Financial Stability and Central Banks:

Do Announcements Help?

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1 Introduction

A common, if not consensus, view among academics and policy makers is that the most important role of a central bank in a modern society is to provide a stable means of payment. Thus, low inflation is the mandated primary goal of many countries' central banks. Central banks, however, may also be interested in promoting a secure financial system. Some threats to financial stability are best dealt with by appropriate supervision and regulation; they do not require a monetary policy response. But one particular threat – a coordination failure – can occur even in the presence of a good regulatory framework and vigilant oversight. This paper looks at how monetary policy makers might affect the likelihood of such a coordination failure occurring.

Two types of coordination failures are of particular importance to monetary authorities. The first is one that produces a bank run or a speculative attack on a pegged exchange rate. In this scenario there are multiple possible equilibria. In the socially desirable outcome a bank run or a speculative attack does not occur; in the coordination failure equilibrium the bank run or the speculative attack occurs. The second type of coordination failure is when an asset prices, such as the exchange rate, house prices or equity prices, cease to depend solely on the appropriate fundamentals. One way that this can occur with rational market participants is if they believe that a variable that ought to be extraneous is important and their beliefs are self fulfilling: the asset price diverges from what is implied solely by the fundamentals.

It is sometimes suggested that conventional monetary policy can be used to affect asset prices that are out of line with the fundamentals. Unfortunately, using monetary policy to influence an asset price – such as an exchange rate – may conflict with providing low and stable inflation. Suppose, for example, that a central bank is confronted with a rising value of its domestic currency that it

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perceives as undesirable. If inflation is to be contained, it is not possible to reduce interest rates to lower the currency's value. It is not possible to use monetary policy to target both inflation and the exchange rate.

A possible solution is to adopt a more flexible attitude about the primary role of a central bank and to give the central bank multiple objectives, to allow it some discretion in trading off the costs of inflation against the costs of asset price misalignments or other coordination failures that threaten the financial system. Unfortunately, this increased flexibility comes at the cost of a loss of credibility. Suppose, for example, that inflation is low and the home currency is appreciating in a manner that suggests a bubble. The central bank could lower the interest rate for opportunistic reasons unrelated to fostering financial stability under the guise of trying to contain the exchange rate.

If society – sensibly – rejects the notion of the central bank using its interest rate policy to achieve multiple goals, then a central bank interested in combatting bubbles, sunspots, bank runs and speculative attacks must search for additional instruments. One class of instruments is those that are intended to be signals. The idea is that the central bank might signal – either through announcements or actions – that an asset price has moved away from the fundamentals or it might use its signal to coordinate the market away from a bank run or speculative attack equilibrium.

In this paper, I use results from the recent (and not-so-recent) game theory literature to suggest how the central bank's signalling might matter in three scenarios. In the first scenario I suppose that the central bank can make an informative announcement about the state of the economy. I discuss how this may be useful for aligning asset prices with the fundamentals – at least if the central bank's information is reasonably precise – but it can cause the possibility of a bank run or speculative attack, especially if the central bank's information is precise. In the second scenario I suppose that the central bank has an incentive to misrepresent

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its information. I explain that as long as a central bank's interests are not too different from a private sector agent's it may still be able to provide the private sector with some useful information. Finally, I suppose that it is possible for a central bank to affect the likelihood of a bank run or a speculative attack through a costly action. I discuss how the possibility of the action functioning as a signal of the fundamentals and can give rise to self-fulfilling expectations and multiple equilibria.

2   What happens when the central bank provides useful information?

Indeterminacy is a prominent feature of financial asset prices. How much a person is willing to pay for a financial asset depends upon what the person believes that other people are willing to pay for that asset now and in the future. This gives rise to the possibility of self-fulfilling expectations and multiple equilibria.

As an example, suppose that the exchange rate is pegged and that the central bank has the will and resources to withstand a limited attack on its currency, but not a sufficiently large attack. If market participants believe that other market participants will not attack the currency then they know that they cannot successfully attack it alone and they do not attack: the central bank successfully maintains its peg. On the other hand, if market participants believe that all other market participants are going to attack, they know that the attack will be successful and they have an incentive to join in: the peg collapses. As another example, suppose that all economic fundamentals are expected to remain constant over time and the home exchange rate floats. Then, there is a *fundamental* equilibrium where the value of the home currency remains constant over time. There are, however, also an infinite number of *bubble* equilibria where the currency appreciates or depreciates at some particular rate because it is expected that this is likely and market participants' beliefs are self-fulfilling.

Coordination failures, where market participants force a bank run or a speculative attack, even though this is not required by the fundamentals, or where asset prices depart from what they would be if they were determined solely by the fundamentals are costly. The after effect of an attack on a currency or the eventual collapse of a bubble is not just a redistribution of income. The inevitable bankruptcies and restructurings eat up real economic resources. In this section I consider the case where the central bank can provide useful information to the private sector and ask whether this information can coordinate the private sector on a "good" equilibrium or whether it is likely to cause or exacerbate a coordination failure. In the first subsection I consider the effect of central bank information on speculative attacks; in the second I consider the central bank's role in preventing asset price misalignments.

2.1 Bank Runs and Speculative Attacks

2.1.1 The classic model of bank runs and speculative attacks

In this section I consider the classical model of a coordination failure in financial asset markets: the model of a bank run or a speculative attack on a fixed exchange rate regime. In this framework the private sector is made up of many small market participants: I represent them as points in the interval $[0, 1]$. Each private sector agent can choose to "attack" (that is, withdraw his money from a bank or to speculate against the domestic currency) or to "abstain" from attacking. Agents who do not attack get a payoff of zero. It costs an agent δ units to attack, but if the attack is successful an agent who participates receives a payment of one unit. Thus, the overall payment to an agent who participates in a successful attack is $1 - \delta$ units and the payment to an agent who participates in an unsuccessful attack is $-\delta$ units.

