Government Induced Bubbles

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Introduction

▶ Goal: study how the behavior of investors is affected by the possibility of government intervention in market crashes

▶ Question: does the government intervention policy lead to bubbles or inflate prices?

▶ Object of study: investment decision on a risky asset, with agents trading-off capital gain vs the risk of a price collapse

▶ Contribution: use of the global games approach to characterize the unique equilibrium of the investors’ game; comparative statics exercise to understand how government’s policy exacerbates bubbles
Model

- Economy with a government sector, populated by a continuum of agents (speculators), $I = [0, 1]$, three dates, $t = 0, 1, 2$;
- 1 risky asset (infinitely-lived security), in infinite supply;
- Preferences: agents are risk-neutral and utility derives from the payoff of the investment strategy at the final date;
- Investment strategy: agents decide whether or not to pay $p_0$ to buy a single unit of the risky security, $X_i = 1$ or $X_i = 0$, respectively;
- Consumption occurs in the final period and is given by the capital gain from the investment strategy: zero if the speculator does not buy the asset and $p_2 - p_0 - t$ otherwise, with $p_2$ being the transaction price of the asset at the final date and $t$ a transaction cost.
Price Adjustment Process

- Upon the investment decision of speculators, the initial price of the risky security adjusts to $p_1$, defined by

$$p_1 \equiv g(\theta, r, \alpha),$$

where:

- $\theta$: state of fundamentals of the economy, $\tilde{\theta} \sim U[0, 1]$;
- $r$: prevailing (initial) interest rate;
- $\alpha$: fraction of speculators who buy the asset.

- The function $g(\cdot)$ is meant to represent the observed price of the asset, with the assumption that $g_\theta > 0$, $g_r < 0$ and $g_\alpha > 0$;

- With the observed price, the idea is to capture a deviation from what would be a fair price of the security - to be defined next - as a consequence of demand pressure, or the fraction of speculators investing in it.
Fundamental Price and Bubbles

- The asset’s payoff being assumed to be a function only of the state of fundamentals, the *fundamental price* - the present value of the future payoff - is given by

\[ p_{1}^{f} \equiv f(\theta, r), \]

with \( f_{\theta} \geq 0 \) and \( f_{r} < 0 \);

- With the observed price being characterized by \( p_{1} = g(\theta, r, \alpha) \) and the fundamental price by \( p_{1}^{f} = f(\theta, r) \), we define a *bubble* at \( t = 1 \) as

\[ b(\theta, \alpha) \equiv p_{1} - p_{1}^{f} = g(\theta, r, \alpha) - f(\theta, r); \]

- The focus is on positive bubbles so it’s assumed that \( g(\theta, r, \alpha) \geq f(\theta, r) \). It’s also imposed that the better the state of fundamentals, the larger the bubble gets, i.e., \( b_{\theta} > 0 \) (and also notice that \( b_{\alpha} > 0 \)).
Bubble Burst and Government Intervention

► The susceptibility of the bubble to a bust - when the observed price drops to the fundamental one - is related to the degree of strength of the economy, defined as:

\[ \theta \geq L \Rightarrow \text{Strong economy, no bust } \Rightarrow p_2 = p_1 = g(\theta, r, \alpha) \]

\[ \theta < L \Rightarrow \text{Weak economy, bubble bursts } \Rightarrow p_2 = p_1 = f(\theta, r^g) \]

► By observing the state of fundamentals and the strength of the economy, the government has the opportunity to act upon a market crash, with such an intervention taking the form of a reduction in the interest rate, i.e., \( r^g = r^* \), with \( r^* < r \);

► With government acting upon a market crash, the observed price collapses to \( p_2 = f(\theta, r^*) \) rather than to \( p_2 = f(\theta, r) \) and, consequentially, given that \( f_r < 0 \), that in fact alleviates the crash for the speculators;

► If the market crashes and there’s no intervention, the cost for the society is assumed to be proportional to the size of the bubble, \( b(\theta, \alpha) \), and, to intervene the cost for the government is \( c \), which implies that government intervenes iff \( b(\theta, \alpha) \geq c \).
Investors’ Payoff and Informational Scenarios

Upon the intervention decision of the government, for any investor $i \in I$ the payoff from the investment strategy adopted is given by

$$R^i \left( X^i_0, \theta, r \right) \equiv X_i \left( p_2 - p_0 - t \right)$$

$$= \begin{cases} 
X_i \left[ g \left( \theta, r, \alpha \right) - p_0 - t \right] & \text{if no bust;} \\
X_i \left[ f \left( \theta, r \right) - p_0 - t \right] & \text{if bust & w/o govt;} \\
X_i \left[ f \left( \theta, r^* \right) - p_0 - t \right] & \text{if bust & w/ govt.}
\end{cases}$$

Assuming $L$ (threshold for the degree of strength) to be common knowledge, speculators main concern is the state of fundamentals of the economy, represented by the random variable $\tilde{\theta}$. Two informational scenarios are considered:

- Perfect Information: the realization of $\tilde{\theta}$ is common knowledge;
- Imperfect Information: speculators receive a private signal, $\xi_i$, such that $\tilde{\xi} \sim U[\theta - \eta, \theta + \eta]$, for some $\eta > 0$. 
Perfect Information

Timeline of events:

▶ $t = 0$:

1. Nature draws $\theta, \tilde{\theta} \sim \mathbb{U} [0, 1]$;
2. Government and speculators observe the realization, $\theta$;
3. Speculators decide whether or not to buy the asset.

