Government Insurance, Information, and Asset Prices

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Abstract

An investment decision problem is studied, in a framework where the government offers insurance against the possibility of the price of a risky asset falling drastically. The problem is considered under different informational scenarios, i.e., information quality, under which agents have to infer the state of fundamentals of the economy. Changes in information quality is shown to affect equilibrium prices despite no concomitant changes in the fundamentals, creating excess volatility. The possibility of government intervention is shown to increase equilibrium prices, which can be ordered as a function of information quality. Empirical evidence supporting the model is presented.

Keywords: Government insurance, information quality, asset prices.

JEL classification: E32, E44, G01.

1. Introduction

During crises episodes, the course of action of the government is always subject to a great deal of controversy. No consensus is ever achieved between those who, on the one side, champion the idea of government intervention and those who, on the other, believe in the self-correcting force of markets. Ex-post, government intervention might be required, if the state of affairs is not to be aggravated; ex-ante, if government intervention is taken for granted whenever bad outcomes happen, risks might be taken in excess.

The way the government behaves in crises episodes has an impact on the payoff of virtually any asset. The reason is that, at least to some degree, there is always a correlation between an asset’s payoff and the state of fundamentals of the economy - those factors that indicate how well the economy is performing, and the very same factors the government aims at upon an intervention. Affecting assets’ payoffs, the government turns out to play an important role in the
investment decision of agents, which in turn affects the demand for assets and, consequently, their prices. Assets’ prices are part of the state of fundamentals, causing the action of the government to feed back into itself. Figure 1 illustrates this process.

One example of the process above is the case of mortgage-backed securities (MBS) in the financial crisis episode of 2008-2009. MBS are securities whose payoffs derive from a pool of mortgages, assembled together and issued as a single asset, a process known as securitization. Securitization creates a secondary market for loans, which helps financial institutions in the transfer of risks, making it easier for them to offer new mortgages.

Of prominent role in this secondary market is Fannie Mae, a company created by the U.S. government in 1938, with the goal of fostering the level of home ownership. Initially established as a government-sponsored enterprise (GSE), it was converted into a publicly traded company in 1968. This change of ownership altered its government guarantee status, from being explicit pre-1968 to being implicit post-1968.

This implied government guarantee would constitute arc number 1 in Figure 1. Since the payoff of a MBS is dependent on the payment of loans it embeds, it is an instrument with a great deal of credit risk. Therefore, the support from the U.S. government conferred to the securities traded by Fannie Mae a lot of appeal, increasing the demand for them, which would be arc number 2.

Given an active secondary market for loans, and a fierce competition for new customers in a business deemed profitable at the time, a plethora of credit became available to those willing to
take a mortgage, and together with that came a decrease in lending standards. The increased demand for houses arguably inflated a bubble, arc number 3, and, when the high level of prices could not be sustained anymore, those disqualified borrowers had no ways of fulfilling their obligations. By the time, a great fraction of the mortgage market was owned by Fannie Mae, whose collapse would pose a serious threat to all of those invested in assets like MBS, making government intervention inevitable, arc number 4, completing the process depicted in Figure 1.

Defining a scenario by the precision of the signals received by the agents of the economy, the effects from the possibility of government intervention should be related to how precise the information available to the agents is. For, agents considering to invest in a risky asset would value more the possibility of an intervention in a scenario with less informative signals, since accurate signals would allow for a decision to be taken regardless of the policy chosen by the government: if the economy will perform well, agents buy the risky asset, otherwise they just invest in the riskless one.

Following this logic, the goal of the paper is to study the effects on equilibrium prices of a policy whereby the government can intervene during a financial crisis, and how these effects are related to the scenario, or precision of information, under which assets are transacted. Not only that, the aim is to compare how those effects change when the government is able to commit to a policy of no intervention. In the setup to be presented, the criterium used by the government to intervene is the social welfare of the agents, defined by the total sum of their portfolios’ payoffs. A financial crisis happens whenever this measure goes below a critical level, which results in the government intervening and the social welfare being restored to the critical level.

The problem faced by the agents is to form a portfolio that can consist of a riskless asset and an indivisible risky asset. The payoff of the risky asset is assumed to be perfectly correlated with the state of fundamentals of the economy, modeled as a uniform random variable on the unit interval. The scenario in which agents make their decisions fall into one of the following three: (i) imperfect information, where each agent receives a noisy private signal of the future payoff of the risky asset, (ii) perfect information, where every agent knows what the payoff of the risky asset will be and, (iii) common prior, where all that is known is the probability distribution of the future payoff of the risky asset.

In terms of government intervention, two frameworks are studied, one where agents entertain the possibility of intervention, to be called the government intervention framework, and another
one where agents rule out that possibility from the outset, the no government framework.\footnote{From now on, framework is related to the possibility or not of government intervention, whereas scenario refers to the precision of the information held by investors about the future payoff of the risky asset.}

In order to understand the effects from the interaction between agents’ precision of information and the possibility of intervention, the equilibrium price for each combination of scenario and framework is derived and compared to each other, as illustrated in Figure 2. Among the results obtained, it is showed that (i) the possibility of government intervention raises equilibrium prices, no matter what the informational scenario under which agents form their portfolios; (ii) equilibrium prices cannot be sustained at particular high levels, and; (iii) the possibility of government intervention matters only when the uncertainty faced by the agents is sufficiently high.

The reason why the possibility of government intervention raises equilibrium prices is that it operates as an insurance, in particular when the agents consider to buy the risky asset. If agents are to pay too high of a price for the risky asset, though, the strategy will be profitable only at high realizations of the state of fundamentals. Given the uniform distribution assumed, such realizations are less likely, and therefore agents will choose to invest their entire endowment in the riskless asset. Thus, an equilibrium in which the risky price is transacted at high prices will fail to hold.

That the possibility of intervention matters only when the uncertainty faced by the agents is sufficiently high shows how pervasive can changes in the quality of information be, and how the possibility of government intervention can amplify the effects from that. For instance, compared
to the framework with no possibility of intervention, the models predicts jumps in asset prices when agents entertain the possibility of the government stepping in and the precision of the information held by agents deteriorate, causing more volatility in prices.

1.1. Related Literature

The paper relates mainly to two strands of literature, one analyzing the effects of the quality of information on assets prices, and another studying the consequences for asset pricing of the possibility of government intervention during crises.

Regarding the effects of the quality of information on asset prices, models were developed and empirical studies were performed focusing on the implications for interest rates and bond prices (Dothan and Feldman (1986), Feldman (1986)), portfolio choice (Genotte (1986), Detemple (1986)) stock market fluctuations and predictability of asset returns (Barsky and DeLong (1993), Timmermannai (1993), Wang (1993), Veronesi (2000), Brennan and Xia (2001), Ali (2010)), effects of central bank and stock exchanges transparency (Rhee and Turdatic (2013), Ke et al. (2013)), and cost of equity capital (He et al. (2013)), among others. Most of these papers, particularly the theoretical ones, explore a dynamic setting where learning plays a crucial role, differently from the present paper which is developed in a static setting with no updating of information whatsoever. Another difference is that, whereas the aforementioned papers explore questions related to stock returns, the interest here is on the level of stock prices.

Another strand of the literature that also touches on the issue of the relation between information quality and asset prices is that of ambiguity, as surveyed in Guidolin and Rinaldi (2013). Particularly relevant to the present paper is Epstein and Schneider (2008). Despite not explicitly considering the possibility of government intervention, Epstein and Schneider show that information quality can have negative effects on asset prices even when fundamentals do not change, a result that is also obtained here.

Models of ambiguity can also explain market non-participation, by modeling agents as having ambiguity aversion preferences (Cao et al. (2005), Antonio et al. (2014)). The model to be presented shows that another explanation can be added to that: even with perfect information, agents may prefer not to participate in the market if prices get too high, since that signals a likely poor return on the investment in case it is made.