The fraction of agents who choose to attack is denoted by A. To capture the

idea that the success or lack of success of an attack depends on the fundamentals, it is assumed that the attack succeeds if and only if $A > \theta$, where θ is a variable representing the fundamentals.

In the classical bank run model, θ is common knowlege. For "good" fundamentals, where $\theta \geq 1$, individual private sector agents know that there can be no successful attack. Thus, they do not attack. For "poor" fundamentals, where $\theta < 0$, agents know that there will be a successful attack and each attacks. With "intermediate" fundamentals, however, where $0 \leq \theta < 1$, multiple equilibria are possible. If each private sector agent believes that all other private sectors will attack then he believes that $A = 1 > \theta$ and a successful attack will occur. Thus, each agent finds it rational to join in and their expectations are validated. Likewise, if each private sector agent believes that no other private sector agent will attack then he believes that $A = 0 \leq \theta$ and there will be no successful attack. Thus, each agent abstains and, again, agents' beliefs are validated.

The two equilibria in the intermediate fundamentals case are *Nash equilibria*: no agent regrets his choice given the behavior of other agents. But, it is difficult to explain how these equilibria arise. The situation is similar to one where two friends have agreed to meet in New York City at noon but have forgotten to specify where to meet (and also their cell phones). They both want to coordinate and end up at the same place, but it is not clear how such an outcome could occur.

As there is no explanation of how agents form their expectations in the classical model of speculative attacks, there is no obvious way for central bank announcements or other signals to affect the outcome. A more modern theory introduces uncertainty about the fundamentals and focuses on how expectations are formed and how coordination might occur. This provides a role for the central bank's provision of information to matter.

2.1.2 A more modern model with imperfect information

Suppose that the model is modified slightly: the fundamental variable θ is no longer known. Instead, each private sector agent $i \in [0, 1]$ has an (improper) prior belief that realizations of θ are equally likely and then receives an independent signal x_i of θ. This signal has mean θ and is his private information.[1]

With this modification the equilibrium becomes unique and has a *threshold* property. There are an x^* and a θ^* such that each agent attacks if his individual signal is less than x^* and the attack succeeds if and only if $\theta < \theta^*$. As a concrete example, suppose that $\delta = 1/10$ so that the payoff to attacking when the attack is unsuccessful is $-\delta = -1/10$ and the payoff to attacking when the attack is successful is $1 - \delta = 9/10$. Suppose also that each agent's signal is distributed uniformly on $[-1/2, 1/2]$.

If a private sector agent who receives the signal x^* is indifferent between attacking and abstaining, then agents with signals less than x^* will find it optimal to attack and agents with signals greater than x^* will find it optimal to abstain abstain. As the payoff to not attacking is zero, to find x^* take θ^* as given and find the x^* such that an agent with $x_i = x^*$ has an expected payoff from attacking that is equal to zero. This is the case when the probability of a successful attack is $1/10$:

$$1/10 = \Pr\left(\theta < \theta^* | x_i = x^*\right) = 1/2 - \left(x^* - \theta^*\right). \tag{1}$$

If the threshold value of θ is θ^* then clearly an attack succeeds if $\theta < \theta^*$ and fails if $\theta > \theta^*$. To find the threshold value θ^* find the value of θ such that the fraction of private sector agents who attack is equal to θ. Given x^*, this fraction of agents who attack is equal to the probability that any individual's signal is less than x^*.

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[1] The idea behind this variant of the model may originate with Carlsson and van Damme (1993), who show that in an incomplete information game where players receive noisy private signals there is a unique equilibrium.

Thus

$$\theta^* = \Pr\left(x_i < x^* | \theta = \theta^*\right) = (x^* - \theta^*) + 1/2. \qquad (2)$$

Solving (1) and (2) yields $x^* = 13/10$ and $\theta^* = 9/10$: there is a unique equilibrium where a private sector agent attacks if and only if his signal is strictly less than $13/10$ and the attack succeeds if and only if θ is less than $9/10$.

The intuition behind this uniqueness result is that, while private sector agents have some information about the fundamentals as a result of their own signal, they do not have enough information about other agents' information either to launch a coordinated attack or to coordinate on abstention.

2.1.3   A role for the central bank

To see how the central bank might play a role in affecting the likelihood of speculative attacks, consider again the problem of the friends who want to meet in New York City. As they gain from coordinating, they will seek to find a way to do so. Suppose that each of them recalls that a popular meeting place is under the clock in Grand Central Station. This in itself is not sufficient for coordination. If one friend knows that the clock is a common place to meet but does not think that the other friend knows this, he is unlikely to go to Grand Central Station. But, if each friend knows that the clock is a typical meeting place and knows that his friend knows this and knows that his friend knows that he knows this and so on, then it is *common knowledge* that the clock is a good place to meet and this can make the clock serve as a *focal point*.

A central bank announcement may play a similar role in coordinating expectations. Suppose that in addition to each private sector agent receiving his own signal that there is a public announcement of useful information. This signal plays two roles: it provides each private sector agent with additional information and it gives agents something to coordinate on.

