tag{12}$$

$$[u_{bub} z + (1 - u_{bub}) A] = (c^y_{bub} + c^o_{bub}) \tag{13}$$

Equation (9) is the Beveridge curve from the DMP setup. Equations (10)-(11) are standard in the OG framework, as households use the bubble in land to smooth their consumptions. Equation (12) is the intertemporal budget constraint of a typical household, and equation (13) represents market-

beliefs are about the value of land.

clearing for bananas.

I can use equations (10)-(12) to solve for $(c^y_{bub}, c^o_{bub}, P^B_{bub})$ as a function of P^L, where $(e^y - e^o)/2 > P^L > 0$:

$$\begin{aligned} P^B_{bub} &= (e^y - e^o - 2P^L)/h \\ c^y_{bub} &= (e^y - P^L)/P^B_{bub} \\ c^o_{bub} &= (e^o + P^L)/P^B_{bub} \end{aligned}$$

Then, I can use equation (13) to solve for the equilibrium unemployment rate u_{bub}:

$$[u_{bub} z + (1 - u_{bub})A] = \frac{(e^y + e^o)h}{(e^y - e^o - 2P^L)}$$

and equation (9) to solve for the labor market tightness θ_{bub}. (Implicitly, I'm assuming that $A > \frac{(e^y+e^o)h}{(e^y-e^o-2P^L)} > z$.)

Given any two of the above equilibria, the unemployment rate is lower and the equilibrium level of market tightness θ_{bub} is higher in the equilibrium with the higher land price. Define the wedge in the job creation condition in terms of bananas to equal:

$$\omega_{bub} = \frac{(1-\beta)(A-z)}{\beta \theta_{bub}} - k/P^B_{bub}$$

(This definition of the wedge assumes that the job-creation costs are in terms of apples, not bananas.) This wedge is lower in equilibria with higher bubbles.

4.2 Equilibrium Without Bubbles

In this subsection, I define non-bubbly equilibria (in which the price of land is zero). I show that, given any bubbly equilibrium, there exists a non-bubbly equilibrium with the same labor market outcomes. In that non-bubbly equilibrium, $r^* < 0$. I interpret this result as saying that labor market outcomes will not be affected by a bubble's collapse if the central bank lowers r^* appropriately.

I begin by defining non-bubbly equilibria in which $P^L = 0$. Given that the real interest rate equals r^*, a non-bubbly equilibrium is a specification of market tightness, unemployment, consumptions, and a banana price $(\theta_{nb}, u_{nb}, c^y_{nb}, c^o_{nb}, P^B_{nb})$ that satisfies:

$$u_{nb} = \frac{s}{s + \phi f(\theta_{nb})} \tag{14}$$

$$U'(c^y_{nb}) = (1 + r^*)U'(c^o_{nb} + h) \tag{15}$$

$$c^y_{nb} = e^y / P^B_{nb} \tag{16}$$

$$c^o_{nb} = e^o / P^B_{nb} \tag{17}$$

$$[u_{nb} z + (1 - u_{nb})A] = (c^y_{nb} + c^o_{nb}) \tag{18}$$

As captured in (16) and (17), households are unable to save in the absence of the bubble. Instead, households consume more bananas when young than when old. However, households do satisfy the household Euler equation (15).

I now demonstrate an isomorphism between non-bubbly equilibria and bubbly equilibria. Given some positive value of P^L, let $(\theta_{bub}, u_{bub}, c^y_{bub}, c^o_{bub}, P^B_{bub})$ be the equilibrium outcome in the corresponding bubbly equilibrium. It is possible to construct a non-bubbly equilibrium with the same labor market outcomes. In that non-bubbly equilibrium, aggregate banana consumption must be the same as in the bubbly equilibrium. Define c^*_{bub} to be the aggregate consumption of bananas in the bubbly equilibrium:

$$c^*_{bub} = c^y_{bub} + c^o_{bub}$$

With that aggregate consumption, I can show from equations (18) and (14) that the unemployment rate u_{nb} and the level of market tightness θ_{nb} are both the same as in the bubbly equilibrium. As well, the price of bananas in the non-bubbly equilibrium will equal the price of bananas in the bubbly equilibrium:

$$P^B_{nb} = P^B_{bub} = \frac{e^y + e^o}{c^*_{bub}}$$

It follows that the consumptions in the non-bubbly equilibrium are given by:

$$\begin{aligned} c^y_{nb} &= e^y/P^B_{nb} = e^y c^*_{bub}/(e^y + e^o) \\ c^o_{nb} &= e^o/P^B_{nb} = e^o c^*_{bub}/(e^y + e^o) \end{aligned}$$