In terms of the effects arising from the possibility of government intervention during crises, in particular financial ones, the literature addresses questions regarding optimal policy, e.g., interest rate versus bailout interventions (Farhi and Tirole (2012), Diamond and Rajan (2012)), banks’
ex-ante choice of liquidity (Acharya et al. (2011)), incentives for failure (Acharya and Yorulmazer (2007)), bank runs (Ennis and Keister (2009)), effects on option prices (Kelly et al. (2012)), central bank’s policy impact on Tobin’s q (Faria et al. (2012)), and consequences of monetary policy shocks (Tsai (2014)), to cite a few. Apart from the analysis of Kelly et al., none of these papers addresses the question of how government’s intervention policy affect the level of equilibrium prices, which is the main focus here.

In the model to be developed, agents might have information which makes them unaware of the intervention decision of the government. However, there is no uncertainty whatsoever regarding the policy to be followed by the government in case an intervention does happen, a question pursued by Pastor and Veronesi (2012) and, indirectly, by Gospodinov and Jamali (2014). Regarding the model of Pastor and Veronesi, whereas the assumption of uncertainty about both government’s action and their impact leads to excess volatility in asset returns, unawareness about intervention leads to excess volatility in asset price levels in the present paper.

The empirical section of the paper assumes that consumer sentiment has an effect on asset prices, and this effect relates to the characteristics of the assets, which here are defined in terms of the quality of the information available. Similar to that is the analysis in Corredor et al. (2013), where a comparison of investors’ sentiment effect on stock prices is carried out considering also country-specific characteristics.

The structure of the paper is as follows: section 2 introduces the model, with the corresponding measure of social welfare upon which the government bases its intervention decision; section 3 focus on the framework where investors entertain the possibility of government intervention, with the following subsections dealing with the different informational scenarios: imperfect information, perfect information and common prior; analogously, section 4 refers to the framework where investors acknowledge the absence of the government; section 5 compares the equilibrium prices across frameworks (with and without the government) and across scenarios (imperfect, perfect and common prior information); empirical evidence supporting the model is presented in section 6; section 7 concludes. The derivation of some of the results is delegated to the appendix.

2. Model

The model consists of a continuum of agents, represented by the unit mass interval, \( I = [0, 1] \), facing a static decision problem. There are four dates, \( t = 0, 1, 2, 3 \), and the sequence of events that unfold is:
Figure 3: Timeline of events.

- $t = 0$: nature draws the state of fundamentals $\theta$ from a uniform distribution $\tilde{\theta} \sim U[0, 1]$;

- $t = 1$: agents decide whether to buy or not, $X_i = 1$ or $X_i = 0$, respectively, a single unit of an asset that has a future payoff equal to the realized state of fundamentals. The information about the state of fundamentals is revealed to the agents according to the informational scenario:
  - Imperfect information scenario: agents receive a noisy private signal about the realized state of fundamentals;
  - Perfect information scenario: agents receive precise information about the realized state of fundamentals;
  - Common prior scenario: agents know only the probability distribution of the state of fundamentals, and this information is common knowledge.

- $t = 2$: the government decides whether to intervene or not, according to the framework:
  - Government framework: the government anticipates the social welfare level (to be defined) that results from agents’ investment strategies and decides whether to intervene or not;
  - No government framework: no intervention whatsoever ensues since the government is absent from the outset.

- $t = 3$: agents liquidate their portfolios and consume the proceeds arising from that.

Figure 3 illustrates the timeline of events. The asset is in unitary supply, and every agent is initially endowed with wealth $A$. In case the price of the asset is $p$, buying is affordable if and
only if $A \geq p$. Without buying, an agent just carries over her initial endowment to the last date of the economy. All the consumption occurs at the final date, as a function of the investment strategy chosen. Agents are risk neutral and their utility is represented by the payoff of their investments' strategy given by:

$$R(X_i, \theta, A) \equiv X_i\theta + A - X_i p = X_i(\theta - p) + A, \quad \forall i \in I. \quad (1)$$

If an agent chooses to buy, $X_i = 1$, she gets the payoff from the asset, $\theta$, plus whatever is left from the initial endowment after the asset was purchased, $A - p$. On the other hand, by not buying, $X_i = 0$, an agent keeps her total endowment, $A$, for later consumption.

In the framework with the presence of the government, intervention occurs whenever social welfare goes below a certain threshold, $C$. Social welfare, $S$, is defined as the sum across the agents of the proceeds from their investment strategies, before the government decides whether or not to intervene, expressed as:

$$S(\theta) \equiv \int_0^1 R(X_i, \theta, A) \, di = \int_0^1 [X_i(\theta - p) + A] \, di. \quad (2)$$

The condition for intervention is:

$$S(\theta) < C. \quad (3)$$

If this condition is satisfied, the government intervenes and social welfare is restored to $C$. Together with the market clearing condition, $\int_0^1 X_i \, di = 1$, this implies that, whenever there is government intervention, the state of fundamentals that the agents of the economy will end up facing is $\theta^*$, given by:

$$S(\theta) = C \iff \theta = C - A + p \equiv \theta^*. \quad (4)$$

Thus, the condition for the government to intervene is met whenever the realization of $\tilde{\theta}$ is sufficiently low, i.e., $\theta < \theta^*$. The interesting case is when $A > C$, for whenever the government steps in the resulting state of fundamentals is such that agents cannot fully recover the amount invested: from (4), conditional on government intervention, the strategy of buying the asset yields $\theta^* - p = C - A < 0$. Also, $A < C$ would imply government intervention even when no agent invests, which is not plausible given the measure of social welfare chosen.

Summarizing, the problem faced by each agent is to build a portfolio whose future payoff depends not only on the state of fundamentals of the economy, but also on the decision of the
government to intervene or not, which in turn is a function of social welfare. The possibility of intervention affects agents’ problem since it works as an insurance mechanism, as it is shown in the sequence.

3. Framework with the Possibility of Intervention

In the framework with the presence of the government, agents are aware of the possibility of intervention. Since government’s action affects the payoff of the risky asset, when building their portfolios agents need to determine the probability of an intervention happening. Beliefs are formed in accordance with the informational scenario at hand, i.e., imperfect, perfect or common prior information as described in Section 2. The imperfect information scenario is analyzed first.

3.1. Imperfect Information

In the imperfect information scenario, each agent \( i \) receives a noisy private signal \( \xi_i \) about the state of fundamentals. Signals are uniformly distributed around the realized value, \( \xi \sim U[\theta - \tau, \theta + \tau] \), with \( \tau > 0 \). Agents know that \( \theta \) is at most \( \tau \) units away from the signal received, i.e., \( \theta \in [\xi_i - \tau, \xi_i + \tau] \), \( \forall i \in I \). Agents’ problem is then:

\[
\max_{X_i} U(X_i; \xi_i, A, p) \equiv \mathbb{E}[X_i (\theta - p) + A | \xi_i] = X_i \left[ \mathbb{E}(\theta | \xi_i) - p \right] + A \tag{5}
\]

s.t. \( A \geq p \) if \( X_i = 1 \), \( \forall i \in I \).

An equilibrium is defined as:

**Definition 1.** An equilibrium is a collection of decision rules, \( \mathcal{X} = \{X_i | X_i \in \{0, 1\}, \forall i \in I \} \), and price \( p \in \mathbb{R}_{++} \), such that:

(i) given price \( p \) and private signal \( \xi_i \), \( X_i \in \arg \max \{U(X_i; \xi_i, A, p) | A \geq p \text{ if } X_i = 1 \}, \forall i \in I \); and

(ii) market clears: \( \int_0^1 X_idi = 1 \).