2.1.4 How do central bank announcements of useful information affect the likelihood of speculative attacks?

Suppose that private sector agent i receives his own signal

$$x_i = \theta + \epsilon_P^i, \ i = 1, 2, 3 \tag{3}$$

and that there is a common knowledge central bank signal

$$y = \theta + \epsilon_G, \tag{4}$$

where ϵ_P^i, $i \in [0, 1]$ and ϵ_G are mean zero, independent and normally distributed. The private sector signals have variance $1/\rho$ and the central bank's signal has variance $1/\gamma$. The variables ρ and γ can be interpreted as the quality or precision of the private sector and central bank signals, respectively. It can be shown that after receiving his signal each private sector agent i believes that θ is normally distributed with mean $x_i^* = \frac{\gamma y + \rho x_i}{\rho + \gamma}$ and variance $\frac{1}{\rho + \gamma}$. Given y and θ, private sector agents believe that x_i^* is normally distributed with mean $\frac{\gamma y + \rho \theta}{\rho + \gamma}$ and variance $\frac{\rho}{(\rho + \gamma)^2}$.

As in the previous section, I now look for threshold equilibria where x^* and θ^* are such that an agent with $x_i^* = x^*$ is indifferent between attacking and abstaining and a successful attack occurs if and only if $\theta < \theta^*$. Analagously to equation (1), x^* is found by equating the cost of attacking, δ, to a private sector agent's probability assessment that $\theta < \theta^*$ when his signal is x^*:

$$\delta = \Phi \left(\frac{\theta^* - x^*}{\sqrt{\rho + \gamma}} \right), \tag{5}$$

where Φ is the c.d.f. of a standard normal distribution. Analagously to equation (2), θ^* is found by equating θ^* to the probability that a private sector agents signal

is less than x^* when $\theta = \theta^*$:

$$\theta^* = \Phi \left(\frac{(\rho + \gamma) x^* - \gamma y - \rho \theta^*}{\sqrt{\rho}} \right). \tag{6}$$

It can be shown that a unique equilibrium exists if and only if $\frac{\gamma}{\sqrt{\rho}}$ is sufficiently small.[2] That is, the equilibrium is unique if and only if the central bank's information is not too precise. If the central bank information becomes too precise multiple equilibria can occur.
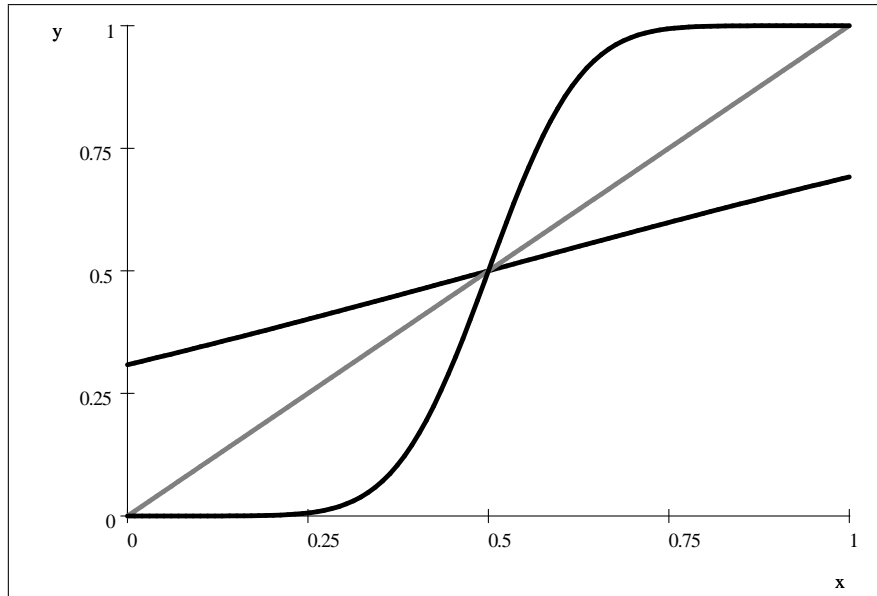
This result can be seen for the particular example of $\delta = 1/2$. In this case, solving equation (5) yields $\theta^* = x^*$. Substituting this into equation (6) yields

$$\theta^* = \Phi \left(\alpha \left(\theta^* - y \right) \right), \tag{7}$$

where $\alpha \equiv \frac{\gamma}{\sqrt{\rho}}$. For the case of $y = 1/2$, the outcome is shown in the figure below. The grey line is the forty-five degree line (the left-hand side of equation (7); the straight black curve that crosses the forty-five degree line once is the case of $\alpha = 1$ and the other black curve is the case of $\alpha = 10$. For the smaller value of α there is a unique equilibrium; for the larger value of α there are three equilibria.

NormalDist $(x - 1/2)$

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[2]These results are due to Hellwig (2002), Metz (2002) and Morris and Shin (2004).

The Possibility of Multiple Equibria

2.1.5 Policy advice

The information in the above models is assumed to be common knowledge. Not alll announcements by the government are believed to be true, let alone common knowledge. The private sector does not typically treat finance ministers protestations that it is unthinkable that their currency ever be devalued as a common knowledge statement that the fundamentals are strong enough to resist any attack. However, some government information may be common knowledge. An announcement that last month's inflation was two percent might result in it being common knowledge that the government's best guess is that inflation was indeed two percent. If the central bank or government wishes it to be common knowledge that its announcement is a truthful revelation of the information it has, then an institution for conveying this information should be set up and any decisions about how precise the information ought to be must be set up in advance, before the fundamentals are realized. It must be prohibitively costly to influence the institution or change a decision about precision in response to a particularly good or bad signal that is the central bank or government's private information.

