

Coordination of Expectations in the Recent Crisis: Private Actions and Policy Responses

By Russell Cooper and Jonathan L. Willis

The financial crisis of the past two years is unprecedented in the postwar United States. In magnitude and breadth, the crisis has resembled the Great Depression. Policymakers have responded by drawing on standard fiscal and monetary policy tools but also, as the crisis worsened, on a range of exceptional policy actions.

Some of the events have made clear the importance of expectations in an economy. The economic choices individuals make are often based on their expectations of what other people will do—in what economists call a “coordination game.” In such situations, changes in the beliefs of what others may do can affect the actions of individuals. A key element in such situations is that, as the collective beliefs change and individuals respond to these altered expectations, the outcome in the marketplace can change. In the recent crisis, the coordination of expectations played a key role in areas such as financial markets, the housing market, and the automobile sector.

When the coordination of expectations results in a crisis or a panic, policymakers are the primary group with the ability to alter the expectations of individuals. By using various policy tools, policymakers

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can lessen the damage from the crisis. Such tools include providing guarantees and changing marketplace incentives, such as interest rates and tax rates.

This article develops a framework to illustrate how the coordination of expectations was instrumental in the recent economic and financial crisis. The framework also helps describe the actions policymakers took to limit the severity of the downturn by coordinating expectations to achieve more positive outcomes. The first section explains the essential elements of the coordination-game framework. The second section discusses several aspects of the U.S. economy that became important events in the crisis due to changing expectations. The third section describes policy actions that can effectively reshape expectations and restore confidence in the economy. The fourth section discusses actions taken by policymakers in response to the events in the current crisis.

I. A FRAMEWORK FOR ANALYSIS

Coordination games highlight the role of expectations in the choices of economic agents, such as households and firms. In this game, the choices of agents are complementary, meaning that agents have an incentive to do what others are doing. These complementarities often generate multiple outcomes of the interaction between agents. Some of these outcomes are better than others, but no single individual, acting alone, can coordinate the choices of all individuals to achieve the best outcome.

This section describes the general framework of a coordination game. The framework then provides a basis for understanding a classic example of coordination games in financial markets: a bank run.

Coordination games

A coordination game is a strategic situation in which an individual's payoff to taking an action depends on the choices of others (Cooper and John; Cooper).¹ Such situations are widespread in an economy: firms interacting with other firms, households interacting with one another, and firms and even governments interacting with each other and with individuals.

A simple example can illustrate a coordination game: the choice of which side of the road to drive on. In the absence of government rules, how would a driver decide whether to drive on the right or left side of

the road? The driver would likely make that decision based on his or her belief of what other drivers are most likely to do, thus minimizing the risk of an accident.

As in this example, a couple of characteristics distinguish a coordination game from other forms of strategic interaction. First, individuals in a coordination game want to do what others do. That is, in these games the payoff to an action is higher when that action conforms to the expected action of others. In the driving example, an individual clearly wants to match his or her choice of which side to drive on with the expected choices of all other drivers. This feature will be a common ingredient in the coordination games found in the financial crisis.

Second, the coordination game often fails to have a unique prediction about the outcome of the strategic interaction. That is, a coordination game may have multiple outcomes (multiple equilibria). Each outcome satisfies the property that everyone is acting in their own self-interest, given expectations that are consistent with the choices of others. For the driving example, the two possible outcomes are that everyone drives on the left or everyone drives on the right. Both outcomes are feasible and sustainable, as evidenced by comparing driving habits in the United States and the United Kingdom.

Moreover, some of these outcomes may be more desirable than others from a social perspective. Thus, a coordination game can generate bad outcomes for society even if each individual acts in his or her best interest. In the driving example, there is not a distinguishable difference between everyone driving on the left or right. But for the examples from the financial crisis, there is often a clear distinction between good and bad outcomes.

In short, economists focus on outcomes (sometimes called equilibria) of coordination games that satisfy two main conditions:

- Each actor in the game makes choices in his or her best interest, given expectations about the actions of others.
- The expectations that each actor has about the actions of others are consistent with the choices of others.

Put succinctly, these are conditions of *optimization* and *consistency of expectations*.

This article focuses on identifying interactions in the economy that have the essential features of coordination games. For these interactions, the expectations of the behavior of others can have powerful economic impacts. Given that some outcomes of these coordination games may be socially undesirable, it is natural to think about corrective policy actions, which themselves often work through expectations.