Agent \( i \)'s signal \( \xi_i \) conveys information not only about \( \theta \) but also about the likelihood of government intervention. When deciding whether to buy or not the asset, each agent asks what is the probability of intervention conditional on the information received, i.e., the probability that \( \theta < \theta^* \) conditional on \( \theta \in [\xi_i - \tau, \xi_i + \tau] \). This probability in turn depends on the price of the asset, since \( \theta^* \) is a function of \( p \) as defined in (4).

Given \( p \), for each agent \( i \) one of the following three possible cases hold:
(I) \( C - A + p \leq \xi_i - \tau \);  
(II) \( \xi_i - \tau < C - A + p \leq \xi_i + \tau \);  
(III) \( \xi_i + \tau < C - A + p \).

In (I), it follows that \( C - A + p = \theta^* \leq \theta \), since \( \theta \in [\xi_i - \tau, \xi_i + \tau] \). Therefore, conditional on the price being \( p \) and having received a signal \( \xi_i \) such that (I) holds, agent \( i \) knows that there will be no government intervention. Thus:

\[
E\left( \theta \mid \xi_i \right) = \frac{1}{2\tau} \int_{\xi_i - \tau}^{\xi_i + \tau} \theta d\theta 
= \xi_i.
\]

(6)

(7)

In (II), agents cannot rule out the possibility of government intervention and, accordingly, they calculate the expected value of the state of fundamentals as:

\[
E\left( \theta \mid \xi_i \right) = \frac{1}{2\tau} \left[ \int_{\xi_i - \tau}^{C - A + p} \theta^* d\theta + \int_{C - A + p}^{\xi_i + \tau} \theta d\theta \right] 
= \frac{1}{2\tau} \left\{ (C - A + p) \left[ \frac{1}{2} (C - A + p) - (\xi_i - \tau) \right] + \frac{1}{2} (\xi_i + \tau)^2 \right\}.
\]

(8)

(9)

Finally, in (III) agents know that there will be intervention, resulting in:

\[
E\left( \theta \mid \xi_i \right) = \frac{1}{2\tau} \int_{\xi_i - \tau}^{\xi_i + \tau} \theta^* d\theta 
= C - A + p.
\]

(10)

(11)

Given all the three possible cases, the objective function in (5), \( U_i (X_i; \xi_i, A, p) \), can be rewritten as:

\[
U_i (X_i; \xi_i, A, p) = \! X_i \left[ E\left( \theta \mid \xi_i \right) - p \right] + A 
= \! X_i \! \|_{(I)} \xi_i 
+ \! X_i \! \|_{(II)} \frac{1}{2\tau} \left\{ (C - A + p) \left[ \frac{1}{2} (C - A + p) - (\xi_i - \tau) \right] + \frac{1}{2} (\xi_i + \tau)^2 \right\} 
+ \! X_i \! \|_{(III)} (C - A + p) - p \! + \! A, \forall i \in I,
\]

(12)

where \( \|_{(I)} \) is the indicator function for case (I), namely \( \|_{(I)} = 1 \) if \( C - A + p \leq \xi_i - \tau \) and zero otherwise, and similarly for \( \|_{(II)} \) and \( \|_{(III)} \).
Agents can secure their entire wealth for consumption in the final period, and since they must satisfy a budget constraint, the optimal strategy will be $X_i = 1$ in case the following two conditions are satisfied:

$$U_i(1; \xi_i, A, p) \geq A,$$  \hspace{1cm} (13)

$$A \geq p.$$  \hspace{1cm} (14)

Using (12), inequality (13) can be equivalently written as:

$$I(i)\xi_i + I(II) \frac{1}{2\tau} \left\{ (C - A + p) \left[ \frac{1}{2} (C - A + p) - (\xi_i - \tau) \right] + \frac{1}{2} (\xi_i + \tau)^2 \right\} + I(III) (C - A + p) \geq p.$$  \hspace{1cm} (15)

Hence, assuming that the budget constraint is satisfied, condition (15) is the pivotal one in determining whether an agent chooses to buy the risky asset or not. The equilibrium price is the only variable endogenously determined in the definition of $\theta^*$, and thus to each equilibrium price there is an associated likelihood of government intervention given by $\theta^*$. The equilibrium price and the likelihood of government intervention are two sides of the same coin, determined jointly.

According to the price, $p$, the corresponding critical level of intervention $\theta^*$ falls in one of the following intervals:

(i) $0 \leq C - A + p \leq \theta - 2\tau \iff 0 \leq \theta^* \leq \theta - 2\tau$;

(ii) $\theta - 2\tau < C - A + p \leq \theta - \tau \iff \theta - 2\tau < \theta^* \leq \theta - \tau$;

(iii) $\theta - \tau < C - A + p \leq \theta \iff \theta - \tau < \theta^* \leq \theta$;

(iv) $\theta < C - A + p \leq \theta + \tau \iff \theta < \theta^* \leq \theta + \tau$;

(v) $\theta + \tau < C - A + p \leq \theta + 2\tau \iff \theta + \tau < \theta^* \leq \theta + 2\tau$;

(vi) $\theta + 2\tau < C - A + p \leq 1 \iff \theta + 2\tau < \theta^* \leq 1$.

In intervals (i), (ii) and (iii), intervention does not occur in equilibrium, whereas in intervals (iv), (v) and (vi) it does. One would expect an equilibrium to be more likely to emerge in the intervals associated with a higher $\theta^*$, after all those are the ones where investing in the asset is
supposedly safer due to a higher possibility of intervention. However, it is also true for those cases that the price to be paid to acquire the asset, \( p \), is higher, making the buying decision less attractive. It is the interaction of these two opposite effects that ultimately determines the overall likelihood of having an equilibrium in a particular interval.

Moving from interval (i) to (vi), agents’ uncertainty, or unawareness, changes from being related to the fact that the government does not intervene to the fact that the government does intervene. From interval (i) to (iii), accurate signals indicate that the government will not intervene, whereas from (iv) to (vi) accurate signals indicate that the government will intervene.

In intervals (i), (ii) and (iii), government intervention does not take place in equilibrium and no agent mistakenly believes that such an intervention would certainly occur. The mass of agents knowing exactly what the government behavior will be gets progressively smaller, as one goes from interval (i) to (iii). For instance, in interval (i), everyone knows the government will not intervene, in (ii) a fraction of the investors knows there will not be intervention and in (iii) a relatively smaller mass of agents acknowledges that the government will not intervene, even though this is what happens in equilibrium.

In intervals (iv), (v) and (vi), government intervention does take place, with no agent mistakenly ruling out such a possibility. Differently from the previous intervals, however, the mass of agents who know exactly what the government behavior will be gets progressively larger, as one moves from interval (iv) to (vi). In interval (iv), some agents know that the government will intervene, in (v) a relatively larger fraction of the investors acknowledges that and in (vi) everyone knows how the government will react.

Formalizing the argument, recall that intervention ensues if and only if \( \theta \in [0, \theta^*] \), and that agents receive noisy private signals distributed as \( \tilde{\xi} \sim U[\theta - \tau, \theta + \tau] \). Agents therefore know that \( \theta \in [\xi_i - \tau, \xi_i + \tau] \), to be called individual range of uncertainty, for each agent \( i \in I \).

The union of the individual ranges of uncertainty, \( \bigcup_i [\xi_i - \tau, \xi_i + \tau] \), is \( [\theta - 2\tau, \theta + 2\tau] \), to be called total range of uncertainty. In interval (i), it holds that \( 0 \leq \theta^* \leq \theta - 2\tau \), hence no agent believes in government intervention since \( [0, \theta^*) \cap [\theta - 2\tau, \theta + 2\tau] = \emptyset \). In (ii) and (iii), on the other hand, \( [0, \theta^*) \cap [\theta - 2\tau, \theta + 2\tau] \neq \emptyset \), and since \( \theta^* \) increases as one moves along the intervals, the fraction of agents unaware of the fact the government does not intervene becomes larger.