▶ $t = 1$:

1. Price adjustment: $p_0 \rightarrow p_1$;
2. Government observes the mass of speculators who invested in the asset, $\alpha$, and decides whether or not to intervene.

▶ $t = 2$:

1. Price adjustment: $p_1 \rightarrow p_2$;
2. Speculators liquidate their portfolio and consume the proceeds.
Assumptions

To make the problem economically meaningful, additional assumptions are imposed on $b(\theta, \alpha)$:

- $b(L, 0) < c$: there’s no intervention if investors don’t buy the asset;
- $b(0, 1) < c$: if the economy is rotten enough, it’s too costly for the government to rescue the investors;
- $b(L, 1) > c$: at a certain level of the state of fundamentals, a market crash cannot be tolerated if speculators’ activity is large enough.

Also, for the fundamental and observed prices:

- $f(\theta, r) < p_0 + t$: if the market crashes and there’s no intervention, return on the investment is negative;
- $f(\theta, r^*) = p_0 + t$: if the state of fundamentals are not too low, government intervention leads to break even;
- $g(L, r, \alpha) \geq p_0 + t$: if the market does not crash, capital gain is at least as large as the investment cost.
Indeterminacy of Equilibrium

Figure: Tripartite division of the support of $\tilde{\theta}$. 
Imperfect Information

Timeline of events:

$t = 0$:
1. Nature draws $\theta, \tilde{\theta} \sim \mathbb{U} [0, 1]$;
2. Government observes the realization, $\theta$, but speculators only receive a private signal, $\xi_i$, such that $\tilde{\xi} \sim \mathbb{U} [\theta - \eta, \theta + \eta]$, for some $\eta > 0$;
3. Speculators decide whether or not to buy the asset.

$t = 1$:
1. Price adjustment: $p_0 \mapsto p_1$;
2. Government observes the mass of speculators who invested in the asset, $\alpha$, and decides whether or not to intervene.

$t = 2$:
1. Price adjustment: $p_1 \mapsto p_2$;
2. Speculators liquidate their portfolio and consume the proceeds.
Uniqueness Result

Following the global games approach as in Morris and Shin (AER, 98), by showing that:

(i) Investment decision of investors are strategic complements;
(ii) Expected utility function of the speculators is continuous and monotonic w.r.t. the signal received, $\xi_i$;
(iii) Equilibrium strategy of speculators is a step function, with a unique $\xi^*$ such that the speculators buy the asset iff $\xi_i \geq \xi^*$.

we can prove the following:

**Theorem**

*There is a unique $\theta^*$ such that, in any equilibrium of the game with imperfect information, conditional on a market crash episode, the government intervenes if and only if $\theta^* \leq \theta \leq L$.***
Determinacy of Equilibrium

- \( a(\theta) \): critical mass of speculators to induce government intervention, defined by \( b(\theta, a(\theta)) = c \);
- \( s(\theta, \pi) \): fraction of speculators long in the asset if each follows strategy \( \pi \) (probability of buying conditional on the signal received, \( \xi \)), given by \( s(\theta, \pi) = \frac{1}{2\eta} \int_{\theta-\eta}^{\theta+\eta} \pi(\xi) \, d\xi \);

**Figure:** Mass of speculators buying the asset and critical mass requiring government intervention.
Comparative Statics

- Consider the marginal speculator, the one who receives signal $\xi_i = \theta^*$, which, for small $\eta$, means that the realized $\theta$ is close to $\theta^*$ (recall that $\theta \in [\xi_i - \eta, \xi_i + \eta]$);
- With the government intervening iff $\theta > \theta^*$, such a marginal speculator attaches equal probability to the government intervening and not;
- For the marginal speculator, therefore, the expected payoff from investing in the asset is equal to its cost when

$$\frac{1}{2} [f(\theta^*, r) + f(\theta^*, r^*)] = p_0 + t,$$

so that, for less liquid assets, i.e., the ones with larger $t$, $\theta^*$ should be correspondingly larger and, accordingly, less likely the government is to intervene;
- Increasing $c$ (cost of intervention) makes it harder for the government to step in, increasing $\theta^*$;
- Increasing $L$ (threshold of bubble burst) raises the likelihood of busts so that speculators will adopt a strategy with a higher $\xi^*$, leading to a higher $\theta^*$ as well.
Testable Implications

- Less liquid assets command a higher liquidation cost and, therefore, investors are more cautious investing in those, implying that large bubbles should be less observable in this class of securities;
- Economies with weak fundamentals, i.e., those such that, for any given bubble size, the probability of a bust is larger, also make speculators to be more cautious and, therefore, should be less prone to episodes of large bubble inflation;
- Assets where the distortion that would eventually be created by the government in an intervention episode is larger, i.e., those that command a higher cost for the government to step in, should be less prone to bubbles since also when investing in them speculators should be more cautious;
- Overall, assets (or markets) less susceptible to government intervention should be less prone to bubbles (or those should be smaller in size).
Extensions

- Adding uncertainty to strength of the economy via changes in the bubble burst parameter: overconfidence would lead speculators to think that bubbles are less likely to burst than they actually are;
- Endowing speculators with wealth, possibly in a way that wealthier investors would receive more precise signals;
- Adding a real sector so that the optimal intervention policy of the government (the one minimizing the cost of intervention or maximizing welfare) could be determined.
Related Literature

Financial Crises:

▶ Brunnermeier & Pedersen (2009): market liquidity and funding liquidity;
▶ Mendoza (10): Fisherian debt-deflation mechanism.

Bubbles:


Runs and indeterminacy of equilibrium:

▶ Diamond & Dybvig (83): bank runs as an equilibrium phenomenon.

Global games: