SPECULATIVE BUBBLES AND TAX POLICY

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ABSTRACT

In this paper, I will consider effects of capital gains tax and other tax policy in the model explicitly incorporating bubbles. Rational bubbles may occur when the return from bubbles is taxed more lightly than other assets even in a dynamically inefficient economy. With higher capital gains tax, bubbles should grow faster in order to keep the arbitrage condition with other assets. However investors realize that such higher growth of bubbles is unsustainable. Then, rational bubbles will collapse totally or partially. After the collapse of bubbles, there can be multiple paths; a bubbly equilibrium path converging to the new bubbly steady state with a smaller bubble than before, a bubbly equilibrium path converging to the bubbleless steady state and a bubbleless equilibrium path where there is no bubble at all. I consider two episodes of bubble and tax policy in Japan; land price bubble in late 1980s and rabbit bubble in 1872-73. Both experiences seem to be consistent with the prediction of our model.

Keywords: Bubble, Capital gains tax, Rabbit tax

JEL Classification Codes: H24, E62, E65

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1. Introduction

Asset price bubble was one of the most important causes of the recent financial crisis and is still now one of the most serious economic problems faced by some countries such as China. In order to curb asset price bubbles, many governments adopted higher capital gains tax and other land related taxes. For example, in early 1990s, Japanese government raised land taxes against speculative bubble in land prices, as explained later in this paper. Recently, China tried to discourage land bubbles by its land policy including the more extensive usage of existing land related taxes.

On the other hand, the existing academic research on the role of tax policy in the financial crisis mainly focus on possible role of financial transaction tax and excess leverage caused by differential treatment of debt and equity. While the role of financial friction and monetary policy on asset bubbles is actively studied by macroeconomists recently (Kocherlakota (2009, 2011), Farhi and Tirole (2010), Martin and Ventura (2010), Gali(2014)), the effects of tax policy (except financial transaction tax) on asset price bubbles have not attracted much attention. For example, Keen, Klemm and Perry (2010) conclude that “Tax measures can have significant effects on asset price dynamics but are unlikely to be the best way to deal with bubbles (p75)”.

However, the existing analyses consider the effects of tax policy on fundamental asset prices, but not on speculative bubbles explicitly (for example, see Box 2 of Keen, Klemm and Perry (2010)). As long as I know, Kunieda (1989) is only formal analysis of the effects of capital gains tax on asset prices incorporating speculative bubbles explicitly. His analysis shows that capital gains tax can be very effective tax policy for discouraging speculative bubbles. Since one essential feature of speculative bubbles is
that investment return of speculative bubbles takes the form of capital gains. If the tax treatments of capital gains and other capital income are different, tax policy will affect speculative bubbles. As we can show in partial equilibrium analysis, in order to keep arbitrage between speculative bubbles and other financial assets, speculative bubbles should grow faster rather than slower with higher capital gains tax. However, speculative bubbles with higher growth rate may be unsustainable. In that case, speculative bubbles will collapse immediately.

In this paper, I will consider the effects of capital gains tax and other taxes (except transaction taxes) on asset bubbles using Kunieda (1989)’s framework. In Section 2, I will consider effects of capital gains tax and other taxes on asset bubbles in a partial equilibrium framework. In Section 3, I will consider effects of capital gains tax and other taxes on asset bubbles in the general equilibrium framework of Kunieda (1989). In the next two sections, I will consider the role of tax policies in two asset bubble episodes in Japan. In Section 4, I will consider the role of capital gains tax and other land-related taxes in Japanese land price bubbles since late 1980s. In Section 5, I will introduce the relatively unknown episode of “rabbit mania” in early 1870s and consider the role of the “rabbit tax” in collapse of rabbit mania. There is a brief concluding remark.

2. Speculative Bubbles and Capital Gains Tax in a Partial Equilibrium Framework

In this section, I will consider effects of capital gains tax and other taxes in a partial equilibrium framework. Consider an asset with dividend (or rent) \( d_t \) in the period \( t \).
With the capital gains tax and the tax on dividend (or rent), the arbitrage condition (1) between this asset and alternative financial asset with the same risk as this asset should hold.

\[
\frac{(1-t_g)(p_{t+1} - p_t)}{p_t} + \frac{(1-t_d)d_t}{p_t} = r
\]

where \( p_t \): asset price at period \( t \)

\( t_g \): capital gain tax rate

\( t_d \): tax rate on dividend (or rent)

\( r \): return rate of alternative financial return (given)

By repeating substitution of (1), I will get:

\[
p_t = \left( \frac{1-t_d}{1-t_g} \right) \sum_{i=0}^{\infty} (1+r')^{-i}d_{t+i} + \lim_{i \to \infty} (1+r')^{-i} p_{t+i}
\]

where \( r' = \frac{r}{1-t_g} \)

If the second term of (2) converges to 0, then asset price can be shown by (3). This is the tax adjusted fundamental asset price \( p^*_{t} \).

\[
p^*_{t} = \left( \frac{1-t_d}{1-t_g} \right) \sum_{i=0}^{\infty} (1+r')^{-i}d_{t+i}
\]

If dividend (or rent) grows at the constant rate of \( g \) and the dividend at period 0 is denoted by \( d_0 \), then

\[
d_{t+i} = (1+g)^{t+i} d_0
\]

In this case, the tax adjusted fundamental price will be:

\[
p^*_{t} = \frac{(1-t_d)(1+g)^t d_0}{r-(1-t_g)g}
\]
In this case, asset price grows at the rate of g.

If the tax rate on dividend (or rent) $t_d$ is raised, from the equation (5), we can know that the asset price will drop. The price change is equal to the present value of the increased tax revenue. This is an example of “tax capitalization.”

Also, if the capital gains tax rate is raised, the asset price determined by (5) will drop.

With given growth rate of dividend (or rent), the asset price still grow at the rate of g. However, due to the existence of capital gains tax, the after tax growth rate of asset price is $(1 - t_g)g$. Higher capital gains tax will reduce this after tax growth rate of asset price, so that the current asset price will drop. In this case, still, we can show that the change of asset price should be equal to the present value of the increased tax revenue. This is another example of tax capitalization.

Further, while I will not show it with equations, asset holding tax (such as property tax) will have similar tax capitalization effect. Namely, the fundamental asset price will drop after the introduction of asset holding tax by the amount of the expected present discounted value of current and future asset holding tax revenue.

However, we cannot exclude the possibility where the second term of the equation (2) does not converge. In this case, there may be a bubble term defined by the equation below.

$$b_{t+1} = (1 + r')b_t = (1 + \frac{r}{1-t_g})b_t \quad (6)$$

Then, the asset price can be shown as:

$$p_t = p_t^* + b_t \quad (7)$$

where the bubble term grows according to the equation (6).

When capital gains tax rate $t_g$ increases, from the equation (6), we can know that the
bubble term will grow faster than before. In order to satisfy the arbitrage condition, after tax growth rate of bubble should be equal to the return rate of alternative asset (r). Thus, the bubble term should grow faster with higher capital gains tax rate. It may seem strange that higher capital gains tax brings higher growth of asset bubbles. In order to understand its meaning, we need to consider effects of capital gains tax on asset bubbles in a general equilibrium framework.


3.1 Capital Gains Tax in a General Equilibrium Model with Rational Bubbles

The capital gains tax is imposed not only on productive capital but also on unproductive bubbles. To analyze the effects of the capital gains tax, we need a general equilibrium model with productive capital and unproductive bubbles, which was introduced by Tirole (1985), and further studied by Weil (1987). Following Kunieda (1989), I will incorporate a capital gains tax and a dividend income tax into Tirole (1985)'s model.

The model is based on Diamond's OLG model (1965). The consumer lives two periods. He receives wages when young and saves in productive capital or unproductive bubble. His savings are represented by the individual saving function s(w,r). Population grows at the rate n. The production function has constant returns to scale and is well behaved. It is denoted by f(k) where k is capital stock per worker.
A bubble may occur on something useless, say, M pieces of paper. When the price of each piece in terms of the consumer goods is denoted by $P_t$, the total bubble will be $B_t = MP_t$. The bubble is assumed to be deterministic and to grow forever. Stochastic bubbles in the same framework were studied by Weil (1987).

There are two equilibrium conditions. First, the total savings will be equal to the sum of next period's capital stock and bubble. Namely, in per worker term,

$$ (1 + n)k_{t+1} = s(w_t, r_t) - b_t $$

(8)

where $b_t$ is the bubble per worker.

Second, as long as the bubble exists ($P_t$ is positive), the net rate of return from productive capital and unproductive bubble must be equal as a result of arbitrage transactions.

Here I assume that the ownership of productive capital is represented by stocks, and that the returns from productive capital will be distributed to the old generation in the form of dividend or capital gains, which are realized when the old generation sells the stocks to the young generation. The stock market is efficient, so that the capital gains reflect the value of the retained earning. We assume that the dividend payout ratio (\(\alpha\)) is constant for simplicity. (Kunieda (1989) analyzes the case when dividend payout ratio changes.)

The after-tax rate of return from productive capital is

$$ ((1 - t_d)\alpha + (1 - t_g)(1 - \alpha))f'(k_{t+1}) = (1 - \tau)f'(k_{t+1}) $$

(9)

where \(\tau\) is the weighted tax rate on return from productive capital.

The before-tax rate of return on the bubble is:
\[
\frac{P_{t+1}}{P_t} - 1 = \frac{B_{t+1}}{B_t} - 1 = \frac{b_{t+1}(1+n)}{b_t} - 1
\]

(10)

By assuming that the government imposes the same rate of capital gains tax \( t_g \) on capital gains from the bubble, the after-tax rate of return will be

\[
(1 - t_g)\left[ \frac{b_{t+1}(1+n)}{b_t} - 1 \right]
\]

As long as the bubble exists (\( p \) is positive), the after tax rate of return from productive capital and the bubble should be the same.

\[
(1 - t_g)[\frac{b_{t+1}(1+n)}{b_t} - 1] = [(1 - t_d)\alpha + (1 - t_g)(1 - \alpha)]f'(k_{t+1})
\]

(11)

Last, I assume that the government returns the tax revenue to the old generation as lump-sum transfers \( T \), eliminating any direct wealth effect of the two taxes.

In the steady state, \( k_{t+1} = k_t = k \) and \( b_{t+1} = b_t = b \). First, the capital accumulation condition (8) will be

\[
(1 + n)k = s(w, r) - b = s(k, b, t_d, t_g) - b
\]

(12)

where I rewrite the individual saving function as a function of \( k, b, t_d \) and \( t_g \), since \( w, r \) and lump-sum transfers are functions of \( k, b, t_d \) and \( t_g \). Second, the arbitrage equation (11) will be

\[
(1 - t_g)n = [(1 - t_d)\alpha + (1 - t_g)(1 - \alpha)]f'(k)
\]

(13)

where the bubble is assumed to exist (\( p \) is positive). If \( p \) is zero, there is no arbitrage.

By rearranging (13), the arbitrage equation will be

\[
n = f'(k)[1 + \frac{(t_g - t_d)\alpha}{1 - t_g}]
\]

(14)

So, given \( t_g \) and \( t_d \), we can calculate the steady state capital level \( k^* \), as long as bubble exists.
As Tirole (1985) points out, there can be two kinds of equilibria, bubbleless equilibria and bubbly equilibria in his terminology. A steady state bubbleless equilibrium always exists and can be represented by the capital accumulation equation,

\[(1 + n)k = s(k, 0, t_d, t_g)\]  \hspace{1cm} (15)

where \(k\) is the capital stock in a steady state bubbleless equilibrium. Even with no tax \((t_d = t_g = 0)\), \(k\) can be higher or lower than the golden rule capital stock. The effects of an interest tax in this economy were studied by Diamond (1970).