In intervals (iv) and (v), no agent can rule out the possibility of government intervention, since for both it is true that \( [0, \theta^*) \cap [\theta - 2\tau, \theta + 2\tau] \neq \emptyset \). Again using the fact that \( \theta^* \) increases with the intervals, the fraction of agents aware of the fact the government does intervene becomes larger, the extreme case being interval (vi), where everyone knows what the government’s course
of action will be: \((\theta^*, 1] \cap [\theta - 2\tau, \theta + 2\tau] = \emptyset\).

A measure of the level of unawareness of government’s equilibrium action, defined as the fraction of investors that is uncertain about the behavior of the government, i.e., intervention or not, is depicted in Figure 4 called degree of confusion. According to the previous discussion, the degree of confusion is a function of the critical level of government intervention, \(\theta^*\).

In deriving the equilibrium price, the magnitude of the dispersion parameter \(\tau\) relative to the downside risk \(A - C\) is the key factor defining the functional form of \(p\). The high (low) uncertainty case is the one where \(\tau > (\tau <) A - C\). Recall that \(\tau\) is the parameter that defines how disperse is the range of uncertainty of each agent, and also the support of the distribution of signals: a higher \(\tau\) means both that investors contemplate a larger interval where the realized \(\theta\) might lie and also that the signals are more spread out. The characterization of the equilibrium price according to the dispersion parameter \(\tau\) is given in Table 1.

<table>
<thead>
<tr>
<th>Uncertainty level, (\tau)</th>
<th>Price Functional, (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\tau &gt; A - C)</td>
<td>(p = \theta + (A - C - 2\sqrt{\tau(A - C)}))</td>
</tr>
<tr>
<td>(\tau &lt; A - C)</td>
<td>(p = \theta - \tau)</td>
</tr>
</tbody>
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Table 1: Equilibrium price as a function of the dispersion parameter.

The effects on the equilibrium price, \(p\), of changes in the state of fundamentals \(\theta\), wealth \(A\), insurance \(C\) and dispersion parameter \(\tau\) are given by:

(i) \(p_\theta > 0\);
(ii) $p_A < 0$;

(iii) $p_C \geq 0$;

(iv) $p_r < 0$.

The equilibrium price of the risky asset is increasing in both the state of fundamentals and
the insurance provided by the government, whereas it is decreasing in the wealth of investors
and the dispersion parameter. The only counter-intuitive of these results relates to $p$ decreasing
in the wealth $A$ of agents, and the reason for that is twofold. First, agents can only buy a single
unit of the risky asset, thus the demand for it does not necessarily increase when agents become
wealthier. Second, agents are allowed to carry their entire endowment for future consumption,
so increasing its level makes choosing the riskless asset more attractive relative to buying the
risky one.

Another result is that no equilibrium price exists such that the critical level of government
intervention, $\theta^*$, lies in interval (vi), where it would be at its highest. Equivalently, no equilibrium
price exists such that every agent is aware that government intervention will ensue. For, agents
would be paying too high of a price to purchase the risky asset, and only upon an unlikely high
realization of the state of fundamentals such a strategy would be worth. Facing a high price,
therefore, investors prefer to abstain from buying the asset, which results in the market clearing
condition not being satisfied and an equilibrium failing to hold.

This non-existence of equilibrium could be related to the burst of a bubble, indicating the
impossibility of prices being supported at extremely high levels. As bubble burst episodes are
related to a lack of demand to keep prices increasing, so it is this non-existence of equilibrium
also caused by an insufficient mass of investors willing to buy the risky asset, despite high prices
signaling a higher probability of government intervention in case the risky asset performs poorly.

3.2. Perfect Information

In the perfect information scenario, agents know the realized state of fundamentals, $\theta$. Based
on the price of the risky asset, they acknowledge if an intervention will follow or not. The critical
level of government intervention, $\theta^*$, leads to one of the two following outcomes:

(i) $0 < C - A + p \leq \theta \Leftrightarrow 0 \leq \theta^* \leq \theta$;

(ii) $\theta < C - A + p \leq 1 \Leftrightarrow \theta < \theta^* \leq 1$. 

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In (i) the government does not intervene, whereas in (ii) it does. Investors’ maximization problem is:

\[
\max_{X_i} X_i (\theta - p) + A \quad \text{s.t.} \quad A \geq p \quad \text{if} \quad X_i = 1.
\]  

Therefore, in case agents can afford to buy the asset, \( A \geq p \), they choose \( X_i = 1 \) only if \( \theta - p + A \geq A \), or equivalently, if \( \theta \geq p \). If this is the case, \( A > C \) implies that:

\[
[p, 1] \cap [C - A + p, 1] = [p, 1],
\]  

whereas

\[
[p, 1] \cap [0, C - A + p) = \emptyset,
\]

which means that an equilibrium can be supported only in the range where there is no government intervention.

The reason why an equilibrium cannot be supported when agents anticipate an intervention by the government is the same as in the imperfect information scenario, i.e., they acknowledge that the price of the risky asset is too high and therefore it is not worth to buy it. This implies that the market clearing conditions does not hold, and hence an equilibrium fails to exist.

Defining \( p^{PI} \) as the equilibrium price in the perfect information scenario, in equilibrium it follows that \( p^{PI} \leq \theta \). As a benchmark for comparison later, one takes the equilibrium price in the present informational scenario to be:

\[
p^{PI} = \theta,
\]

which is the maximum price investors would be willing to pay knowing the government will not act.

Following the expression of the equilibrium price, the comparative statics are straightforward: the price is increasing in the state of fundamentals. There is no downside risk to be considered by the investors since they know what the payoff of the asset will be. Because of that, the wealth level \( A \) and the government insurance parameter \( C \) do not appear in the equilibrium price and thus do not matter in terms of comparative statics.
3.3. No Information: Common Prior About the Fundamentals

The common prior scenario refers to the case where the only information known by the agents is the distribution of $\tilde{\theta}$, given by $\tilde{\theta} \sim U[0, 1]$. Agents’ problem is now:

$$\max_{X_i} \mathbb{E} \left[ X_i \left( \tilde{\theta} - p \right) + A \right] = X_i \left[ \mathbb{E} \left( \tilde{\theta} \right) - p \right] + A$$

s.t. $A \geq p$ if $X_i = 1$.

As usual, agents acknowledge that intervention takes place only if $\theta < \theta^*$, a condition which is equivalent to $\theta < C - A + p$, as in (1). Also, agents know that, upon government intervention, the state of fundamentals is set at $\theta^*$. Hence:

$$\mathbb{E} \left( \tilde{\theta} \right) = \int_0^1 \theta d\theta = \int_0^{C-A+p} \theta^* d\theta + \int_{C-A+p}^1 \theta d\theta = \frac{1}{2} \left[ 1 + (C - A + p)^2 \right].$$

(21)

In case agents can afford to buy the asset, $A \geq p$, they choose $X_i = 1$ only if:

$$\frac{1}{2} \left[ 1 + (C - A + p)^2 \right] - p + A \geq A \Leftrightarrow \frac{1}{2} \left[ 1 + (C - A + p)^2 \right] - p \geq 0.$$  

(22)

Taking the constraint in (22) to be binding, the equilibrium price in the common prior scenario, denoted by $p^{CP}$, is given by:

$$p^{CP} = 1 + \left[ A - C - \sqrt{2(A - C)} \right].$$

(23)

With $p^{CP}$ as the equilibrium price, the fact that $\theta^* \in [0, 1]$ requires $A - C < 1/2$, and with that one has the following comparative statics of the equilibrium price:

(i) $p^{CP}_A < 0$;

(ii) $p^{CP}_C > 0$.

As before, the only counter-intuitive result is the equilibrium price decreasing in the wealth of investors. The explanation is the same given previously: an increase in $A$ makes the option of saving the entire wealth for future consumption more attractive, and, together with the fact that agents are allowed to buy at most one unit of the risky asset, it holds that $p^{CP}_A < 0$. 