The classic example: Bank runs

A bank run provides a clear example of a coordination game, much like choosing which side of the road to drive on.² Consider the following generalized depiction of how a bank operated and how its depositors made choices in the days before deposit insurance, such as at the beginning of the Great Depression.

As one of many individuals with a bank account, suppose you deposit \$100 in a bank that offers an annual interest rate of 10 percent. The bank takes the deposits and invests them in a couple of ways. Some of the money is put into long-term investments, like financing the purchase of a house. A long-term investment is typically illiquid, meaning that if it needed to be sold on short notice, it would likely be sold at a discount. The rest of the money is invested in a more liquid asset, or even held as cash in the vault. The portfolio of assets chosen by the bank reflects higher returns on illiquid investments tempered by the recognition that some depositors will have liquidity needs in the short run. In normal times, the bank's portfolio balances these interests.

After the bank has chosen its portfolio, some depositors will go to the bank and withdraw funds. This is a normal occurrence reflecting the liquidity needs of depositors to have cash on hand to make purchases. The other depositors without liquidity needs normally leave their money in the bank where it is both safe and can earn interest.

But what if times are not normal? Suppose instead that individuals without immediate liquidity needs become concerned about the viability of the bank. So, just to be safe, they decide to withdraw their deposits. If enough depositors begin to worry and take their funds out, this could lead to difficulties for the bank.

In such a scenario, the bank may face a liquidity problem. To earn higher returns, it invested some of its assets in illiquid investments, expecting enough depositors would leave funds in the bank for a long

time. But if too many depositors demand their funds back at once, the bank most likely will be unable to meet their demands. Unable to repay the full value owed to these depositors, the bank will close. This is called a *bank run*.

There are two outcomes to this simple coordination game, where everyone is doing the best they can for themselves, given expectations of others. If one expects that all other depositors will leave their money in the bank for a year, an individual will choose to do the same and earn \$10 in interest. With this choice, the individual ends up with \$110 after a year rather than \$100 if he or she had chosen to withdraw funds from the bank immediately.

On the other hand, if one expects that all depositors are going to engage in a bank run, an individual will choose to join in the run. By doing so, the individual has a chance of redeeming some of his or her deposits before the bank runs out of funds and closes its doors. If the individual chooses to leave his or her deposits in the bank while others engage in a bank run, then the depositor will be even worse off.

Both outcomes are cases where expectations are consistent with the actions taken by others. If the outcome is a bank run, everyone's payoff is lower, in some cases much lower, than in the alternative outcome. Still, this is an equilibrium outcome since each individual, acting alone, is choosing the best possible action. The possibility of getting stuck in a bad outcome is what motivates the label *coordination game* for these types of interactions.

A key feature of a coordination game is that it is in your interest to do what you expect others to do. And, as in this example, expectations are critical to the survival of a bank.

During the Great Depression, the prospect of bank runs became reality. Between 1929 and 1934, more than 10,000 banks failed. Some of those failures were due to bad investments and loans made by the banks, leaving the banks with more liabilities than assets. As the numbers of failures grew, however, deposit holders across a wide range of banks became increasingly concerned about their own funds. In such a heightened atmosphere of uncertainty, a bank run could be triggered by any type of news or rumor that reached a sufficiently large group of deposit holders.

In the classic movie “It’s a Wonderful Life,” the Bailey Building & Loan Association faces a bank run in the midst of the Great Depression when a crowd gathers to withdraw their funds. George Bailey (Jimmy Stewart) explains to his skittish deposit holders that their funds are not in the vault—but instead are invested in their neighbors’ houses. Bailey finally convinces the depositors that their money is safe, and so they withdraw only a fraction of their deposits rather than fully liquidating their accounts. In other words, Bailey calms them down by reshaping their expectations, thus averting a bank run.

As the number of bank runs increased during the Great Depression, government officials acknowledged the role played by expectations in the banking and economic crisis. In his inaugural address in 1933, President Franklin Delano Roosevelt urged Americans to be calm: “Let me assert my firm belief that the only thing we have to fear is fear itself—nameless, unreasoning, unjustified terror which paralyzes needed efforts to convert retreat into advance.”

II. COORDINATION GAMES IN THE RECENT CRISIS

Expectations of others’ behavior contributed to several aspects of the recent crisis: financial markets, the housing market, and the market for durable goods. This section focuses on how the underlying interactions between economic agents contributed to the worsening of the crisis in these areas.