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Extracting policy advice from the above literature about institutions for releasing information is somewhat difficult. It has been suggested that central bank announcements might be used as a way of coordinating the private sector away from bank runs and speculative attacks. But, the it appears that providing precise enough information may make such equilibria possible, where they were not before. It is not possible to say whether the multiple equilibrium outcome with precise central bank information or the unique equilibrium outcome of the less precise central bank information is better: we do not have a theory of how likely the different outcomes are in the multiple equilibrium case.

A paper by Metz (2003) provides some suggestions however. Suppose that central bank information is insufficiently precise to generate multiple equilibria. Then comparative statics are possible and the effect of a marginal change of the precision of central bank announcements on the likelihood of a speculative attack is possible. She demonstrates that there is cutoff value of θ^* such that when θ^* is above this cutoff value (and speculative attacks are relatively likely) then an increase in the precision of central bank announcements makes them more likely. If θ^* is below this cutoff value (and speculative attacks are relatively unlikely) then an increase in the precision of central bank announcements makes them less likely. The intuition is simple. Suppose that speculative attacks are relatively likely and the precision of central bank announcements increases. Then central bank signals that suggests that fundamentals are poor occur more likely and when they do the increased precision has two effects. Private sector agents believe smaller attacks will succeed so coordination is less important and they believe that other agents will be putting more weight on the central bank signal so more coordination will occur. The intuition for the case of relatively good fundamentals is similar.

2.2 Asset Price Misalignments

Can the central bank use common knowledge information as a policy tool to improve welfare when asset prices are misaligned? An interesting recent paper by Morris and Shin (2002) argues that this need not be the case; in their framework informative central bank announcements can make society worse off and lower quality announcements can be better than higher quality announcements. Thus this paper is often viewed as making the case that central banks might improve matters by deliberately withholding information from the public, or at least by making the information that they provide more ambiguous. In this section I review the paper and discuss its implications and empirical relevance. I consider whether ambiguity might be desirable in other contexts and discuss suggestions for how publicly provided information can be made less damaging.

2.2.1 Some background and intuition

In financial markets, if there is no information that is common knowledge, then people will act on the basis of what they know about the fundamentals. But if there were a focal point, then people might coordinate on that focal point. Examples of such a focal points were the announcements of Henry Kaufman, the Solomon Brothers economist who was famous during the 1970s and early 1980s for his interest rate forecasts, and the comments of former Fed chairman Alan Greenspan, whose recent remarks on China promoted a decline in Chinese equity prices and whose mention of recession helped cause US stocks to tumble earlier this year. In both cases market participants viewed these pundits' announcements as not just informative about the state of the economy; they also knew that other market participants actions would depend on what was said.

In Morris and Shin's (2002) paper, the central bank has information about the economy that it can make common knowledge. Thus, the central bank's

announcements become a focal point and this can be good and bad. By providing useful information the central bank makes the private sector better informed. But, it gives the private sector a way to coordinate. If the private sector has an incentive to coordinate then it will place too much weight on the central bank's information and too little weight on its own information: the central bank information crowds out the private sector's information. If the second effect dominates the first, the central bank information can be harmful.

If the central bank provides information, then making the information of marginally better quality can also lower welfare. This is because an increase in the quality of the central bank information increases the weight that the private sector puts on the central bank signal. If the quality of the central bank signal is poor then this latter effect can dominate the effect of better available information.

In the remainder of this section, I present a simplified version of Morris and Shin's paper and then argue that the result is empirically irrelevant. The central bank would have to be woefully incompetent for the central bank's information to worsen things or for more precise information to be harmful. I also discuss the implications of central banks being ambiguous in other scenarios and discuss what might be done to ameliorate any harmful effects of central bank information.

2.2.2 Morris and Shin's (2002) model

Market participants would like to choose the most appropriate action given the fundamentals, but they would also like to pick the action that other market participants pick. If the central bank made no announcement, market participants would have to rely on their own private information; they would have no way to coordinate

The model consists of the central bank and the private sector, which comprises three agents.[3] The state of the economy is again given by the variable s.

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[3]This is a simplification: Morris and Shin (2002) consider a continuum of agents, but the

The objective functions of the private sector agents capture the idea that, while there are welfare gains from picking the action that is most appropriate for the fundamentals, agents who coordinate on an action that is not justified solely by the fundamentals can gain at the expense of those who do not coordinate.

The private sector welfare functions of agents one, two and three are:

$$
\begin{aligned}
W_P^1 &= -\phi\left(a_1 - s\right)^2 - (1-\phi)\left[\frac{1}{2}\left(a_1 - a_2\right)^2 + \frac{1}{2}\left(a_1 - a_3\right)^2 - \left(a_2 - a_3\right)^2\right] \\
W_P^2 &= -\phi\left(a_2 - s\right)^2 - (1-\phi)\left[\frac{1}{2}\left(a_2 - a_1\right)^2 + \frac{1}{2}\left(a_2 - a_3\right)^2 - \left(a_1 - a_3\right)^2\right] \quad (8) \\
W_P^3 &= -\phi\left(a_3 - s\right)^2 - (1-\phi)\left[\frac{1}{2}\left(a_3 - a_1\right)^2 + \frac{1}{2}\left(a_3 - a_2\right)^2 - \left(a_1 - a_2\right)^2\right],
\end{aligned}
$$

where $\phi \in [0,1]$ is a parameter measuring the importance to individual agents of picking the action justified by the state of the economy relative to picking the action that helps them coordinate. Each agent dislikes deviations of his action from s and dislikes deviations of his actions from the other agents' actions. This specification ensures that the coordination is a zero-sum activity and the central bank's welfare, which is equal to average private sector welfare, depends only on picking actions that fit the fundamentals:

$$
W_G = \frac{W_P^1 + W_P^2 + W_P^3}{3} = -\frac{\phi}{3}\left[\left(a_1 - s\right)^2 + \left(a_2 - s\right)^2 + \left(a3 - s\right)^2\right]. \quad (9)
$$

Given their welfare functions, each agent's optimal action is a weighted average of his forecast of the state of the economy and the average actions of the other

results are the same.