To have a bubbly equilibrium, we need

\[s(k^*, b^*, \tau_d, \tau_g) > (1 + n)k^*\]  \hspace{1cm} (16)

where \(k^*\) is the solution of (14). In Tirole (1985)'s original model without taxes, a bubbly equilibrium can exist only when the bubbleless economy is dynamically inefficient \((f'(k) < n)\). However, with taxes, as long as the after-tax return rate from the bubble is higher than the after-tax rate from the productive capital in the bubbleless equilibrium \((n > f'(k)[1 + \frac{(t_g - t_d)\alpha}{1 - \tau_g}])\), a bubbly equilibrium can exist. In this case, productive capital and an unproductive bubble coexist. The equilibrium bubble per worker will be

\[b^* = s(k^*, b^*, t_d, t_g) - (1 + n)k^*\]  \hspace{1cm} (17)

which is constant in the steady state equilibrium.

If a bubbly equilibrium exists it may be stable or unstable. However, as in Tirole (1985)'s non-tax case, we can show that when a bubbleless equilibrium with taxes is stable as in Diamond (1970) and the capital gains tax rate \(t_g\) is close to zero, this equilibrium is a saddle point (See the Appendix 3 of Kunieda(1989) for details.). Following Tirole (1985) and Weil (1987), the dynamics can be shown in a phase
diagram like Figure 1.

In Figure 1, the $k_{t+1}=k_t$ locus corresponds to the saving equation (12). And the $b_{t+1}=b_t$ locus corresponds to the arbitrage equation (14). The point $E_d$ on the horizontal axis ($b=0$) is a bubbleless equilibrium, which is represented by the equilibrium condition (15). The $k_{t+1}=k_t$ locus passes $E_d$ with negative slope if $E_d$ is stable. If the $b_{t+1}=b_t$ locus passes in the left of $E_d$, a bubbly equilibrium satisfying (12) and (14) exists, which is represented by the point $E_b$. As shown in the Appendix 3 of Kunieda (1989), $E_b$ is a saddle point, and the saddle path can be shown as AA in Figure 1. The dynamics are almost the same as Tirole (1985) and Weil (1987) described, except that we need the stability of the bubbleless equilibrium with taxes to get the dynamics around the bubbly equilibrium with taxes.

In many countries, the effective tax rate on capital gains is lower than the tax rate on other income. Following this fact, I assume that $t_g < t_d$. Given $t_g$ and $t_d$, we can determine the steady state capital stock from (14). Since (14) can be rewritten as

$$\frac{n}{f'(k^*)}=1+\frac{(t_g - t_d)\alpha}{1-t_g}\leq 1 \quad (18)$$

which implies that the steady state capital stock $k^*$ is lower than the golden rule capital stock $k_{gr}$ (which satisfies $f(k_{gr})=n$) unless $t_g = t_d$.

In Tirole (1985)'s original model, where there are no taxes, the steady state capital stock in a bubbly economy is the golden rule level ($f(k^*) = n$), and rational bubbles occur only when the bubbleless economy is dynamically inefficient (i.e., $f(k) < n$). Abel, Mankiw, Summers and Zeckhauser (1989) argue that most industrialized economies are dynamically efficient and doubt that there exist rational bubbles. However, with taxes, their argument does not hold. First, from (12), the steady state capital stock in a bubbly
The economy can be lower than the golden rule level when the capital gains tax rate is lower than other capital income tax rates. Second, as long as 

\[ n > f'(k)\left[1 + \frac{(t_g - t_d)\alpha}{1 - t_g}\right], \]

when the bubbleless equilibrium is dynamically efficient \( f(k) > n \), rational bubbles can exist. So, even when it is observed that the actual economy is dynamically efficient as in Abel, Mankiw, Summers and Zeckhauser (1989), the possibility of rational bubbles cannot be ruled out⁴.

### 3.2. Effects of the Capital Gains Tax in a Bubbly Economy

Now we can consider the effects of an increase in the capital gains tax in a bubbly economy. From (18), we know that lowering the capital gains tax rate from a level equal to the dividend income tax rate will reduce the capital stock from the golden rule level.

Further, by differentiating (18) with respect to \( k^* \) and \( t_g \) and rearranging, we will get:

\[
\frac{dk^*}{dt_g} = -\left[\frac{(1-t_d)\alpha}{(1-t_g)^2}\right] \left[\frac{n f'(k^*)}{(f'(k^*))^2}\right] > 0
\]

(19)

Therefore, higher capital gains tax will **increase** the capital stock.

It may sound strange that a higher capital gains tax increases capital accumulation, but the logic is simple. When productive capital pays a positive dividend and the dividend income tax rate is higher than the capital gains tax, productive capital suffers a tax disadvantage relative to the unproductive bubble. From the usual second best argument,

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³ Here I define that the economy with taxes is "dynamically efficient" if no lump-sum transfer between generations can improve the utility of one generation without reducing utility of the other generations. Since different from private agents, government faces the before-tax returns rate rather the after-tax returns rate, the criterion of whether the economy is "dynamic efficient" or not is still \( f(k) > n \).

⁴ Farhi and Tirole (2010) and Martin and Venture (2010) also show that rational bubbles are possible even when the economy is dynamically efficient if there is
raising the capital gains tax will reduce the distortion in the portfolio choice between capital and the bubble, and encourage capital accumulation. I call this effect the "portfolio substitution effect".

What happens to the size of the bubble? The steady state bubble level is given by (17). When the capital gains tax increases, there will be two effects on the bubble. One effect is the "portfolio substitution effect" studied above, which is represented by the second term of (17), which clearly reduces the size of the bubble. Another effect is the "total wealth effect," namely the effect on total saving \( s(k^*, b^*, t_d, t_g) \). In general, the capital gains tax will affect total saving, through higher capital stock due to portfolio substitution effect, through a lower after-tax return at a given gross return; and through higher lump-sum transfers. Although these effects may work in opposite directions, the Appendix 4 of Kunieda (1989) proves that the steady state bubble \( b^* \) will decrease with the stability condition.