Financial markets

While the recent crisis is not a consequence of bank runs in a narrow sense, a number of bad outcomes during the crisis resembled bank runs. As Paul Krugman noted, one of the biggest surprises of the financial crisis was not that the housing market collapsed but that the damage spread to so many other sectors of financial industry:

We fell into the mistake of thinking that a bank is a big marble building with a row of tellers; that a bank has to look like a traditional bank; or that a bank has to be a depository institution. ... We thought that a bank had to look like something that Jimmy Stewart would run. ... A bank is any institution or any arrangement that allows people to have what seems to be ready access to their funds while at the same time financing long term and/ or illiquid investments. A bank is anything that borrows short and lends long; anything that borrows liquid and lends illiquid.

Two segments of financial markets that experienced difficulties due in part to the coordination of expectations were the market for asset-backed commercial paper and the money market fund industry.

The *asset-backed commercial paper* (ABCP) market has experienced three periods of crisis in the past few years. ABCP is a form of short-term financing used primarily by mortgage lending institutions and auto producers. This form of commercial paper is a promissory note collateralized by financial assets, such as home and auto loans.

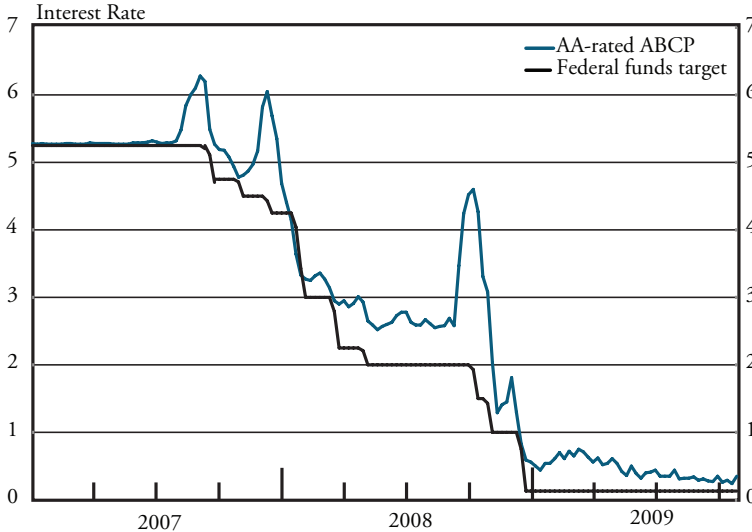
The first crisis occurred in August 2007. During this month, the ABCP market began showing signs of increased uncertainty among market participants. Several issuers of ABCP stated that they would be unable to redeem ABCP and would instead make use of an option to extend the maturity date. In response, interest rates for the entire ABCP market began to rise (Chart 1). In a *Wall Street Journal* article on August 8, 2007, David Sylvester, an executive vice president at Wells Capital Management stated, “The widening of risk premiums is more about fear than substance” (Saha-Bubna).

Over the next several days, investors continued to exit the ABCP market. While there were no visible lines of panicked depositors as in a traditional bank run, investors in the ABCP market exhibited similar behavior.³ A portion of the exit was due to information about specific firms that were likely to have trouble repaying their ABCP. But news of financial difficulties faced by a few issuers of ABCP also led to increased expectations that other issuers would have difficulties repaying their promissory notes. Reports that some investors were fleeing the market changed expectations. As a result, a large number of investors withdrew their funds from the market because they saw others doing it. Analysis of financial data suggests that the behavior of investors was relatively indiscriminate across ABCP issuers during this stage of the financial crisis (Covitz and others).

A second crisis emerged in November 2007. Financial institutions and investors once again became reluctant to purchase new issuance of commercial paper as economic and financial uncertainty continued to mount. A second spike in the interest rate on AA-rated ABCP occurred due to the fall in demand (Chart 1). From August 2007 to December 2007, more than one-third of all ABCP programs were confronted with a run by their investors (Covitz and others).

Chart 1

INTEREST RATE FOR AA-RATED ASSET-BACKED COMMERCIAL PAPER (30-DAY)



Source: Federal Reserve Board

The third crisis occurred in middle of September 2008. Following the bankruptcy filing of Lehman Brothers on September 15, investors rushed to move their funds to safer investments, in part due to concerns about potential collapses of additional financial institutions. The combination of the heightened uncertainty of investors with news that some investors were leaving the ABCP market changed investor expectations regarding the behavior of other market participants. Within the span of a few weeks, the interest rate for AA-rated ABCP jumped 2 percentage points.

The money market fund industry was another financial sector that experienced significant difficulties during the peak of the financial crisis in September 2008. One day after the failure of Lehman Brothers, a large money market fund, the Reserve Primary Fund, announced that its net asset value had fallen below \$1 per share. This event is referred to as “breaking the buck,” which had not happened to a money market fund in more than ten years. Over the next two days, nearly two-thirds of investors in the Reserve Primary Fund attempted to withdraw their money (Kim and Laise).