16
3.4. Equilibrium Prices Across the Informational Scenarios

After deriving the equilibrium prices prevailing in each informational scenario, this section proceeds with the intra framework, inter scenario analysis of Figure 2. By ranking the equilibrium prices across the informational scenarios one can assess the impact of information on asset prices.

The equilibrium prices to be compared are:

(i) Imperfect information:

- \( p^{IP} = \theta + [A - C - 2\sqrt{\tau(A - C)}] \) (high uncertainty);
- \( p^{IP} = \theta - \tau \) (low uncertainty).

(ii) Perfect information: \( p^{PI} = \theta \);

(iii) Common prior: \( p^{CP} = 1 + [A - C - \sqrt{2(A - C)}] \).

As mentioned in the derivation of \( p^{CP} \) in (23), an extra assumption required is \( 0 < A - C < 1/2 \). With this assumption in place, it is shown in the appendix - Propositions 3 and 4 - that the ordering of equilibrium prices across the informational scenarios will depend on the realization of the state of fundamentals. In particular, for both cases of low uncertainty and high uncertainty, i.e., low and high levels of \( \tau \), there exists \( \theta \) and \( \overline{\theta} \) such that, for a sufficiently high level of the state of fundamentals \( \theta \), i.e., \( \theta \in [\overline{\theta}, 1] \), the ordering of equilibrium prices is given by:

\[
p^{PI} > p^{IP} \geq p^{CP},
\]

whereas for an intermediate level, i.e., \( \theta \in [\hat{\theta}, \overline{\theta}] \), the ordering is:

\[
p^{PI} \geq p^{CP} > p^{IP},
\]

and, finally, if the state of fundamentals is sufficiently low, i.e., \( \theta \in (0, \hat{\theta}) \), it follows that:

\[
p^{CP} > p^{PI} > p^{IP}.
\]

For any level of \( \theta \), therefore, the equilibrium price under perfect information, \( p^{PI} \), is higher than the one prevailing in a scenario of imperfect information, \( p^{IP} \), which reflects the value of having accurate information about the state of fundamentals of the economy. On the other hand, if investors only have knowledge of the distribution of \( \hat{\theta} \), the expected state of fundamentals they envisage is higher than the true one when the realization of \( \theta \) is low, and the converse when the
realization of $\theta$ is high. This leads to $p^{CP} > p^{PI} > p^{IP}$ whenever $\theta \in (0, \theta^*)$, and $p^{PI} > p^{IP} > p^{CP}$ when $\theta \in [\theta^*, 1]$. The ordering of equilibrium prices shows that changes in the informational scenario faced by agents leads to changes in asset prices even without a concomitant change in the state of fundamentals. This is important because it highlights the fact that the environment where trade occurs, with its specific information structure, can create volatility in asset prices that otherwise would not be warranted.

As a thought experiment, consider the case where information is not disseminated properly in the economy, leading agents to make their decisions based only on the knowledge of the distribution of returns of the risky asset. If one considers the fundamental price of the risky asset as the one prevailing in the perfect information scenario without informational frictions, then the model says that positive bubbles would exist when the state of fundamentals is low and negatives bubbles when it is high, since in the former case one has $p^{CP} > p^{PI}$, whereas in the later $p^{PI} > p^{CP}$. In terms of government policy, therefore, one implication of the model would be that measures aiming at improving the quality of the information known by the agents would lead to a correction in prices.

4. Framework without the Possibility of Intervention

In the framework with the absence of the government, agents rule out the possibility of intervention from the outset, regardless of the realization of the state of fundamentals. As for the framework with the possibility of government intervention, this section derives the equilibrium prices under different informational scenarios, which are then compared to each other. The imperfect information scenario is discussed first.

4.1. Imperfect Information About the Fundamentals

In the imperfect information scenario with no possibility of government intervention, it follows from (6) that $E\left(\tilde{\theta} \mid \xi_i\right) = \xi_i$, and from (15) that agents opt to buy the risky asset only if $\xi_i \geq p$ and the budget constraint is satisfied, i.e., $A \geq p$. The market clearing condition is:

$$\frac{1}{2\tau} \int_{p}^{\theta + \tau} d\xi = 1 \iff \theta + \tau - p = 2\tau \iff p = \theta - \tau \equiv p^{NG}.$$
Hence, the higher the dispersion parameter, $\tau$, the lower the price of the risky asset emerging in equilibrium. Also, the functional form of the equilibrium price coincides with the one prevailing in the imperfect information scenario with the possibility of intervention and low uncertainty, given in Table 1. There, the equilibrium price does not depend on government’s insurance policy since such an insurance is irrelevant when the of uncertainty faced by agents is low, whereas here the government insurance parameter does not appear in the expression of the equilibrium price since there is no government whatsoever in the current framework.

Also, whereas changes in the level of uncertainty lead to discontinuous changes in prices in the framework with the possibility of intervention, as given by Table 1 here such a discontinuity is not present by virtue of the fact that a unique expression of the equilibrium price holds, regardless of the level of $\tau$. This implies that the possibility of government intervention creates an excess volatility in prices that would not exist otherwise.

4.2. Perfect Information About the Fundamentals

In the perfect information scenario, agents’ maximization problem is:

$$\max_{X_i} \quad X_i (\theta - p) + A$$

s.t. $A \geq p$ if $X_i = 1$.

Therefore, in case agents can afford to buy the asset, $A \geq p$, they choose $X_i = 1$ only if:

$$\theta - p + A \geq A \Leftrightarrow \theta \geq p.$$  \hspace{1cm} (28)

For later comparison, the constraint in (28) is taken to be binding, and therefore the equilibrium price when agents have perfect information is given by:

$$p^{NGP} = \theta,$$ \hspace{1cm} (29)

which is the same as in the framework with the possibility of government intervention.

4.3. No Information: Common Prior About the Fundamentals

Finally, the focus turns to the case where agents do not receive any signal, being aware only of the distribution of $\tilde{\theta}$, given by $\tilde{\theta} \sim U[0, 1]$. Agents’ problem is:
\[
\max_{X_i} \quad \mathbb{E} \left[ X_i \left( \tilde{\theta} - p \right) + A \right] = X_i \left[ \mathbb{E} \left( \tilde{\theta} \right) - p \right] + A
\]
\[
\text{s.t. } A \geq p \quad \text{if } X_i = 1. \tag{30}
\]

With no possibility of intervention, it follows that:

\[
\mathbb{E} \left( \tilde{\theta} \right) = \int_0^1 \theta d\theta = \frac{1}{2}. \tag{31}
\]

Therefore, in case agents can afford to buy the asset, \( A \geq p \), they choose \( X_i = 1 \) only if:

\[
\frac{1}{2} - p + A \geq A \iff \frac{1}{2} - p \geq 0. \tag{32}
\]

If the constraint in (32) is binding, the equilibrium price is given by:

\[
p^{NGC} = \frac{1}{2}.
\]

Hence, in the common prior scenario without the government, the equilibrium price is simply the expected value of the random variable representing the payoff of the risky asset.

4.4. Equilibrium Prices Across the Informational Scenarios

Given the equilibrium prices holding in each of the informational scenarios, namely \( p^{NG} \) (imperfect), \( p^{NGP} \) (perfect) and \( p^{NGC} \) (common prior), the same analysis as in the framework with the possibility of intervention is performed now, namely the intra framework, inter scenario comparison of Figure 2. The objective is, again, to assess the impact of information on equilibrium prices, taking into account that agents cannot rely on the government to absorb potential losses from an investment in the risky asset.