We can show the results above using the phase diagram in Figure 2. From (19) and the argument above, we know that a higher capital gains tax will shift the \( b_{t+1} = b_t \) locus (the arbitrage condition) to the right, which corresponds to the "portfolio substitution effect". On the other hand, the "total wealth effect" will shift \( k_{t+1} = k_t \) down, since, given any capital stock (i.e. given the gross interest rate and wage rate), a capital gains tax will raise the price of the consumption for the old and with compensation (lump-sum transfer), it will raise consumption of the young and reduce the savings. Then the steady state bubbly equilibrium will move from \( E_b \) to \( E'_b \). As seen in Figure 2, the steady state capital stock will increase and the bubble will decrease.

Furthermore, we can consider the short run dynamics after an unexpected increase of financial frictions.
the capital gains tax in Figure 2. Namely, after an unexpected increase of the capital gains tax, the economy should be on the new saddle path to reach the new steady state bubbly equilibrium. However, since the capital stock is the state variable, the bubble (the price of the useless fixed asset) should drop to the point on the new saddle path at A in Figure 2. After the drop (or crash), since more saving goes to productive capital due to the crash of the bubble, the capital stock will begin to increase. On the other hand, since the return rate from productive capital is higher than the rate on the $b_{t+1} = b_t$ locus, to maintain the same after-tax return, the bubble will grow at a higher rate than $n$, although it will not go back to the original level. In this way, the economy will gradually reach a new steady state bubbly equilibrium according to the saddle path.

At the same time, the bubbleless equilibrium will move from $E_d$ to $E_d'$. Namely, the capital stock will decrease with a higher capital gains tax. This corresponds to Diamond (1970)’s result that an interest tax will reduce the capital stock in an OLG model. One interesting point is that the steady state capital stock in a bubbly equilibrium and a bubbleless equilibrium will move in opposite directions. Therefore it is possible that by a large increase of the capital gains tax, a bubbleless equilibrium $E_d$ moves to the left of $k^*$ satisfying (14) like Figure 3a. In this case, a bubbly equilibrium does not exist after the tax increase, and only a bubbleless equilibrium $E_d$ exists. Then, after the unexpected large increase of the capital gains tax, the bubble will collapse due to the large "total wealth effect" and the economy will move to the bubbleless equilibrium. If the "total wealth effect" is too large, it is possible that capital stock decreases after the collapse of bubble by the large increase in the capital gains tax as in Figure 3b.

In summary, under a tax system where the effective tax rate on capital gains is lower than the dividend income tax rate, a higher capital gains tax will make existing bubbles
collapse totally or partially. After the collapse of the bubble, there are three possibilities; a bubbly equilibrium reaching to a steady state bubbly equilibrium, a bubbly equilibrium converging to a steady state bubbleless equilibrium and a bubbleless equilibrium.

3.3 Welfare Implications

While a higher capital gains tax increases the capital stock, it does not mean that a capital gains tax is not distortionary. As Feldstein (1978) points out, even when capital stock is unchanged, a higher capital gains tax will distort intertemporal consumption choices, and can have a significant welfare cost. So there is a tradeoff between decreasing the distortion in portfolio choice and increasing the distortion in intertemporal consumption choice.

However we can show that when the initial capital gains tax rate is zero, increasing the capital gains tax will always improve welfare in the steady state following Diamond (1970).

Each generation’s utility in the steady state can be expressed as

\[
U = u(c_1, (w - c_1)(1 + (1 - \tau)f') + T))
\]

(23)

where \(c_1\) is the consumption during young and T is transfer.

By differentiating \(U\) with respect to \(t_g\) and rearranging as shown in Kunieda (1989), I will get:

\[
\frac{dU}{dt_g} = u_2 f' h_n \frac{dk}{dt_g} + u_2 g' (1 + n) \frac{dk}{dt_g} + t_g n \frac{db}{dt_g}
\]

(24)

Since the first term and the third term are negative, while the second term is positive,
(24) can be positive or negative. So the higher capital gains tax may raise or reduce each generation's utility. This reflects the tradeoff between decreasing the distortion in portfolio choice and increasing the distortion in intertemporal consumption choice. However, if the initial capital gains tax rate is zero \((t_g=0)\), then (24) will be

\[
\frac{dU}{dt_g} = u_z f'(1 + n) \frac{dk}{dt_g} > 0
\]  

(25)

Therefore, when the initial capital gains tax rate is negligible, raising the capital gains tax will improve welfare. Note that this result is opposite to Diamond (1970)'s result, because the capital stock increases by a higher capital gains tax in this model. Since some argue that the effective tax rate on capital gains is nearly zero, in that case, increasing the capital gains tax rate will not only increase the capital stock but will also improve welfare\(^5\).

Of course, the first best policy is to lower the dividend income tax to the level of the capital gains tax. However, it is still true that when some tax revenue is collected from capital income, there is no justification for having the capital gains tax lower than the dividend income tax, because this reduces welfare through a distortionary "portfolio substitution effect".

### 3.4 Effects of Specific Capital Gains Tax and Asset Holding Tax

While we consider ordinary capital gains tax, we can consider other types of taxes as

\(^5\) This result gives an important policy implication. There has been a long debate about whether lower capital gains tax raises higher revenue since Feldstein, Slemrod and Yitzhaki (1980). However, this paper shows whether a lower capital gains tax raises higher revenue or not is not a crucial criterion for the desirability of a lower capital gains tax. Namely, in a bubbly economy, a lower capital gains tax brings more bubbles and may raise higher capital gains tax revenue than before. However, it decreases the
specific capital gains tax and asset holding tax.

If we can differentiate between productive capital and unproductive bubble, we can achieve the golden rule capital stock by taxing capital gains on the bubble at a higher rate than capital gains tax on capital, but lower than the dividend income tax rate. Suppose that the specific capital gains tax rate on the bubble is $t_s$. Then the arbitrage condition (13) will be modified as:

\[
(1 - t_s)n = [(1 - t_d)\alpha + (1 - t_g)(1 - \alpha)]f'(k)
\]  

(26)

To achieve $f'(k)=n$, $t_s$ should satisfy

\[
t_s = \alpha t_d + (1 - \alpha)t_g
\]  

(27)

Therefore, when we can differentiate between capital and bubble, a smaller increase of the capital gains tax rate is required than in the case where we cannot differentiate. It suggests that raising the specific capital gains tax on unproductive bubbles like gold or fine arts will effectively increase the capital stock. However, because the distinction between productive capital and unproductive bubble is ambiguous and because of horizontal equity considerations, it may be difficult to impose such a specific capital gains tax in the actual economy.

Similar argument is possible for the case of asset holding tax. Suppose that the asset holding tax is imposed only on bubble. The tax rate is $t_a$, and the tax base is the price of bubble. Then, when there is a bubble, the net return from a bubble is:

\[
\frac{P_{t+1} - t_a P_{t+1}}{P_t} - 1 = \frac{(1 - t_a)B_{t+1}}{B_t} - 1 = \frac{(1 - t_a)(1 + n)b_{t+1}}{b_t} - 1
\]  

(28)

The arbitrage equation will be:
\[(1-\tau)f'(k) = \frac{(1-t_a)(1+n)b_{t+1}}{b_t} - 1 \quad (29)\]

In the steady state, \(b_t = b_{t+1}\). Then, (29) will be:

\[f'(k) = \frac{(1-t_a)(1+n) - 1}{1-\tau} \quad (30)\]

Thus, when the government raises the asset holding tax rate, we can expect similar effects on bubbles as in the case of capital gains tax.

Another type of the asset holding tax imposes the given amount of tax \(T_a\) if individual owns the asset. As seen later, the rabbit tax was this type of asset holding taxes.

\[
\frac{P_{t+1} - T_a}{P_t} - 1 = \frac{B_{t+1}}{B_t} - \frac{T_a}{B_t} - 1 = n - \frac{T_a}{B_0} \quad (31)
\]

This type of the asset holding tax also works similarly as capital gains tax, while the impact of the tax is determined by the relative size of the amount of the tax over the initial size of bubble.

In summary, our model predicts;

(1) Higher capital gains tax or higher asset holding tax may cause the collapse of asset bubble. When the asset bubbles collapse, the drop of the asset price can be larger than the price decrease only reflecting fundamental price changes.

(2) Even when the capital gains tax rate or asset holding tax rate returns to the original tax rate, if a bubble fully collapsed already, the asset price may not return to the initial price. If the asset prices only reflect fundamentals, then the asset price should return to the initial price, unless there is a big change of fundamentals.

3. 5 Growth Enhancing Bubbles
While our model shows that lower capital gains tax may reduce capital stock by encouraging unproductive bubbles, some of the recent studies ((Kocherlakota (2009, 2011), Farhi and Tirole (2012), Martin and Ventura (2012)) emphasize the possibility that bubble may crowd in productive capital investment when there is financial friction. For example, when young entrepreneurs cannot raise sufficient capital, asset bubbles may provide liquidity to them, and increase economic growth.

In this case, some may argue that lower capital gains tax on asset bubbles can encourage bubbles and increase economic growth. However, we should be cautious not to hasten to conclude that capital gains tax should be cut for encouraging speculative bubbles.

In order to consider the effects of capital gains tax, we can consider the model with young entrepreneurs cannot raise sufficient capital. As the recent studies show, bubbles may provide liquidity to those young entrepreneurs and encourage productive capital. However, bubbles may encourage unproductive investment and crowd out productive capital investment. For example, many historical bubbles such as Dutch tulip mania and Japanese rabbit mania occurred on apparently unproductive assets. Further, while some historical bubbles such as Japanese land price bubbles increased capital investment, they turned out to be overinvestment. Lower capital gains tax may crowd out rather than crowd in productive capital investment.

One possible solution for this problem is the differential taxation of capital gains. Namely, if government imposes the same rate of capital gains tax on ordinary assets as other capital income taxes, but allows certain preferred tax treatment of capital gains for venture capitals in innovation-promising areas, then bubbles on unproductive assets are
discouraged as in our model above, while innovations will not be discouraged at the same time. The possibility of differential taxation is one advantage of tax policies to monetary policy as policy instruments with bubbles. Tighter monetary policy may discourage bubbles not only on unproductive assets but also on productive capital. Thus, the effects of tax policies on bubbles on productive and unproductive assets deserve more attention from policy makers and researchers of policy response to asset bubbles.

3.6 Discussion

Another topic this two periods model does not deal with is lock-in effect of capital gains tax. In their study of Taxpayer Relief Act of 1997 in the U.S., Dai et al. (2008) show that lock-in effect of capital gains tax may raise stock prices, while its tax capitalization effect reduces stock prices. Shan (2011) points out that lower capital gains tax rate increased home sales rate through lock-in effect, while she does not mention about its effects on real estate prices. Their argument depends on the fundamental asset price models.

With the possibility of speculative bubbles, lock-in effect provides another implication. Namely it may discourage short-term speculative transactions and the growth of speculative bubbles, and encourage long term transactions based on fundamental price of assets. Then, the lock-in effect provides similar effects as the financial transaction taxes. Further study of lock-in effects of capital gains tax on speculative bubbles is desirable.
4. Japanese Land Price Bubble and Land Tax Reform since late 1980s

4.1 Japanese land price movement and land tax policy since late 1980s

In order to consider the implications of the analysis in the previous sections, I will consider two examples of speculative bubbles and tax policy. In this section, I will consider the effects of capital gains tax and other tax policies on famous Japanese land price bubble and its collapse. The land price movement in Tokyo is shown in Figure 4. In mid-1980s, the land prices in Tokyo and major cities started to increase rapidly. Initially, it is considered that the land price increase was reflecting very rapid economic growth and internationalization of Tokyo. Based on this view, the land price increase simply reflected the increase of fundamental price.

However, too large increase of land price caused larger income inequality and provoked non land holders’ complaints. Japanese policy makers became to believe that land price increase is caused by speculative bubbles. In order to curb more speculative bubbles, Japanese policy makers and economists started to discuss comprehensive land tax reforms in the end of 1980s, in addition to the introduction of much stronger regulation on bank loan to real estate related industries and tighter monetary policy,

In the land tax reform debate, one hottest topic was whether higher capital gains tax will reduce or raise land price. Japanese policy makers and some economists held the orthodox view that higher capital gains tax is necessary to stop speculative bubbles. On the other hand, there was also another influential view supported by many Japanese economists. It argues that higher capital gains tax would raise land prices because of
“lock-in “effects of capital gains tax.  (The argument of this “lock-in effects induced bubble” view will be explained in more detail in the next subsection.) Finally, Japanese government picked the orthodox view that higher capital gains tax curbs speculative bubbles.  In 1991, Japanese capital gains tax rates on land was substantially raised, while capital gains tax on sales of qualified land for housing was reduced reflecting some political support for “lock-in effect induced bubble” view.

Another important issue of the land tax debate was land holding tax.  In Japan, the most important land holding tax had been local property tax.  However, since local governments were politically reluctant to raise the appraised land price (the tax base for local property tax), effective property tax rate decreased significantly in 1980s.  Policy makers and most economists agreed that land holding tax should be raised.  At national level, “land price tax” was introduced in 1992.  This land price tax rate was 3% of land price, while only the large land holders were effectively taxed because of various deductions and exemptions.  At local government level, the appraised land prices for local property tax were gradually raised to 70% of market prices of land.  Thus, the comprehensive land tax reform during 1991-93 effectively raised capital gains tax rates and land holding tax rates.

The land prices in Tokyo started to fall in 1991 when the comprehensive land tax reform was determined.  As Figure 4 shows, the land prices continued to drop rapidly until mid-1990s.  Recognizing that the land price decreased too rapidly, the Japanese government changed the stance of its land price policy and turned to decrease land related tax rates since 1996.  For example, capital gains tax was cut, and the land price tax was suspended in 1998.  However, land prices continued to fall gradually until 2005, as shown in Figure 4.
4.2. Alternative Views on Japanese Land Price Bubbles and Land Tax Reform

There are many literature about whether Japanese land price increase in late 1980s was a bubble or not. Most of them found that very rapid land increase cannot be explained by fundamental prices and conclude a part of the land price in late 1980s was a bubble (For example, Inoue, Shimizu and Nakagami (2009)).

As explained in the previous sub-section, there are two alternative views on the effects of capital gains tax on land price in Japan, while most researchers agree that land holding tax such property tax will reduce land prices.

One view of capital gains tax on land price (“orthodox view”) supports the idea that higher capital gains tax reduces land price. This is consistent with our model predicting that capital gains tax will reduce land prices through “tax capitalization” effects even when there is no asset bubble. In addition, our model predicts that when land price bubble exists (i.e. bubbly equilibrium), higher capital gains tax make the sustainability of existing bubble more implausible and cause the total or partial collapse of the land price.

On the other hand, many Japanese researchers (for example, Yamazaki (2009)) claim that higher capital gains tax raises land price. This “lock-in effects induced bubble” has been very influential in Japan. Some of these researchers even claimed that capital gains tax cut is effective to curb speculative bubbles (Miyao (1991)). Their argument is relatively simple; lock-in effects of capital gains tax curb sales of land significantly, so that the land price increases due to smaller supply of land.

However, while the possibility of asset price increase due to lock-in effect cannot be
dismissed as Dai et al. (2008) show in the case of stock market, the models used by Japanese researchers on the side of “lock-in effects induced bubble” view have some crucial problems.

First, the typical models of Japanese “lock-in effect induced bubble” view consider only the case that farmers sell their farm land to house owners. They assume that the farmers invest their earnings from the sales of their farm land into financial assets, while traditional analysis of lock-in effects of capital gains tax on assets such as Constantinides (1984) assumes that the earnings from the sales of asset is reinvested in the similar assets. With this assumption of the models of “lock-in effect induced bubble” view, Sinn (1986) and Kanemoto (1996) show that lock-in effect occurs only when the difference between initial land price and its purchased price is significantly large.

Second, some of their models assume that buyers of lands never sell the land after the land purchase. One implausible consequence of this crucial assumption is that higher capital gains tax does not affect the demand side in the land market, so that only lock-in effects on the supply side determine the land price. This assumption is too restrictive especially when we consider the land price movement in the bubble periods. In reality, lands were frequently sold after a short time in the period of land price bubble. Also, as Tirole (1982) shows, if landowners never sell their land, there will be no rational bubble. Kocherlakota (2011) defines “fundamental price” as the asset price when there is no resale of the asset forever. Thus, the assumption that buyers of lands never sell the land after land purchase excludes the possibility of bubble simply by assumption. This assumption is clearly inappropriate for analyzing the land price with bubbles. In fact, one of their empirical studies (Ch.7 of Yamazaki (1999)) found that their model is
not well fitted for the urban area where most speculative bubble occurred.

Finally, since their models do not have any explicit model of bubbles, their model cannot provide clear picture about the relationship between speculative bubbles and capital gains tax. While some previous empirical studies such as Inoue, Shimizu, and Nakagami (2009) claim that they found the evidence that higher capital gains tax caused speculative bubbles, their argument are not convincing since there is no explicit bubble in their model.

Thus, while “lock-in effects induced bubble” view is still now influential in Japan, I believe that their argument is not convincing, and the model explicitly incorporating speculative bubbles such as our model is required to discuss the effects of tax policy on asset bubbles.