Growing concerns of potential losses at other money market funds led to an industry-wide withdrawal similar to that seen in a bank run. Investors became concerned that other money market funds might “break the buck,” but there was little information available to indicate which money market funds were safe and which faced losses. As news spread that some investors were withdrawing from prime money market funds, expectations changed.

Once investors believed that a large number of investors were withdrawing or planning to withdraw funds from prime money market funds, many of them decided on the same course of action. In just a few weeks, institutional investors withdrew approximately one-third of their assets from prime money market funds and increased their investment in government money market funds (Chart 2). This rapid withdrawal of funds threatened to create additional losses and fund closures in the industry since prime money market funds had a significant share of assets that could not be quickly liquidated without a sizable loss.

Housing prices

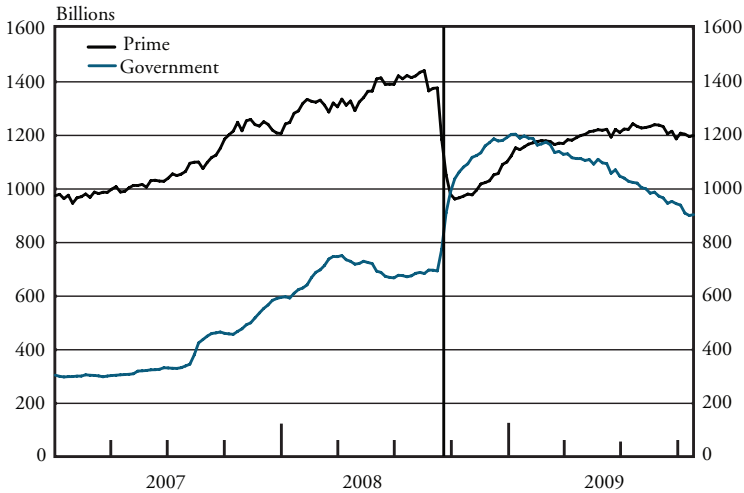
The plight of the housing market has been a key factor in the current crisis. One of the most notable features of the housing crisis has been the dramatic change in housing prices over a very short period of time. While there were many elements that contributed to the wild swings in housing prices, one was the expectation of the behavior of others.

To better understand this, it is useful to examine the main determinants of housing prices. Basic economic theory states that the price of an asset is equal to the sum of its expected stream of revenue generated over time. In the case of a house, the expected stream of revenue is the rental income (less any taxes and expenses) that can be earned from owning the property, or the implicit rental value of living in the house. This valuation can be simplified into a price that is a function of the current rent or service flow of living in the house for a year plus the discounted value of the house next year. This is represented in the following equation, where p_t represents the price of a house in year t , sf_t represents the service flow or rent in year t , and $p_{t+1}/(1+r_t)$ represents the value of the house next year, discounted by today's interest rate, r_t .

$$p_t = sf_t + \frac{p_{t+1}}{1+r_t} \quad (1)$$

Chart 2

ASSETS OF INSTITUTIONAL MONEY MARKET FUNDS



Source: Investment Company Institute

In this formulation, it is assumed that everyone knows next year's price. Alternatively, one can think of this as the anticipated price.

Based on this equation, there are two ways to explain variations in the current price of housing. One explanation for a drop in housing prices, such as seen in recent years, is that the actual flow of services from homeownership has fallen. That is, we could try to explain a drop in p_t by a fall in y_t^h . This is certainly consistent with the equation, but does it make good economic sense? Can the fall in housing prices of more than 30 percent over the past three years be explained by a drop in housing services? This seems unlikely.

The second term in the equation is the price of the house in the future, discounted by the interest rate. Could the collapse in house prices be due to changes in interest rates? The answer is probably no. With interest rates falling in recent years, housing prices should have gone up, not down.

This leaves us with the possibility that the price of houses fell today because the price is anticipated to fall next year. Once again, expectations are important. Here expectations matter because the value of the house (or any other asset for that matter) depends in part on the ex-

pected price that someone else will pay for it in the future. When one expects the price to fall tomorrow, today's value of the house is reduced.

This analysis, however, seems circular: Lower house prices are explained by... lower prices. As in a coordination game, a decline in house prices caused by a large number of people selling their houses can lead to additional price declines if people expect other buyers to offer even less in the future.