The equilibrium prices are:

(i) Imperfect information: \( p^{NG} = \theta - \tau \);

(ii) Perfect information: \( p^{NGP} = \theta \);

(iii) Common prior: \( p^{NGC} = 1/2 \).
Similarly to the analysis in the framework with the possibility of government intervention, Proposition 5 in the appendix shows that exists $\theta$ and $\bar{\theta}$ such that, for a high realization of $\theta$, i.e., $\theta \in [\bar{\theta}, 1]$, the ordering of equilibrium prices is:

$$p^{NGP} > p^{NG} \geq p^{NGC},$$  \hspace{1cm} (33)

whereas for an intermediate level, i.e., $\theta \in [\bar{\theta}, \theta)$:

$$p^{NGP} \geq p^{NGC} > p^{NG},$$  \hspace{1cm} (34)

and, finally, if the state of fundamentals is sufficiently low, i.e., $\theta \in (0, \theta)$:

$$p^{NGC} > p^{NGP} > p^{NG}.$$  \hspace{1cm} (35)

The ordering of equilibrium prices is, therefore, similar to the one obtained in the framework with the possibility of intervention. Regardless of the realization of $\bar{\theta}$, it is always the case that $p^{NGP} > p^{NG}$, i.e., the equilibrium price in the perfect information scenario is always higher than the one prevailing when investors have imperfect information: better (perfect) information commands a higher price than worse (imperfect) information.

For a sufficiently low realization of the state of fundamentals, $0 < \theta < 1/2$, the unconditional expected value assigned by the agents to the asset’s payoff, $1/2$, is higher than the value one would expect in both the perfect and imperfect information scenarios, thus higher is the equilibrium price, $p^{NGC}$, compared to what would be agreeable in the other scenarios. This argument is reversed for a sufficiently high state of fundamentals, i.e., for $1/2 + \tau \leq \theta \leq 1$, in which case $p^{NGC}$ is the lowest of the equilibrium prices.

The ranking of equilibrium prices shows that, even without concomitant changes in the state of fundamentals, changes in the precision of information should cause changes in prices. Therefore, the previous remark that changes in the informational scenario bring excess volatility in prices holds here as well.

5. Government vs No Government Prices

From the analysis of the two frameworks, i.e., with and without the possibility of government intervention, across the different informational scenarios, i.e., imperfect, perfect and common prior information, the conclusion is that, overall, prices respect the following order:
• For a sufficiently high realization of the state of fundamentals, the equilibrium price under perfect information is the highest, whereas the lowest equilibrium price is reached in the common prior scenario;

• For a moderate realization of the state of fundamentals, the perfect information scenario leads to the highest price, whereas it is the imperfect information scenario that leads to the lowest;

• For a sufficiently low realization of the state of fundamentals, the equilibrium price in the common prior scenario is the highest, whereas the lowest equilibrium price is reached in the imperfect information scenario.

The possibility of government intervention, therefore, does not alter the ordering of equilibrium prices, when a comparison is made across the different informational scenarios. The other results that follow are:

• Changes in the information structure creates excess volatility by leading to changes in prices even when the state of fundamentals remains constant;

• The possibility of intervention makes equilibrium prices to be more volatility, by inducing a discontinuity in prices when the level of uncertainty in the economy changes from low to high in the imperfect information scenario;

• If the equilibrium price of the risky asset under the scenario of perfect information is to be deemed as the fundamental one, situations where agents can rely only on minimal information such as the distribution of fundamentals, positive bubbles exist when the state of fundamentals is low and negative bubbles when it is high.

Being an insurance, the possibility of government intervention should intuitively make equilibrium prices higher than the equilibrium prices in the framework without the possibility of intervention. This is the result obtained in turn by performing the inter framework, intra scenario analysis of Figure 2.

5.1. Imperfect Information

In the imperfect information scenario with the possibility of government intervention, the equilibrium price depends on the uncertainty level faced by agents. From Table (1):

\[ p_{IP} = \theta + \left[ A - C - 2\sqrt{\tau (A - C)} \right] \] (high uncertainty);
• \( p^{IP} = \theta - \tau \) (low uncertainty).

Without the possibility of intervention, the equilibrium price is, from (27), given by:

\[
p^{NG} = \theta - \tau.
\]  
(36)

In the low uncertainty case, \( \tau < A - C \), the equilibrium price in the two frameworks coincide, i.e., \( p^{IP} = p^{NG} \). The reason is that, with low uncertainty, agents’ information is accurate enough and allows them to decide whether to buy or not the risky asset regardless of the possibility of intervention. In the high uncertainty scenario, however, the possibility of government intervention turns out to be essential in agents’ investment decision. Comparing the equilibrium prices across the frameworks with and without intervention, one has:

\[
p^{IP} > p^{NG} \iff \tau^2 - 2\tau (A - C) + (A - C)^2 > 0.
\]  
(37)

By definition, under high uncertainty it holds that \( \tau > A - C \), which in turn implies (37) being true, and hence \( p^{IP} > p^{NG} \).

Therefore, combining the low and the high uncertainty cases, the equilibrium price is at least as high with the possibility of government intervention as it would be without. This goes according to what one would expect, as government intervention represents an insurance associated with the risky asset and as such should be reflected positively in the equilibrium price.

5.2. Perfect Information

In the perfect information scenario, the equilibrium price is the same in both frameworks, with and without the participation of the government, i.e.:

\[
p^{PI} = p^{NGP} = \theta.
\]  
(38)

Recall that, in the framework with the possibility of intervention, the equilibrium price is always such that the government ends up not intervening, and this is the reason why the equilibrium price is identical to that in the framework without the possibility of intervention.
5.3. Common Prior

When agents only have knowledge of the distribution of the state of fundamentals, the equilibrium price in the framework with the possibility of government intervention is given by:

\[ p^{CP} = 1 + \left[ A - C - \sqrt{2(A - C)} \right], \tag{39} \]

whereas in the framework without the possibility of intervention it is:

\[ p^{NGC} = 1/2. \tag{40} \]

It follows that:

\[ p^{CP} > p^{NGC} \iff 1/2 > \sqrt{2(A - C)} - (A - C). \tag{41} \]

The assumption that \( 0 < A - C < 1/2 \) and the fact that the right-hand side is increasing in \( A - C \) implies that (41) holds, and therefore \( p^{CP} > p^{NGC} \).

The reason is straightforward: since agents do not receive any information regarding the level of the state of fundamentals, all they calculate is the unconditional expectation of \( \tilde{\theta} \). In the framework without the possibility of intervention, that expectation is taken over the whole support of the distribution of \( \tilde{\theta} \), whereas in the framework with the possibility of intervention the support is truncated at the critical level of intervention, after all agents know that the payoff of the asset will not be lower than that. This truncation makes the expected value of the state of fundamentals higher in the framework with the possibility of intervention than in the one without, and the same goes for the equilibrium prices.

5.4. Frameworks and Informational Scenarios Combined

Combining the conclusions obtained after a comparison across frameworks of equilibrium prices under each informational scenario, the main result is the following:

**Proposition 2.** Regardless of the informational scenario faced by investors being one of imperfect, perfect, or common prior information, the resulting equilibrium price is at least as high in the framework with the possibility of intervention as in the one without.
6. Empirical Evidence

This section digresses on the main testable implications of the model, i.e., the ranking of equilibrium prices under different informational scenarios as a function of the state of fundamentals, and the positive effect of the possibility of government intervention on equilibrium prices.

6.1. Ranking of Equilibrium Prices

The model asserts that equilibrium prices should respect a particular ordering according to the realized state of fundamentals, and this should hold regardless of the possibility of government intervention.

In order to test this hypothesis, it is used the FRED (Federal Reserve Economic Data) database from the Federal Reserve Bank of St. Louis to assemble the data used herein. In particular, the series used are the Consumer Sentiment Index compiled by the University of Michigan, and the Price Index for small, mid and large capitalization firms in the U.S. calculated by Wilshire. All the data is publicly available.

The Consumer Sentiment Index is used as a proxy for the state of fundamentals and, as such, the higher it is, the better the overall shape of the economy. The informational scenarios are proxied by the capitalization of U.S. firms, the assumption being that agents have more information about a firm, the better capitalized the firm is. This leads to the perfect scenario being associated to large capitalization firms, the imperfect scenario to mid capitalization firms, and the common prior scenario to small capitalization firms.