Finally, define r^*_{nb} so as to satisfy the equation:

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

In this fashion, given a bubbly equilibrium $(\theta_{bub}, u_{bub}, c^y_{bub}, c^o_{bub}, P^B_{bub})$, I can construct a non-bubbly equilibrium:

$$
\begin{aligned}
u_{nb} &= u_{bub} \\
\theta_{nb} &= \theta_{bub} \\
P^B_{nb} &= P^B_{bub} \\
c^y_{nb} &= \frac{e^y c^*_{bub}}{e^y + e^o} \\
c^o_{nb} &= \frac{e^o c^*_{bub}}{e^y + e^o}
\end{aligned}
$$

Intuitively, the equilibrium is constructed so as to ensure that aggregate banana consumption is the same as in the bubbly equilibrium. I then pick the equilibrium interest rate r^* so that young households do not want to save. Note that:

$$
\begin{aligned}
c^y_{bub} &< c^y_{nb} \\
c^o_{bub} &> c^o_{nb}
\end{aligned}
$$

It follows that the central bank is setting $r^*_{nb} < 0$, which is the equilibrium interest rate in the bubbly equilibrium.

This construction shows that the disappearance of a bubble need not affect the labor market (at least in the long run). As long as the central bank lowers r^* sufficiently, the unemployment rate u_{nb} equals u_{bub} and the level of labor market tightness θ_{nb} equals θ_{bub}. Intuitively, the unemployment rate and the level of labor market tightness are determined (primarily) by labor market matching efficiency considerations. The disappearance of the bubble, in and of itself, does not affect these considerations. The collapse of the bubble does make all households worse off (in steady state), because they are unable to save.

5 Non-Accommodative Monetary Policy

In the previous section, I showed that the collapse of a bubble need have no impact on the economy, as long as the central bank lowers r^* sufficiently. In this section, I analyze what happens if the central bank does not set r^* as low as r^*_{nb}. My motivation for this analysis is similar to that of Hall (2011). He argues that given relatively rigid inflationary expectations, the zero lower bound on the nominal interest rate may translate into a lower bound on the real interest rate. Choosing any $r^* > r^*_{nb}$ generates extra unemployment relative to the bubbly labor market outcomes (because U exhibits non-decreasing relative risk aversion). However, I will focus on the case in which $r^* = 0$. In this case, the bank's policy choice is insufficiently accommodative to restore the bubbly labor market outcomes, regardless of the size of the original bubble.

5.1 A "Trap" Equilibrium

Suppose the central bank sets the real interest rate equal to $r^* = 0$, given that the price of land equals zero. I'll refer to the resultant equilibrium as being a trap equilibrium. It is defined by the following five equations in five unknowns $(u_{trap}, \theta_{trap}, c^y_{trap}, c^o_{trap}, P^B_{trap})$:

$$u_{trap} = \frac{s}{s + \phi f(\theta_{trap})} \tag{19}$$

$$U'(c^y_{trap}) = U'(c^o_{trap} + h) \tag{20}$$

$$c^y_{trap} = e^y / P^B_{trap} \tag{21}$$

$$c^o_{trap} = e^o / P^B_{trap} \tag{22}$$

$$[u_{trap} z + (1 - u_{trap})A] = (c^y_{trap} + c^o_{trap}) \tag{23}$$

The equations (20)-(22)) imply that c^y_{trap}, c^o_{trap} and P^B_{trap} equal:

$$P^b_{trap} = \frac{e^y - e^o}{h}$$

$$c^y_{trap} = \frac{he^y}{(e^y - e^o)}$$

$$c^o_{trap} = \frac{he^o}{(e^y - e^o)}$$

Note that for any land bubble $P^L > 0$:

$$\begin{aligned} P^B_{bub} &= \frac{[e^y - e^o] - 2P^L}{h} \\ &< \frac{e^y - e^o}{h} \\ &= P^B_{trap} \end{aligned}$$

The high real interest rate serves to increase the price of bananas (relative to apples). Intuitively, with the high real interest rate, young households want to save more than in the non-bubbly equilibrium. But, without the land bubble, aggregate saving is zero. Hence, the extra demand for bananas keeps pushing up the price of bananas until households no longer want to save them. Put another way, the price of a banana bond (that would deliver future bananas) cannot rise, and so the price of bananas themselves does.