This analysis suggests there might be many paths for prices consistent with expectations of the future home purchasing decisions of others. For example, it may be the case that most people believe buyers will pay more for houses in the years to come. That expectation makes houses more valuable today in anticipation of a higher resale value in the future. As time progresses, as long as the prices paid for houses continue to increase as expected, then indeed house prices will continue to rise. This type of self-fulfilling belief is often called a bubble. And, as the name suggests, bubbles sometimes "pop." With the bursting of a bubble, the growth rate of prices may decline unexpectedly, or prices may even fall.⁴

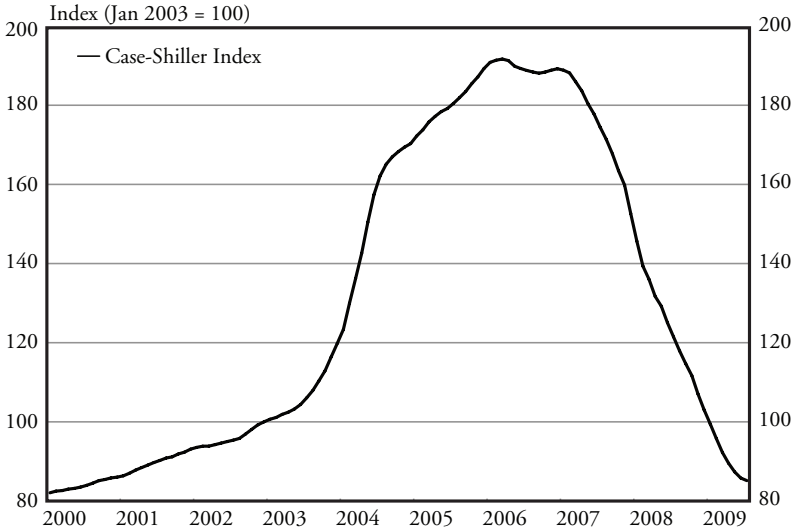
The recent housing crisis also exposes how expectations of foreclosures can influence housing prices in a coordination game. From the perspective of an individual, it might be wise to walk away from a house when its value falls below the outstanding mortgage on the property, especially if one thinks the value of the house will continue to decline in the future. In such a case, the bank takes over the property and puts it up for sale. This increased supply of houses on the market depresses prices (especially in neighborhoods most affected by foreclosures), inducing more households (especially in affected neighborhoods) to walk away from their houses, further depressing prices and so forth.

One of the cities hardest hit by the housing crisis was Las Vegas. Starting in late 2003, housing prices increased abruptly, rising for about two years (Chart 3). This huge price increase was fueled by a coordination of expectations that other people would pay far more for Las Vegas houses in the future.

By the middle of 2007, however, prices began falling just as rapidly. It is hard to imagine that this swing in prices was caused by fluctuations in the value to an individual of living in a house. Instead, it is more likely that these variations in housing prices were driven by the variable

Chart 3

LAS VEGAS HOUSE PRICES



Source: S&P/Case Shiller Home Price Index

in equation (1) associated with expectations of what others would pay for houses in the future. Before the “bubble” burst in 2007, expected future increases in housing prices contributed to a sharp increase in the value of homes. When expected prices in the future began to fall, the value of homes plunged.

Automobile warranties

As several automobile manufacturers faced the prospect of bankruptcy in 2009, consumer expectations played an important role in determining the viability of these firms.⁵ Here is a simple story to illustrate how consumer expectations can affect consumer choices in this industry.

Suppose that you are interested in buying a durable good, such as a car or a computer. Being a durable good, the object is expected to last for a few years. But, of course, there is no guarantee that the car or computer will operate properly in a few years or even when you buy the product in the first place. The firm selling the product appreciates the fact that, all else the same, you would prefer not to bear this risk of product performance. As a result, many producers of durable goods provide warranties.

If you believe the producer will make good on its promise under the warranty, then you are presumably more likely to buy the product. But before you do, it is useful to consider whether the firm will have an incentive in the future to abide by the terms of the warranty. What, for example, prevents the firm from going out of business, leaving you with a worthless warranty?

The answer lies in profits and incentives. The firm has an incentive to continue in business in the future as long as doing so is profitable. Those profits, in turn, will not come from fulfilling warranty obligations. Rather, they will come from sales of new goods to new and returning customers.

So, your warranty has value to you today insofar as you believe the firm will be in business in the future. And, the firm will be in business in the future as long as future customers believe in the value of the firm's warranty.