4.3 Discussion

In the actual process of the comprehensive land tax reform in 1991, the government supported the orthodox view, and raised capital gains tax rates in order to curb speculative bubbles.

As Figure 4 shows, the land price actually started to fall in 1991, which corresponds to the timing of the policy decision of the comprehensive land tax reform. This is consistent with the view that higher capital gains tax rate make land prices fall, while the adjustment took a little time rather than predicted in our model. Later, the land price continued to fall gradually, which seems to correspond to the part of bubbly equilibrium path converging to the steady state bubbleless equilibrium.

One very interesting observation is that while the government reduces capital gains
tax and other related tax in late 1990s, the land price did not increase. This can be explained by multiple equilibria nature of bubbles. Our model predicts that even when capital gains tax is cut, it is possible that new bubbles will not occur. On the other hand, if the land price is determined by only fundamental price, lower capital gains should raise land prices. Thus, the fact the land price did not increase after the capital gains tax cut in late 1990s seems to be consistent with our model.

However, we should admit one weak point of the explanation above. In early 1990s, not only tax policy, but also monetary policy was used for curbing speculative bubbles. In 1990, the discount rate of Bank of Japan was raised, and the Ministry of Finance introduced much stricter regulation on bank loan to real estate industry. It is very difficult to differentiate the effects of tax policy change from the effects of monetary policy change, since the timing of change of tax policy and monetary policy was very close. Further, since land is used very often as collateral of bank loan, as Kiyotaki and Moore (1997) shows, the effects of the drop of land price may have longer effects on Japanese economy through credit contraction. This negative effects may reduce fundamental price, and offset positive effects brought by lower capital gains tax and other land related tax in late 1990s. Then, it is very difficult to differentiate the effects of credit contraction from the effects of land-related tax policy change.

In conclusion, the land price movement from mid-1980s in Japan seems to be consistent with our model. However, since it is difficult to differentiate the effects of tax policy from the effects of monetary policy, more studies are required to know the exact effects of tax policy on land prices.
5. Japanese Rabbit Mania and Rabbit Tax in Early 1870s

5.1 Japanese Rabbit Mania in 1872-73

In order to consider the effects of tax policy on speculative bubbles, we will consider relatively unknown Japanese bubble, “rabbit mania” in 1870s.

In Japan, after the Meiji Revolution in 1868, a new government was established in Tokyo, and it implemented very drastic political and economic reforms. One of the drastic reforms was abolishing the class system of “samurai (worrier),” “farmer,” “engineer,” and “merchant.” Samurai lost their privilege while they received compensation from the central government, and they should find a new business or investment opportunities using the compensation they received.

At the same time, some foreign merchants started to import rare foreign rabbits for pets to Japan. Those rabbits became very popular among rich Japanese celebrities in 1872, and the price of rabbits gradually increased. People including former samurais looking for investment opportunities purchased and raised rabbits for profit. The rabbit auction meetings were frequently opened in Tokyo. The rabbits with rare features such as yellow ears were traded at high prices. Even the champion rabbit ranking list (shown in Figure 5) was created, which is resembled to the champion ranking list of Japanese sumo wrestlers. With higher and higher rabbit prices, more and more people joined speculative rabbit trading. Speculative madness was obvious. For example, a Japanese newspaper even reported that some wanted to sell their daughters in order to purchase rabbits (Kawasaki (1976)).

While some could earn a large profit, there were many speculators who suffered large
loss because of failed transactions or sudden death of their rabbits\(^6\). Worrying about bankruptcy of many former samurais, Governor of Tokyo issued the order to prohibit rabbit auction meetings in January of 1873.

However, since foreigners were enjoying extraterritorial privilege and rights in Japan at that time, they (and Japanese borrowing foreigners’ names\(^7\)) could continue to run frequent rabbit auction meetings. The price of rabbits increased further. One of the most valuable rabbits was traded at 600 Japanese yen (when average monthly rent was 0.577 yen in 1872\(^8\).) The popularity of rabbit trading was spreading to ordinary people. Rabbit mania did not seem to end at all even after the prohibitive order of Governor of Tokyo.

### 6.2 Rabbit Tax and Its Consequences

Recognizing that many people devote themselves to speculative rabbit trading rather than work in real business, the government and business leaders in Tokyo really worried about negative influences of rabbit mania. After the failure of the prohibitive order of Governor of Tokyo, they discussed various proposals of prohibitive tax on rabbit ownership. After serious consideration of those proposals, the rabbit tax (local tax) was introduced by Governor of Tokyo in December 1873 finally.

The rabbit tax is imposed on registered rabbits. The tax rate on a rabbit is 1 yen par

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\(^6\) *The Times of London* (Aug. 21, 1973) reported a story that a man killed his farther because the father refused $150 for a rabbit which they possessed, but which unfortunately died before morning.

\(^7\) *The North-China Herald* (July 12, 1873) reported “These (rabbit auction markets in Shimabara area) are all carried by five or six Europeans, who earn from $100 to $250 a month by merely lending their name to some of these establishments.”

\(^8\) Kaheiseido Chousakai (the Research Committee of Monetary System)(1895)
a month. If a rabbit is not registered, the owner should pay 2 yen par a month.

After the sudden announcement of the introduction of the rabbit tax, a kind of panic was observed immediately. Beautiful rabbits held in fancy boxes disappeared from Tokyo. Many of them were simply thrown away near rivers and woods in night. Unlucky remaining rabbits were eaten in hot pots or killed for fur and skin. Figure 6 shows a caricature of departures of rabbits from their owner family at that time.

The price of rabbits dropped quickly. Unfortunately, there was no formal statistic of the price movement, since rabbit auction was illegal since January of 1873. However, newspapers reported the sudden end of rabbit mania. For example, one newspaper described that fancy rabbits were sold at a few hundred yen before the introduction of rabbit tax, but rabbits were sold at 0.2 yen on average after the introduction of rabbit tax. Similar explanation can be found in other newspapers. Although the quality of rabbits whose prices were quoted in those newspapers may be different, it is certain that the price of rabbits dropped rapidly by the introduction of rabbit tax in December of 1873.