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two agents. Specifically,

$$
\begin{aligned}
a_1 &= \phi E^1(s) + (1-\phi) E^1\left(\frac{a_2+a_3}{2}\right) \\
a_2 &= \phi E^2(s) + (1-\phi) E^2\left(\frac{a_1+a_3}{2}\right) \\
a_3 &= \phi E^3(s) + (1-\phi) E^3\left(\frac{a_1+a_2}{2}\right),
\end{aligned}
\tag{10}
$$

where E^i is the expectation or forecast of agent i given his information: his own signal and the publicly observed central bank signal.

It is assumed that the private sector agents and the central bank noisy signals of s. As in section 2.1.4 (equations (3) and (4)), private sector agent i receives a signal of the fundamental $s + \epsilon_P^i$ and the central bank receives a signal of the fundamental $s + \epsilon_G$. The error terms are normally distributed with mean zero and precisions ρ and γ, respectively.

Agent i's expectation of the state of the economy is a weighted average of his own signal and the central bank's signal:

$$
E^i(s) = \frac{\gamma y + \rho x_i}{\rho + \gamma}.
\tag{11}
$$

The more precise is the central bank's signal, the more weight is placed on it.

There is a unique equilibrium. To find it, conjecture that in equilibrium the private sector agents' actions are weighted averages of their own signal and the central bank's signal. Then

$$
a_i = \omega x_i + (1-\omega) y, \ \omega \in (0,1).
\tag{12}
$$

To find the weight ω, substitute equation (12) into equation (10) to find

$$
\omega x_i + (1-\omega)\phi y = (\phi + \omega - \phi\omega) E^i(s).
\tag{13}
$$

Substituting equation (11) into equation (13) yields

$$[\omega \left(\gamma/\rho + \phi\right) - \phi] \left(x_i - y\right) = 0. \tag{14}$$

Equation (14) always holds if and only if $\omega = \phi/\left(\gamma/\rho + \phi\right)$. Thus, by (12) an equilibrium has

$$a_i = \frac{\phi\rho x_i + \gamma y}{\gamma + \phi\rho}. \tag{15}$$

The more precise is the central bank's signal relative to the private sector's signal, the more weight the private sector puts on the central bank's information in the determination of its actions. To compute the central bank's expected welfare, substitute equation (15) into equation (9) and take the expected value to find

$$E\left(W_G\right) = -\frac{\phi\left(\gamma + \rho\phi^2\right)}{\left(\gamma + \rho\phi\right)^2}. \tag{16}$$

Differentiating equation (16) yields

$$\frac{\partial E\left(W_G\right)}{\partial\gamma} = \frac{\phi\left[\gamma + \left(2\phi - 1\right)\phi\right]}{\left(\gamma + \rho\phi\right)^3}. \tag{17}$$

As long as private sector agents do not place too much weight on coordination ($\phi \geq 1/2$), the above expression must be positive and expected welfare is increasing in the quality of the central bank signal, falling to $-\phi/\rho$ as the quality goes to zero and rising to zero as the signal becomes perfect. The policy advice in this case is clear: the central bank should be as precise as it is able to be. However, if agents place sufficient weight on coordination ($\phi < 1/2$) expected welfare can be decreasing in the precision of the central bank signal. This is the case if

$$\frac{\rho}{\gamma} > \frac{1}{\phi\left(1 - 2\phi\right)}. \tag{18}$$

2.2.3   The empirical relevance

This striking result suggests that central banks might improve matters by refusing to provide any information. But, is this the appropriate police advice? Even if there is reason to believe that $\phi < 1/2$ – and this is questionable – the answer is probably no. For a central bank to do better by refusing to provide any information (that is, by setting $\gamma = 0$), equation (16) implies that that the ratio of the quality of the central bank's signal to the quality of any private sector signal must be less than $1 - 2\phi$. Thus, even in the most extreme case where the private sector cares solely about coordination and $\phi = 0$ the central bank's signal would have to be more imprecise than a private agent's signal and this seems unlikely to be true.

It is even more unlikely that a marginal increase in imprecision would raise welfare. When, for example $\phi = 1/4$, the precision of any private sector agent's signal has to be *eight* times as high as the precision of the central bank's signal for this result to be relevant. As $\phi = 1/4$ minimizes the right-hand side of condition (18), this is the least extreme case! When $\phi = 1/20$ or $9/20$ then the precision of any private sector agent's signal must be over 22 times as high as the precision of the central bank's signal for increasing ambiguity to be beneficial.

2.2.4   Central bank ambiguity is unambiguously bad in scenarios where coordination is good

That public signals might conceivably be bad in a particular scenario does *not* imply that imprecision may be desirable in other scenarios. Angeletos and Pavan (2006) argue that Morris and Shin's (2002) result is driven by coordination being privately, but not socially, beneficial. If coordination yields social benefits, then public information may unambiguously increase welfare. An example, due to Hellwig (2005) and Roca (2006) is a scenario where monopolistically competitive firms set prices based on idiosyncratic signals leading to distorted relative prices.

Increased precision of a central bank announcement helps to reduce this welfare-lowering price dispersion.