Now, you can see why this is like a coordination game. As a consumer today, you are more likely to buy a durable good if you think that other consumers will also be buying products in the future. In other words, you have an incentive to conform to what others are doing.

Based on the structure of this coordination game, there are several possible outcomes. If everyone is currently *optimistic* about the future of a company, and if everyone expects others to be optimistic as well in the future, then the firm's warranty is more likely to have value. Thus, people will buy the product and, facing demand for their product both now and in the future, the firm has an incentive to stay in business. Sales will be high, profits will be high, and consumers will be satisfied that their warranties have value.

Another possible outcome is based on everyone being *pessimistic*. In this case, people are doubtful that the firm will remain in business in the future. Thus, they do not value the warranty and do not buy the product—which leads to bankruptcy for the firm.

In both cases, expectations were consistent with the market outcome. This consistency implies that in markets where products come with warranties, expectations matter.

In the recent recession, sales of U.S. automobiles dropped sharply, and news reports suggested that some of the auto manufacturers might be facing bankruptcy. The news of a potential automaker's failure can

slash sales if consumers become pessimistic about the future of the auto firm and their warranty. In that case, car sales of the company may fall, not just because of the recession, but also because of the effects of the recession on expectations.

This expectation effect then magnifies the direct effects of the recession. As the number of consumers who share this belief grows, so will the negative effects on the car-purchasing decisions of other consumers. And, as car sales decline due to the changing expectations, the likelihood of bankruptcy for the firm only increases. This coordination of expectations may ultimately result in a situation where virtually no consumers purchase a car from a manufacturer because they observe that no one else is purchasing from that company. In short, if these expectations are strong enough, the firm could be driven out of business.

III. POLICY INTERVENTION IN COORDINATION GAMES

As already seen, a coordination of expectations can lead to severe outcomes. The problem in each of these situations is that no individual, acting alone, can resolve the coordination problem. Through common action, however, it may be possible to coordinate a better outcome. But doing so is difficult in an economy consisting of many individuals acting alone. This explains why there may be a role for monetary or fiscal policy.

Policy intervention can influence the outcome of a coordination game in two main ways. Policymakers can choose to change incentives or provide guarantees. (Box 1 describes a third option for policy intervention.) This section describes these options, and the following section examines how these tools were used in the recent crisis.

Before proceeding, it is important to note that this discussion explores actions that can be taken by policymakers in the midst of a crisis. Once expectations have coordinated toward a negative outcome, a crisis has likely emerged and normal policy tools are not likely to be effective. The policy actions discussed below are not likely to be the best long-term policies, so they should be implemented with care and, in some cases, only for short periods of time until a crisis has been resolved and expectations have shifted toward a more positive outcome. If left in place for longer periods of time, many of these extraordinary policy actions would likely affect the decisions of individuals and firms in a way that could lead to more frequent periods of crisis in the future.

Box 1

PROVIDING INFORMATION

Policymakers can also act to avoid coordination problems by providing information or requiring that information be provided to individuals.¹¹ In previous examples, it was effectively assumed that everyone knows what all other individuals are doing. But in reality, individuals are not sure what others are doing. This may be because individuals are receiving different signals about the state of the economy or different signals about what others are likely to do. Therefore, individuals may base their choices of action on the information they have received about others' most likely action.

To see how this might work, suppose an individual is inclined to choose one action, which would lead to a positive economic outcome. But if the individual receives false information indicating that other individuals are choosing a different action, he or she may choose a less-positive action if there is an incentive to follow the actions of others. If a sufficient number of people receive and act on this false information, expectations are confirmed, but the outcome is not good.

In some cases, policymakers may be in the position to provide valuable information. Suppose that policymakers let it be known to everyone that many individuals are indeed inclined to choose the action with a positive outcome. If they can accumulate this information and provide it to all individuals, this may offset the private false information individuals receive about others and will enhance incentives to choose the positive action. In the recent crisis, the provision of information was not one of the main tools used by policymakers. However, this may be a valuable tool for policymakers to use in future situations.

Changing incentives

One way to deal with coordination problems is to change incentives. Policymakers have a variety of tools that can be used to induce individual households and firms to change their behavior. These include fiscal policy variables, such as taxes and spending, as well as monetary policy tools, which ultimately influence interest rates.

The coordination of driving behavior can be used as a simple illustration. If individuals in a community (without existing rules and regulations) are having difficulties determining which side of the road to drive on, the government could institute a fine for anyone seen driving on the left side of the road. With the introduction of this penalty, an individual's choice becomes simple. The individual will prefer to drive on the right side of the road to avoid the penalty and will assume that others will do likewise. Since this is true for all individuals in the economy, the outcome is that everyone drives on the right side of the road.