This rise in the price of bananas lowers the households' aggregate demand for bananas. Given (c^y_{trap}, c^o_{trap}), equation (23) implies that:

$$\begin{aligned} [u_{trap}z + (1 - u_{trap})A] &= \frac{h(e^y + e^o)}{(e^y - e^o)} \\ &< \frac{h(e^y + e^o)}{(e^y - e^o - P^L)} \\ &= [u_{bub}z + (1 - u_{bub})A] \end{aligned}$$

The high real interest rate drives down the aggregate demand for bananas, relative to the bubbly equilibrium. The equilibrium unemployment rate rises ($u_{nb} < u_{trap}$) and equilibrium market tightness falls ($\theta_{trap} < \theta_{nb}$). The equilibrium now exhibits a *larger* wedge in the job creation condition because:

$$
\begin{aligned}
\omega_{nb} &= \frac{(1-\beta)(A-z)}{\beta\theta_{nb}} - k/P^B_{nb} \\
&< \frac{(1-\beta)(A-z)}{\beta\theta_{trap}} - k/P^B_{trap} \\
&= \omega_{trap}
\end{aligned}
$$

To summarize: Suppose that there is a bubble in the price of land and that bubble collapses in an unanticipated fashion. In the aftermath of the bubble's collapse, if the central bank can lower the real interest rate sufficiently, then the bubble's collapse has no impact on long-run labor market equilibrium. However, if the central bank fails to lower the real interest rate sufficiently, then the unemployment rate rises and market tightness falls. For a fixed ϕ, the economy moves downward along the Beveridge curve. The wedge in the job creation condition will grow because market tightness falls.

5.2 Declines in Labor Market Matching Efficiency

As I discuss above, it appears that labor market matching efficiency has declined sharply over the past three years. In the trap equilibrium, the impact of this decline on labor market quantities is distinctly counterintuitive. In the trap equilibrium, labor market quantities are determined by the two equations:

$$u_{trap}z + (1 - u_{trap})A = \frac{h(e^y - e^o)}{e^y + e^o}$$
$$u_{trap} = s/(s + \phi f(\theta_{trap}))$$

These two equations imply that the unemployment rate is independent of ϕ. A decline in ϕ results in an increase in θ_{trap} - but no change in u_{trap}. In a Beveridge curve graph drawn in u-v space, the economy moves vertically and upward off the original Beveridge curve. Intuitively, the level of consumption demand determines the unemployment rate. Then, any decline in labor market matching efficiency means that to replace the workers lost due to separations, firms have to create more vacancies.

6 Policy

In this section, I discuss how unemployment insurance benefits, and monetary and fiscal policy can affect the economy if it is in the "trap" equilibrium described above (with $r^* = 0$).

6.1 Unemployment Insurance Benefits

Suppose the government decides to make a transfer of δ bananas to each unemployed person, financed by a lump-sum tax of δ bananas on each young household. What is the equilibrium impact of this policy if δ is small?

Given that the real interest rate $r^* = 0$, the resulting non-bubbly equilibrium is characterized by the following five equations in five unknowns $(u_{ui}, c^y_{ui}, c^o_{ui}, P^B_{ui}, \theta_{ui})$:

$$\begin{aligned}
u_{ui} &= \frac{s}{s + \phi f(\theta_{ui})} && (24) \\
c^y_{ui} &= c^o_{ui} + h && (25) \\
P^B_{ui} c^y_{ui} &= e^y - P^B_{ui}\delta && (26) \\
P^B_{ui} c^o_{ui} &= e^o && (27) \\
[u_{ui} z + (1 - u_{ui})A] &= (c^y_{ui} + c^o_{ui}) && (28)
\end{aligned}$$