2.2.5 What can be done to lessen the harmful effects of announcements

Some authors have suggested measures that central banks might take to reduce the harmful effects of public information provision. Heinemann and Illing (2002) suggest that matters may be improved upon if the central bank sends its signal to different agents separately and containing agent-specific noise. Cornand and Heinemann (2002) suggest that if the central bank information is insufficiently precise to be welfare enhancing, then the central bank may improve matters by releasing its information to only a subset of the population. The partial disclosure suggested in both of these papers reduces the incentive of any agent who receives a signal to overreact to it.

While of theoretical interest, these suggestions are likely to be of limited usefulness to central banks. Deliberately releasing different market information to different agents or to a subset of agents is unlikely to be popular in a democratic society.

3 Cheap Talk

"One peso, one dollar, full stop." (President Carlos Menem)

In some situations policy makers may know with greater certainty than the private sector what has happened or what will happened and they may want to convey some of this information to the public. One tactic for policy makers is to just say what they want the public to know. Unfortunately, in its strategic interaction with the central bank, the public is aware that – as well as wanting to be informative – the central bank often has an incentive to misrepresent the truth. Its credibility is frequently suspect. The markets did not believe Chancellor of the Exchequer Norman Lamont's assurances that in 1992 that there was not a

"scintilla of doubt about the pound" and they quickly brushed off Fed Chairman Alan Greenspan's 1996 warnings about "irrational exuberance". It is frequently suggested that speeches are poor signals of future events because – to be effective – a signal must be costly and "talk is cheap". The information conveyed in a speech need not become common knowledge.

On the other hand, not all policy makers are ignored. Market participants pore over central bank central bankers' speeches, hoping to understand their views. In this section I suggest that as long as the central bank has some incentive to misrepresent its knowledge, then it will be unable to convey precise information to the public with "cheap talk". But, as long as the central bank and the private sector's interests are not too divergent, speeches can be an additional tool for monetary policy makers; policy makers can credibly convey *imprecise*, but useful, information to the private sector about the health of the economy.[4]

To see this, consider a scenario where the central bank has private information about the health of the economy. The public wants to know the information exactly so that it can make the best possible decision. The central bank cares about the public making the right decisions, but perhaps for opportunistic political reasons, it would like the private sector to believe that the economy is doing better than it actually is. Thus, the central bank and the public have some common interest: the central bank does not want the public to be too imperfectly informed. But, their interests are not perfectly aligned.

Formally, assume that the central bank information about the state of the economy is summarized in the variable s. The public does not observe s but it knows that s is drawn from a uniform distribution on $[0, 1]$. The public makes a report to the public about s. Then, given what it knows about s following the

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[4]This is based on the work of Crawford and Sobel (1982).

report, the public chooses an action a. The public's welfare is given by

$$W_P = -\left(a - s\right)^2 . \tag{19}$$

Thus, the private sector dislikes any deviation of its action from the correct state of the economy. Given its welfare function, the public chooses its action a to be equal to the expected value of s given its updated information following the central bank report.

Given s and the public's choice of an action, the central bank's welfare is given by

$$W_G = -\left[a - (s + \phi)\right]^2 , \;\; \phi > 0 \tag{20}$$

This says that the central bank wants the private sector to choose an action $s + \phi$, and it dislikes any deviation from this. Thus, it wants the private sector's expected value of s to be $s + \phi$. If ϕ were equal to zero, then the central bank's and private sector's interests would be perfectly aligned. The smaller is ϕ, the more closely their interests are aligned.

Given that the central bank would like to systematically fool the public into thinking that the health of the economy is ϕ units better than it actually is, there can be no equilibrium where the central bank provides precise (that is, deterministic) information. If the public believed the central bank was biasing its report upward by some amount, the public would subtract off the amount of the bias in forming its report. But, then the central bank would want to report an even higher figure and the public would subtract even more, and so on.

There is however an imprecise outcome that involves no sharing of information at all. The central bank announces that the fundamental is somewhere on $[0, 1]$ and, rationally, the public infers nothing from the public's announcement. Since the public does not update its beliefs in response to the central bank's announcement, the central bank has no reason to change its behavior.

If ϕ is small enough ("small enough" turns out to be strictly less than one fourth), there is, however, another possible outcome where the central bank is able to provide useful imprecise, or noisy, information. To see this, suppose that $[0,1]$ is partitioned into two parts: $[0, s^*]$ and $[s^*, 1]$. The central bank then tells the public that the economy is either doing well (that is, $s \in [s^*, 1]$) or that it is doing poorly (that is $s \in [0, s^*]$). If the public is told that the economy is doing well then it knows that the expected value of s is $(s^* + 1)/2$ and it chooses $a = (s^* + 1)/2$. If the public is told that the economy is doing poorly then it knows that the expected value of s is $s^*/2$ and it chooses $a = s^*/2$.

For this to be an equilibrium, it must be that the central bank had no incentive to make an incorrect report. This is the case if the central bank is indifferent between reporting that the economy is doing well and that the economy is doing poorly in the borderline case $s = s^*$. By equation (20) the central bank's welfare when $s = s^*$, the central bank reports the economy is doing well and the public consequently chooses $a = (s^* + 1)/2$ is

$$ - \left[(s^* + 1)/2 - (s^* + \phi) \right]^2 .; \tag{21}$$

Likewise, its welfare when $s = s^*$, it reports the economy is doing poorly and the public consequently chooses $a = s^*/2$ is

$$ - \left[s^*/2 - (s^* + \phi) \right]^2 . \tag{22}$$

The expressions in (21) and (22) are equal to each other when

$$ (s^* + 1)/2 - (s^* + \phi) = -s^*/2 + (s^* + \phi) \tag{23}$$

and, thus, $s^* = (1 - 4\phi)/2$. Such an $s^* \in (0,1)$ exists as long as $\phi < 1/4$.