Figure 6.1 shows the time series of the aforementioned data. The data is monthly, ranging from June, 1996, to March, 2014. The indexes’ values are scaled to 100 to the peak of the last U.S. recession, which is December the 1st, 2007.

From visual inspection, the time series of the Consumer Sentiment Index (CSI) appears to have three breakdates. In order to test for multiple breaks, it is used the methodology developed by Bai (1997). As discussed in Hansen (2001), the idea is that, if taken as a function of the breakdate, the mean square error will be at a local minimum near each break date.

Upon this idea, the following regression is run, taking each monthly data point in the range from June, 1996, to March, 2014, as a potential break date:

\[
CSI_t = \alpha + \beta CSI_{t-1} + \delta d_t + \gamma x_t + e_t, \tag{42}
\]

\[\text{http://research.stlouisfed.org/fred2/}.\]
Figure 5: Regressions’ mean square error as a function of the breakdate.

where $CSI_t$ stands for the Consumer Sentiment Index at date $t$, $d_t$ is the dummy variable which equals 1 if $t$ is after the breakdate and 0 otherwise, and $x_t = d_t.CSI_{t-1}$ is the interaction term. Figure 5 plots the mean square error for all the regressions, as a function of each possible breakdate.

There are three local minima, from which we take two as representing the breakdates of the Consumer Sentiment Index\(^3\), namely November, 2000, and January, 2007. The breakdates are plotted as dashed lines in Figure 6.1, dividing the Consumer Sentiment Index in three periods, according to which the state of fundamentals of the economy is properly defined:

- High state of fundamentals: from June, 1996, to November, 2000;
- Intermediate state of fundamentals: from December, 2000, to January, 2007;

\(^3\)The other candidate was July, 2007, but, due to its proximity to the second breakdate, it was not considered as such.
Let $p^l$ denote the price index of large capitalizations firms, $p^m$ the price index of mid capitalization firms, and $p^s$ the price index of small capitalization firms. The model developed in the previous sections, together with the assumption that the higher the capitalization of firms, the better the quality of the information about them, predicts the following ordering of prices, as a function of the state of fundamentals:

- High state of fundamentals: $p^l > p^m \geq p^s$;
- Intermediate state of fundamentals: $p^l \geq p^s > p^m$;
- Low state of fundamentals: $p^s > p^l > p^m$.

To test the ordering of equilibrium prices, it is first checked whether the level of the state of fundamentals has any impact on the difference among the price indices. For that, the following regressions are run:

\[
\Delta p_{i,j}^t = \alpha + \beta d_1 + \gamma d_2 + e_t, \quad i, j = l, m, s
\]  

(43)
where $\Delta p_{i,j}^t = p^i_t - p^j_t$ is the difference between the price index of firms with capitalization levels $i$ and $j$, $d1_t$ is the dummy variable for the first breakdate, and $d2_t$ for the second one.

The regressions’ results show that, for $\Delta p_{l,m}^t$ and $\Delta p_{l,s}^t$, the coefficients $\beta$ and $\gamma$ are negative and both significant at the 1% level, corroborating the model: as the state of the economy deteriorates, so does the difference in the price index of large capitalization firms compared to that of mid and small ones. The time series of $p^m$ and $p^s$ are too close to each other, yielding not significant results for $\Delta p_{m,s}^t$.

Another test performed is a comparison of means of $\Delta p_{i,j}^t$, for each of the periods defined by the breakdates. For the periods under the high and intermediate state of fundamentals, respectively, the hypothesis that $\Delta p_{l,m}^t \leq 0$ and $\Delta p_{l,s}^t \leq 0$ can both be rejected at the 1% level. Therefore, in the high and intermediate state of fundamentals, it holds that $p^l > p^m$ and $p^l > p^s$, as predicted by the model. As before, the fact that the series of $p^m$ and $p^s$ track each other too closely makes the results for $\Delta p_{m,s}^t$ to be not significant.

On the other hand, for a comparison of means in the period corresponding to the low state of fundamentals, both hypotheses that $\Delta p_{l,m}^t \leq 0$ and $\Delta p_{l,s}^t \leq 0$ can be rejected at the 1% level. Hence, the data shows that, under low fundamentals, $p^m > p^l$ and $p^s > p^l$, and, whereas the first inequality is not supported by the model, the second is. The hypothesis that $\Delta p_{l,m,s}^t \geq 0$ can be rejected at the 1% level, corroborating the prediction that $p^s > p^m$ when the state of fundamentals is low.

6.2. Effects on Prices from the Possibility of Intervention

According to Proposition 2, the possibility of government intervention should command higher equilibrium prices regardless of the informational scenario under which agents make their decisions. It is not straightforward to test this hypothesis, as it requires two assets similar in every dimension other than the possibility of intervention.

To circumvent this problem, it is assumed that the government follows a too-big-to-fail policy for which only large capitalization firms are eligible, but not mid and small ones. Also, it is assumed that the quality of information for large, mid and small capitalization firms is the same.

Under these assumptions, the model predicts that the price index of large firms, $p^l$, should be higher than the corresponding one of mid and small companies, $p^m$ and $p^s$, respectively. Not only that, given that the possibility of intervention is enjoyed only by large firms, the price index...
of mid and small capitalization firms should track each other closely.

Because the uncertainty about the possibility of government intervention was resolved in October 3, 2014, when the former U.S. President George W. Bush signed into law the Troubled Asset Relief Form (Tarp), the relevant range for the analysis runs until that date point. Figure 6.1 depicts the data when the Tarp was signed into law (dotted line). It is clear from the picture that the price index of large capitalization firms was higher than that of mid and small capitalization firms for most of the time, by a significant amount.

The hypotheses that $\Delta p_{l,m}^t \geq 0$ and $\Delta p_{l,s}^t \geq 0$ cannot be rejected at the 1% level, confirming the visual evidence that $p_l$ is significantly higher than both $p_m$ and $p_s$. On the other hand, even though the hypothesis that $\Delta p_{m,s}^t < 0$ cannot be rejected, the confidence interval for $p_m^t - p_s^t$ is much tighter than that when the comparison is between the price index of large capitalization firms and that of mid and small ones. Since the assumption is that only large capitalization firms are eligible for a too-big-to-fail policy, this corroborates the predictions of the model that the possibility of government intervention leads to higher equilibrium prices.

7. Concluding Remarks

This paper studies the impact on equilibrium prices that would result from a policy whereby the government provides free insurance against the fall of agents’ welfare below a particular level, as opposed to a framework where the government is credible in its commitment to not intervene. This problem is analyzed under different scenarios, with agents having different precision of information in each of them.

It is showed that regardless of a framework with or without the possibility of intervention, the comparison of equilibrium prices across different informational scenarios respect a particular ordering determined by the realized state of fundamentals. This ordering implies that changes in the informational scenario faced by agents lead to changes in the equilibrium prices even without changes in the underlying state of fundamentals, hence creating excess volatility in prices. By inducing a discontinuity in prices when the uncertainty of agents changes from low to high in a scenario of imperfect information, the possibility of intervention makes prices to be even more volatile.

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5This intervention targeted mainly financial institutions, but in January, 2009, the government used $23.4 billion of the Tarp funds to create the Automotive Industry Finance Program, benefiting the three major U.S. auto industry companies: GM, Chrysler and Ford.

If the fundamental price of the risky asset is assumed to be the one prevailing in a perfect information scenario, situations where agents discard signals and instead base their investment decisions only on the probability distribution of the asset’s return lead to positive bubbles when the realized state of fundamentals is high and negative bubbles when the realized state is low. This implies that a policy whereby the government makes the market better informed should have a positive effect in terms of a correction of prices.