As a second example, suppose individuals have become extremely pessimistic about the economy and decide to stop providing capital for investment. In that case, the government could enact a tax policy to give a credit to any individuals or firms that choose to invest—an investment tax credit. If the tax credit is large enough, a sufficient number of individuals will choose to invest, expectations will adjust, confidence in the economy will improve, and economic activity will increase.

These examples of policy actions seem like simple solutions to the coordination game. The government can simply pay or penalize individuals or firms to induce them to take the appropriate actions. However, this analysis is incomplete since it fails to take into account how the government pays for a subsidy or how it uses the penalties it collects. In some cases, a subsidy for one group is paid for via a tax penalty on another group. It turns out that the combination of subsidies and taxes used by the government matters for the coordination game.

In the example of the investment tax credit, the decision of how to raise revenue to pay for the tax credit can affect the decisions of firms. The creation of a new tax might undo the intended effect of the subsidy. For example, if the government increases the corporate tax rate to pay for the investment tax credit, then a firm no longer has much of an incentive to invest. The savings from the investment tax credit will be offset by higher taxes on profits that may be produced from the

new investment. On the other hand, if the investment tax credit is financed by issuing more debt now and raising labor taxes to pay off the debt sometime in the future, the incentive effects of the investment tax credit today will be larger for the firm. Other decisions, however, will likely be influenced in the future when labor taxes are raised.

Guarantees

Regardless of how the subsidy is paid for, the fact remains that a subsidy is costly to society. A second form of policy intervention works directly on modifying expectations. In some cases, this policy enables the government to support a specific outcome without paying out any subsidies.

The policy can be best illustrated using the example of bank runs. Suppose a bank with a healthy portfolio of assets is suddenly faced with a bank run, based on unfounded fears by its depositors. Without any assistance, the bank would be forced to liquidate its assets and may be unable to meet all of the withdrawal demands of depositors.

The government could avert this outcome by providing a guarantee on all deposits. With this guarantee, individuals no longer have any reason to participate in a bank run since there is no benefit in being the first to withdraw. Depositors will leave their funds in their accounts, and the bank run will be averted.

This is a very powerful policy that in the end has zero cost to the government when a bank is healthy. Since the government guarantee in this simple example only applies when an individual maintains a deposit while others participate in a run on the bank, the government will never have to make payments to individuals. With this policy in place, there is only one outcome for this coordination game—bank runs are eliminated.

In the United States, this guarantee takes the form of deposit insurance. The introduction of deposit insurance following the Great Depression has virtually eliminated all bank runs. The overall cost to the government is not zero, however, because banks can fail in situations where they have made bad investments with depositors' funds. In such situations, the government will have to pay for any losses of depositors' funds. These losses are covered by premiums that banks pay for deposit insurance or by general government funds if the losses exceed collected premiums. The main point here is that the provision of deposit insur-

ance protects society and healthy banks from bank runs that otherwise could occur in times of crisis.

The government must also remain keenly aware of the adverse incentives created by issuing guarantees. Suppose that the government issued a guarantee on the warranties of an automobile producer. One concern is that a company might now have an incentive to produce low-quality vehicles and sell them at a high price to consumers who are protected by the government guarantee program. Since they are insured by either the firm or the government, consumers are not as vigilant in monitoring quality. The firm could produce low-quality cars and then leave the market with high current profits, leaving the government a large obligation to households who have purchased low-quality vehicles that will soon begin malfunctioning.

IV. POLICY INTERVENTION IN THE CURRENT CRISIS

Over the past few years, policymakers have used these tools to help lessen the effects of certain aspects of the recent economic crisis. The events discussed in Section II are prime examples. In each event, policymakers intervened in the marketplace in an attempt to influence individual actions and coordinate expectations, thus averting further damage to the economy and financial markets. This section returns to each of those events and describes the policy actions taken within the context of a coordination game.

Financial markets

As discussed earlier, the crises faced by many segments of financial markets bore close similarities to classic bank runs. (Box 2) But the markets now facing “bank runs” comprise more complex structures than banks from the 1930s. The actions of policymakers in the recent crisis were traditional at first but became increasingly nontraditional as the crisis worsened. As in Section II, this discussion focuses on two segments of financial markets: the ABCP market and the money market fund industry.