If the central bank and public's interests are even more closely aligned, finer

partitions are possible. For example, if $\phi < 1/12$ the set $[0, 1]$ can be partitioned into three subsets divided by $s^* = (1 - 12\phi)/3$ and $s^{**} = (2 - 12\phi)/3$.

Thus, the lesson from this strand of the game theory literature on cheap talk is that if there is some conflict between the objectives of the central bank and the private sector, no precise statement – such as "One peso, one dollar, full stop," is credible. But it is possible to have outcomes where the central bank is able to use cheap talk to convey less precise information about the outcome. The reason that this "cheap talk" is possible – even though there is no exogenous cost – is that there is an endogenous cost in the form of the public's reaction. Too extreme a statement, say claiming the economy is doing "well" when it is really doing "poorly" causes the private sector to take an action that is harmful to the central bank.

4   Actions as Signals

When governments cannot provide information through announcements, because such announcements are not credible, they may be able to provide information through costly actions. In this section I use the model of Angeletos, Hellwig and Pavan (2006) to discuss how costly intervention by the central bank may be taken by the market as a signal of its type.[5]

Consider again the example of a speculative attack/bank run model of section 2.1.2. There atomistic private sector agents are represented by the interval $[0, 1]$. These agents incur a cost of $1/10$ units if they attack and they receive a benefit of 1 unit if the attack succeeds. The attack is successful if the fraction of agents who attack, denoted by A, is greater than a fundamental variable θ. The fundamental is unobservable and agents' prior belief is that realizations of θ are equally likely. Each agent $i \in [0, 1]$ receives a noisy signal $x_i = \theta + \epsilon_i$ of θ where ϵ_i is uniformly
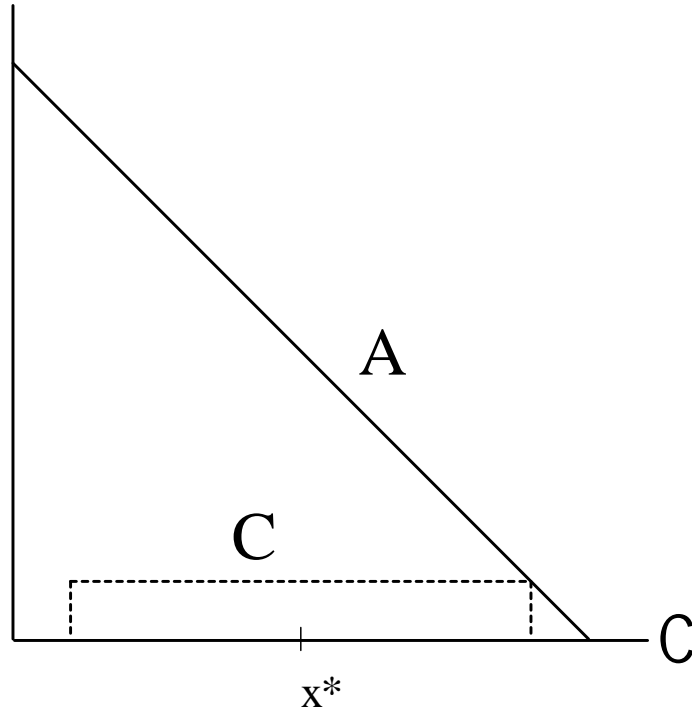
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[5]The model is also related to the signalling and countersignalling model of Feltovich, Harbaurh and To (2001).

distributed on $[-1/2, 1/2]$. This model example has a unique equilibrium where each agent attacks if his signal is strictly less than $13/10$ and the attack succeeds if the fundamental θ is strictly less than $9/10$.

There is no role for the central bank in this simple model. Here, the model is extended to allow for central bank activism. Suppose that the realization of θ is known to the central bank and is its private information. Assume further that the central bank can affect the outcome by a costly intervention that causes the cost to private sector agents of attacking to rise. Let $C(\delta) = \delta - 1/10$ be the cost to the central bank of making the cost to the private sector be $\delta \in (1/10, 1)$. Assume that the central bank gets $\theta - A$ if it averts an attack; this captures the idea that the fundamental represents the will of the central bank to fight an attack. The central bank's payoff is then $\theta - A - C(\delta)$ if the attack fails and $-C(\delta)$ if the attack succeeds.

Central banks with sufficiently good fundamentals do not need to intervene and central banks with sufficiently poor fundamentals find intervention useless. Central banks with intermediate fundamentals, however, might find the cost of intervention to be less than the benefit from reducing the size of an attack. Thus, if the private sector were to see a central bank intervene it would know that the central bank is an intermediate type and this would affect the private sector's behavior. The private sector takes the central bank's costly action as a signal of its type θ.

The result of this is that the original non-intervention equilibrium is still a possible outcome but there exist a continuum of other equilibria as well. These equilibria have the property that they depend on the intervention level that intermediate types choose: $\delta^* \in (1/10, 1)$. Given this (indeterminate) intervention level the equilibrium is as follows. The set of possible central bank types is partitioned into three sets: "poor" types, "intermediate" types and "good" types. Only intermediate types intervene. No private sector agent attacks when there is

intervention. If there is no intervention then there is a threshold level of the signal below which a private sector agent attacks. The attack is successful if and only if the central bank is a poor type.