I can solve for $(P^B_{ui}, c^y_{ui}, c^o_{ui})$ to satisfy (25)-(27):

$$\begin{aligned}
P^B_{ui} &= \frac{e^y - e^o}{h + \delta} \\
c^o_{ui} &= \frac{(h + \delta)e^o}{e^y - e^o} \\
c^y_{ui} &= \frac{\delta e^o + h e^y}{e^y - e^o}
\end{aligned}$$

Then, I can solve for u_{ui} and θ_{ui} to satisfy:

$$\begin{aligned}
[u_{ui} z + (1 - u_{ui})A] &= \frac{h(e^y + e^o) + 2\delta e^o}{e^y - e^o} \\
u_{ui} &= \frac{s}{s + \phi f(\theta_{ui})}
\end{aligned}$$

In this equilibrium, an increase in unemployment insurance benefits - funded by the young - *lowers* the unemployment rate and *raises* market tightness in an upward movement along the Beveridge curve. Intuitively, the increase in taxes on the young lowers their demand for saving, and so lowers the price of bananas. The overall impact is to increase the amount of bananas consumed by the young and old together.

6.2 Maximal Employment Policy

There is a natural way to interpret the “maximum employment” mandate of the Federal Reserve in the context of this model by using the job creation condition of the firm. Define the maximal employment policy $r_{\max}$ to be the interest rate such that $(c^y_{\max}, c^o_{\max}, P^B_{\max}, u_{\max}, \theta_{\max})$ is a non-bubbly equilibrium given $r_{\max}$, and such that:

$$k/P^B_{\max} = \frac{A-z}{\theta_{\max}}\frac{(1-\beta)}{\beta}$$

At this interest rate, firms earn zero profits from job creation. At any other interest rate, either firms earn negative profits or unemployment is higher. In this sense, the monetary policy of setting r^* equal to $r_{\max}$ maximizes employment.

The response of the economy to changes in exogenous parameters depends on what kind of rule is being used by the central bank. I have shown that if the central bank keeps its interest rate r^* fixed while labor market matching efficiency declines, then the unemployment rate stays the same but market tightness rises. The firm's wedge:

$$\frac{A-z}{\theta}\frac{(1-\beta)}{\beta}-\frac{k}{P^B}$$

falls because θ rises. Suppose instead that the central bank is using a maximal employment policy. To offset the fall in the firm's wedge, the central bank raises $r_{\max}$. As a consequence, $u_{\max}$ rises, $P^B_{\max}$ rises, and $\theta_{\max}$ falls.

6.3 Fiscal Policy

There are also fiscal policy interventions in this overlapping generations framework that can affect labor market outcomes. The government can essentially replicate a land bubble by selling 1 period debt and then rolling it over ad infinitum. It is also true, though, that the debt rollover may fail at some point in the future if agents unexpectedly cease to believe that it will work. (See Kocherlakota (2011a) for a fuller discussion of how fiscal policy can be used to replicate the benefits of a bubble.)

7 Conclusion

In Kocherlakota (2011a), I use a holistic approach to describe the impact of bubble collapses in a wide range of models. I argue that such collapses typically lead to falls in the real interest rate. If preferences exhibit wealth effects on labor supply, then the bubble's collapse may (or may not) lead to a fall in employment and output (as in Guerrieri and Lorenzoni (2010)).

In the current paper, I blend a particular model of bubbles (the overlapping generations model) with the canonical DMP model of unemployment. Unlike my prior analysis, labor supply is essentially irrelevant. Instead, I assume that output is "demand-determined" by dropping the job creation first-order condition for firms. In this setup, the bubble collapse has no impact on unemployment or output, given sufficiently accommodative monetary policy. With insufficiently accommodative monetary policy (generated perhaps by the zero lower bound on nominal interest rates), the bubble collapse can lead to increases in unemployment. Environmental changes like increases in unemployment insurance benefits or declines in labor market matching efficiency may have unexpected effects.

From a technical point of view, the trick to my analysis is that I separate labor markets from asset markets. The two are connected only through the exchange of the goods owned by asset market participants and the goods produced by workers. Using this trick, I believe that one could extend my baseline results to the broader class of bubble models considered in Kocherlakota (2011a).

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