Finally, by working as an insurance mechanism, the possibility of government intervention leads to an increase in prices, and this effect is verified regardless of the informational scenario faced by the agents.

References


A. Comparison of Equilibrium Prices across Different Scenarios in the Government Intervention Framework

Proposition 3. In the framework with the possibility of government intervention and low uncertainty scenario, i.e., \(0 < \tau < A - C < 1/2\), and equilibrium prices given by:

(i) Imperfect information: \(p^{IP} = \theta - \tau\);

(ii) Perfect information: \(p^{PI} = \theta\);

(iii) Common prior: \(p^{CP} = 1 + \left[A - C - \sqrt{2(A - C)}\right]\);

the following holds:

- For a sufficiently high level of the state of fundamentals, \(\theta\):
  \[
  1 \geq \theta \geq 1 + \left[\tau + A - C - \sqrt{2(A - C)}\right],
  \]
  \(\theta \) (44)

  the ordering of equilibrium prices is:

  \[p^{PI} > p^{IP} \geq p^{CP};\] (45)

- For an intermediate level of \(\theta\):
  \[
  1 + \left[A - C - \sqrt{2(A - C)}\right] \leq \theta < 1 + \left[\tau + A - C - \sqrt{2(A - C)}\right],
  \]
  \(\theta \) (46)

  the ordering of equilibrium prices is:

  \[p^{PI} \geq p^{CP} > p^{IP};\] (47)

- For a sufficiently low level of \(\theta\):
  \[
  0 < \theta < 1 + \left[A - C - \sqrt{2(A - C)}\right],
  \]
  \(\theta \) (48)

  the ordering of equilibrium prices is:

  \[p^{CP} \geq p^{PI} > p^{IP}.\] (49)
PROOF. Since $\tau > 0$, it follows trivially that $p^{PI} > p^{IP}$. Comparing $p^{IP}$ to $p^{CP}$ one has:

$$p^{IP} \geq p^{CP}$$

$$\Leftrightarrow \theta \geq 1 + \left[ \tau + A - C - \sqrt{2(A - C)} \right].$$

(50)

Therefore, if (50) is satisfied, it follows that $p^{PI} > p^{IP} \geq p^{CP}$. Otherwise, $p^{CP} > p^{IP}$, and it remains to compare $p^{CP}$ to $p^{PI}$:

$$p^{PI} \geq p^{CP}$$

$$\Leftrightarrow \theta \geq 1 + \left[ A - C - \sqrt{2(A - C)} \right],$$

which implies that, for:

$$1 + \left[ A - C - \sqrt{2(A - C)} \right] \leq \theta < 1 + \left[ \tau + A - C - \sqrt{2(A - C)} \right],$$

(51)

the ranking of prices is $p^{PI} \geq p^{CP} > p^{IP}$.

Finally, the last case is when:

$$0 < \theta < 1 + \left[ A - C - \sqrt{2(A - C)} \right],$$

(52)

and, from the above, it follows that $p^{CP} > p^{PI} > p^{IP}$, completing the proof.

**Proposition 4.** In the framework with the possibility of government intervention and high uncertainty scenario, i.e., $1/2 > \tau > A - C > 0$, and equilibrium prices given by:

(i) Imperfect information: $p^{IP} = \theta + \left[ A - C - 2\sqrt{\tau(A - C)} \right]$;

(ii) Perfect information: $p^{PI} = \theta$

(iii) Common prior: $p^{CP} = 1 + \left[ A - C - \sqrt{2(A - C)} \right]$;

the following holds:

- For a sufficiently high level of the state of fundamentals, $\theta$:

$$1 \geq \theta \geq 1 + \left[ 2\sqrt{\tau(A - C)} - \sqrt{2(A - C)} \right],$$

(53)
the ordering of equilibrium prices is:

\[ p^P > p^I > p^C; \quad (54) \]

- For an intermediate level of \( \theta \):

\[ 1 + \left[ A - C - \sqrt{2 (A - C)} \right] \leq \theta < 1 + \left[ 2 \sqrt{\tau (A - C) - \sqrt{2 (A - C)}} \right]; \quad (55) \]

the ordering of equilibrium prices is:

\[ p^P \geq p^C > p^I; \quad (56) \]

- For a low level of \( \theta \):

\[ 0 < \theta < 1 + \left[ A - C - \sqrt{2 (A - C)} \right]; \quad (57) \]

the ordering of equilibrium prices is

\[ p^C > p^P > p^I. \quad (58) \]

**Proof.** Comparing \( p^P \) to \( p^I \), it follows that:

\[ p^P > p^I \iff \tau > \frac{1}{4} (A - C), \quad (59) \]

which trivially holds since, by assumption, \( \tau > A - C \). Therefore, \( p^P > p^I \). Comparing \( p^I \) to \( p^C \) one has:

\[ p^I \geq p^C \iff \theta \geq 1 + \left[ 2 \sqrt{\tau (A - C)} - \sqrt{2 (A - C)} \right]. \quad (60) \]

Therefore, if \((60)\) is satisfied, it follows that \( p^P > p^I \geq p^C \). Otherwise, \( p^C > p^I \) and then one has to compare \( p^C \) to \( p^P \).
\[ p^{PI} \geq p^{CP} \]
\[ \Leftrightarrow \theta \geq 1 + \left[ A - C - \sqrt{2(A - C)} \right], \quad (61) \]

which implies that, for:
\[ 1 + \left[ A - C - \sqrt{2(A - C)} \right] \leq \theta < 1 + \left[ 2\sqrt{\tau(A - C)} - \sqrt{2(A - C)} \right], \quad (62) \]
prices are ranked as \( p^{PI} \geq p^{CP} > p^{IP} \).

Finally, the last case is when:
\[ 0 < \theta < 1 + \left[ A - C - \sqrt{2(A - C)} \right], \quad (63) \]
for which, using the above, \( p^{CP} > p^{PI} > p^{IP} \), completing the proof.

B. Comparison of Equilibrium Prices across Different Scenarios without Government Intervention

**Proposition 5.** In the framework without the possibility of government intervention, with \( 0 < \tau < 1/2 \) and equilibrium prices given by:

(i) Imperfect information: \( p^{NG} = \theta - \tau \);

(ii) Perfect information: \( p^{NGP} = \theta \);

(iii) Common prior: \( p^{NGC} = 1/2 \).

the following holds:

• For a high realization of \( \theta \):

\[ 1/2 + \tau \leq \theta \leq 1, \quad (64) \]

the ordering of equilibrium prices is:

\[ p^{NGP} > p^{NG} \geq p^{NGC}; \quad (65) \]
• For an intermediate realization of $\theta$:

$$1/2 \leq \theta < 1/2 + \tau,$$

the ordering of equilibrium prices is:

$$p^{NGP} \geq p^{NGC} > p^{NG};$$

(67)

• For a low realization of $\theta$:

$$0 < \theta < 1/2,$$

the ordering of equilibrium prices is:

$$p^{NGC} > p^{NGP} > p^{NG}.$$  

(69)

**Proof.** Since $\tau > 0$, it holds trivially that $p^{NGP} > p^{NG}$. Comparing $p^{NG}$ to $p^{NGC}$ one has:

$$p^{NG} \geq p^{NGC}$$

$$\Leftrightarrow 1/2 + \tau \leq \theta \leq 1,$$

(70)

and, therefore, if (70) is satisfied, it follows that $p^{NGP} > p^{NG} \geq p^{NGC}$. Otherwise one has to compare $p^{NGP}$ to $p^{NGC}$:

$$p^{NGP} \geq p^{NGC},$$

$$\Leftrightarrow \theta \geq 1/2$$

(71)

implying that, if $1/2 \leq \theta < 1/2 + \tau$, then $p^{NGP} \geq p^{NGC} > p^{NG}$.

The last case is when $0 < \theta < 1/2$, which yields that $p^{NGC} > p^{NGP} > p^{NG}$, completing the proof.