As an example, suppose that δ^* is $1/5$. Then the cost to intervention is $1/10$. Poor central banks are those with $\theta < 1/10$ and good central banks are those with $\theta > 9/10$. Intermediate types have $\theta \in [1/10, 9/10]$. If there is no intervention, the threshold value of the signal is $1/2$; if the signal is less than $1/2$ the private sector agent attacks if it is greater than $1/2$ the private sector agent does not attack. Thus, if a central bank does not intervene the size of the attack is the probability that a signal $\theta + \epsilon_i$ is less than $1/2$. As the noise term is uniform on $[-1/2, 1/2]$ the probability is zero if θ is greater than one, one if θ is less than zero and $1 - \theta$ otherwise. This is depicted in the figure below by the line labelled "A". The intervention cost incurred is zero for good and poor types and $1/10$ for intermediate types; this is depicted in the figure by the dotted line labelled "C".

To see that this must be an equilibrium consider the central bank of type $1/10$

who is on the borderline between poor and intermediate types. It is indifferent between intervening and not intervening. If it intervenes no private sector agent attacks but it incurs an intervention cost. Its payoff is its type minus the cost: $1/10 - 1/10 = 0$. If this central bank does not intervene the attack is successful and it also gets a payoff of zero. Now consider the central bank who is borderline between being an intermediate and a good type; it too is indifferent between intervening and not intervening. If it intervenes there is no attack and its payoff is its type minus the intervention cost: $9/10 - 1/10 = 4/5$. If it does not intervene then there an unsuccessful attack of size $1/10$; the payoff is again $9/10 - 1/10 = 4/5$. Finally, consider the threshold signal $1/2$. If there is no intervention, an agent who receives such a signal should be indifferent between attacking and not attacking. This is the case if the probability of a successful attack is $1/10$. The likelihood that the attack succeeds is the probability that $\theta < 1/10$ when the signal is $1/2$. This is equivalent to the probability that the noise term is less than $-4/5$ and this probability is $1/10$.

The intuition behind the hump-shaped outcome is that intermediate types can distinguish themselves from poor types by incurring the cost of the signal. The poor types do not find it beneficial to signal; they do not benefit enough from halting an attack. The good types can distinguish themselves from the intermediate types by pooling with the poor types. The intermediate types are unwilling to do this because of the chance of being thought a poor type. Partitioning the central bankers into three groups enables the private sector to coordinate on abstaining when they see a central bank intervene.

That signalling leads to multiple equilibria is troubling as it is not clear how the players in this game would be able to coordinate on any outcome. However, in the simple example, the ability to signal unambiguously makes the central bank at least as well off and it seems reasonable that this result would hold for any intervention level. If the central bank is a poor type then it is unaffected by the

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type of equilibrium: it does not signal and there is a successful attack. If the central bank is an intermediate type then it prefers the signaling outcome. With signalling it incurs a cost but there is no attack; without signalling it does not incur a cost but a successful attack occurs. The former outcome is better. Good types are either unaffected by the type of equilibrium or they prefer the signalling equilibrium. If they are sufficiently good then no private sector agent attacks in either equilibrium. If they are less good then an unsuccessful attack occurs and in either the no-signalling equilibrium or in both equilibria. But, the size of the attack is always smaller in the signalling equilibrium because the private sector does not confuse good central banks with intermediate ones.

5 Conclusion

For central banks that do not want to use interest rate policy to affect asset price misalignments, speeches, the release of data and other signals may potentially provide another policy instruments. It has often been suggested that in situations where there are multiple equilibria, central bank announcements may coordinate the public on the socially optimal outcome, thereby avoiding bank runs, speculative attacks, bubbles and sunspots.

This paper reviews some recent game theory – particularly the literature on global coordination games – and finds that it comes to a different – and rather disconcerting – conclusion. Central bank announcements can possibly improve welfare. However, by providing a focal point the central bank can create a situation where there are multiple equilibria, where there would have been a unique outcome without the intervention.

References

Angeletos, George-Marios (2006), "Socially Optimal Coordination: Characterization and Policy Implications," unpublished paper.

Angeletos, George-Marios, Hellwig, Christian and Alessandro Pavan (2006), "Signalling in a Global Game," unpublished paper.

Carlsson, H. and Eric van Damme (1993), "Global Games and Equilibrium Selection," *Econometrica* 61, 989-1018.

Cornand, Camille and Frank Heinemann (2004), "Optimal Degree of Public Information Dissemination," CESIfo Working Paper 1353.

Crawford, Vincent P. and Joel Sobel (1982), "Strategic Information Transmission," *Econometrica* 50, 1431 - 1451.

Heinemann, Frank and Gerhard Illing (2002), "Speculative Attacks: Unique Sunspot Equilibrium and Transparency," *Journal of International Economics* 58, 429-450.

Hellwig, Christian (2005), "Heterogeneous Information and the Welfare Effects of Public Disclosures," unpublished paper.

Hellwig, Christian (2002), "Public Information, Private Information, and the Multiplicity of Equilibria in Coordination Games," *Journal of Economic Theory* 107, 191-222.

Metz, Christina E. (2002), "Private and Public Information in Self-Fulfilling Currency Crises," *Journal of Economics* 76, 65-85.

Morris, Stephen and Hyun Song Shin (2004), "Coordination Risk and the Price of Debt," *European Economic Review* 48, 133-153.

Morris, Stephen and Hyun Song Shin (2002), "Social Value of Public Information," *American Economic Review* 82, 1521-1534.

Roca, Mauro (2006), "Transparency and Monetary Policy with Imperfect Common Knowledge," Columbia University.