However, this is not the end of the story of rabbit mania. In the summer of 1874, secret rabbit auction came back, and the price of rabbits started to increase again. But, there was a collapse of this small rabbit mania in 1875, then rabbit mania disappeared (Tokyo Metropolitan Government (1963)).

In 1879, the rabbit tax was terminated. Even after the termination of the rabbit tax, the rabbit bubble did not occur again.

5.3 Analysis of Rabbit mania and Rabbit Tax

The episode of rabbit mania and its collapse due to the introduction of rabbit tax
provide valuable implications.

First, the fact that the introduction of rabbit tax (one type of asset holding tax) caused an immediate collapse of rabbit bubbles is consistent with a prediction of our model. Of course, since the rabbit tax rate was very high, the tax had a significant negative effect on fundamental price of rabbits. The present value of rabbit tax can be calculated by the present value of current and future rabbit tax payment;

\[ \Delta p_{rabbit} = -\sum_{t=1}^{T} (1 + r)^{-t} \times 1 \]  

(32)

where \( r \) is interest rate per a month, and \( T \) is longevity of a rabbit (months), and the tax is assumed to be paid at the end of month. When Japanese government introduced the land tax ("chiso") based on the present value of the agricultural income in 1873, it used 6% annual interest rate. I assume that the monthly interest rate \( r=0.005 \) (corresponding to the annual interest rate 6%). Ono (2004) describes that the life expectancy of a rabbit is 7-8 years. So, I will use \( T=12 \times 7.5=90 \) months. Then, from (32), the present value of the rabbit tax for 7.5 years will be 72 yen. In this case, the heavy rabbit tax will make fundamental rabbit price fall by 72 yen, so that the disappearance of rabbit trade below 72 yen can be understood as consequences of fundamental price change. However, the collapse of rabbit trade from the price above 72 yen cannot be explained only by fundamental price change. It is better to be explained as a collapse of speculative bubble in our model.

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9 In reality, the rabbit tax should be paid on 25th of every month.
10 However, if we apply our rational bubble model to rabbit mania very strictly, there is one weak point. While our rational bubble model assumes that bubbles occur only on some assets existing forever, rabbits live only for 7 to 8 years on average in reality. Instead, we can suppose that people invest in not only the rabbits they have but also (some part of) the value of their children. Especially when rabbits have some special valuable features (for example, yellow ears that were highly evaluated during the
Second, the rabbit price movement after the introduction of rabbit tax can be explained as the bubble price movement on bubbly equilibrium path converging to steady state bubbleless equilibrium. Namely, after the collapse of bubble, the bubble price will start to increase again, but the size of bubble will never be as large as before the introduction of rabbit tax. Then, the rabbit price will turn to decrease gradually, and finally reach to a steady state bubbleless equilibrium.

Third, the fact that rabbit bubble did not occur even after the termination of rabbit tax supports the claims that the rapid increase of rabbit price in 1972-73 was caused by speculative bubbles rather than fundamental price changes. If there no speculative bubbles in rabbit trading, rabbit price should have increased rapidly after the termination of rabbit tax. However, it did not occur. On the other hand, since our model with multiple equilibria, bubble may occur or not even under lighter taxation of capital gains or asset holding.

In conclusion, the episode of rabbit mania and the consequences of rabbit tax are consistent with the model explained above\textsuperscript{11}, although further study is required to overcome problems of lack of data.

\textsuperscript{11} One interesting aspect of rabbit mania is similarity with famous tulip mania in Netherland. Rare imported plants (tulip bulb) or animals (rabbit) became very popular among rich people. The auction meetings were frequently opened. Ordinary people joined speculative trading. Still now, there is a controversy about the nature of tulip mania. For example, Garbar (2000) questioned the existence of “bubble” in tulip mania. Because of the similarity, the analysis of Japanese rabbit mania may provide important implications to the controversy about the nature of tulip mania.
In this paper, I consider effects of capital gains tax and other tax policy in the model explicitly incorporating bubbles. Rational bubbles may occur when the return from bubbles is taxed more lightly than other assets even in a dynamically inefficient economy. When rational bubbles exist already, with higher capital gains tax, bubbles should grow faster in order to keep the arbitrage condition with other assets, but investors realize that such higher growth of bubbles is unsustainable. Then, rational bubbles will collapse totally or partially. After the collapse of bubbles, there can be multiple paths; a bubbly equilibrium path converging to the new bubbly steady state equilibrium with a smaller bubble than before, a bubbly equilibrium path converging to the bubbleless steady state equilibrium and a bubbleless equilibrium path where there is no bubble at all.

I consider two episodes of bubble and tax policy in Japan; land price bubble since late 1980s and rabbit bubble in 1872-73. Both experiences seem to be consistent with the prediction of our model. However, because of the existence of simultaneous change of monetary policy in the case of land price bubble and the lack of sufficient data in the case of rabbit bubble, further careful study is necessary.

While more attention is paid to excessive leverage caused by tax-preferred treatment of debt and possible contribution of financial transaction tax in the study of tax policy and financial crisis, as this paper shows, the tax treatment of asset bubbles itself can be an important issue. I hope that the model in this paper provides a useful framework to consider the effects of tax policy on speculative bubbles.
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FIGURES

Figure 1 Dynamics of bubbly equilibrium

Figure 2 Effects of Higher CGT: Bubbly Equilibrium Case
Figure 3a Effects of Higher Capital Gains Tax: One Case of Collapse of Bubble

Figure 3b Effects of Higher Capital Gains Tax: Another Case of Collapse of Bubble
Figure 4 Land price movements in Tokyo
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Figure 6 Caricature of “good bye to rabbits”

(Yubin Hochi Newspaper (1873))