In the *asset-backed commercial paper market*, investors responded to the actions of monetary policymakers. The first crisis in the market (August 2007) coincided with broader uncertainty in many lending markets, including those for interbank lending. The Federal Reserve

Box 2

DEPOSIT INSURANCE AND A RECENT BANK RUN

One of the actions taken in response to the banking instability in the Great Depression was the provision of deposit insurance through the Federal Deposit Insurance Corporation (FDIC). The provision of deposit insurance is a government guarantee for deposit holders.¹²

In this case, the government guarantee can eliminate all bank runs since depositors no longer have to worry about the safety of funds. This is essentially what has happened in the United States following the creation of the FDIC in the Banking Act of 1933. The act specified the type of financial institutions that could be insured and the amount of insurance for a depositor's account. As a result of the government provision of deposit insurance, there have been extremely few banks runs since the Great Depression.¹³

While the provision of deposit insurance has virtually eliminated bank runs in the United States, bank-run coordination failures continue to occur in other countries. In the UK, Northern Rock experienced an old-style bank run in September 2007. The run started following an announcement by the Bank of England stating that it had given emergency funding to Northern Rock. The Bank of England reported that this funding was a temporary measure to help Northern Rock during a period of "turbulence in financial markets." To reassure financial markets, the press release stated:

The [Financial Services Authority] judges that Northern Rock is solvent, exceeds its regulatory capital requirement and has a good loan book. The decision to provide a liquidity support facility to Northern Rock reflects the difficulties that it has had in accessing longer term funding and the mortgage securitisation market, on which Northern Rock is particularly reliant (Bank of England).

In the days following the announcement, Northern Rock's depositors began lining up to withdraw their funds. Under the Financial Service Compensation Scheme, the first 2,000 pounds (approximately \$3,100) of deposits were fully insured and the next 33,000 pounds (approximately \$55,000) were insured at a 90 percent rate in

the event of a bank failure. Any deposits in excess of 35,000 pounds were uninsured. As demonstrated by the number of customers who lined up to withdraw their funds, this guarantee program was not sufficient to prevent a bank run. Over the next three days, depositors withdrew 8 percent of all deposits (Jordan).

At this point, Alistair Darling, chancellor of the exchequer for the UK, intervened by issuing a full guarantee for all deposits. He stated:

I want to put the matter beyond doubt. In the current market circumstances, and because of the importance I place on maintaining a stable banking system and public confidence in it, I can announce today that following discussions with the Governor [of the Bank of England] and the Chairman of the [Financial Services Authority], should it be necessary, we, with the Bank of England, would put in place arrangements that would guarantee all the existing deposits in Northern Rock during the current instability in the financial markets.

This announcement effectively ended the bank run.¹⁴

responded quickly to this situation in an attempt to avoid a larger-scale panic. Their first action was to issue a press release:

The Federal Reserve is providing liquidity to facilitate the orderly functioning of financial markets. ...In current circumstances, depository institutions may experience unusual funding needs because of dislocations in money and credit markets (August 10).

A week later, the Federal Reserve Board modified the terms of the discount window, which is an instrument of monetary policy that allows eligible financial institutions to borrow money directly from a Federal Reserve Bank. The rate on discount window loans was lowered 50 basis points, and the maturity period for these loans was extended from overnight to up to 30 days. Both of these measures taken by the Federal Reserve were efforts to change incentives in financial markets to promote a good outcome.

For the ABCP market, these policy actions were not enough to stem the flight of investors. They became increasingly concerned about the potential for defaults on commercial paper, and they heard reports of investors fleeing this market. This coordination of beliefs regarding the actions of other investors magnified the incentive for an investor to exit the commercial paper market. If an investor was concerned that firms issuing ABCP would be unable to continue to get financing in the market when old paper came due, there was a perceived risk that the firm might run out of funds and default on existing commercial paper. Therefore, expectations of a significant number of investors planning to exit the market would likely cause a concerned investor to exit the market as soon as possible. By early September, the amount of ABCP placed by investment dealers fell by nearly 30 percent, from \$1.1 trillion to \$0.8 trillion, a retrenchment of the market to its size back in March 2006. Interest rates on 30-day, AA-rated ABCP rose from 5.3 percent to 6.3 percent as an indication of the additional return that was required for an investor to purchase ABCP.

The Federal Open Market Committee (FOMC) responded to the broader financial crisis on September 18 by cutting the federal funds target rate. In its press release, the FOMC noted rising concern due to disruptions in financial markets:

Economic growth was moderate during the first half of the year, but the tightening of credit conditions has the potential to intensify the housing

correction and to restrain economic growth more generally. Today's action is intended to help forestall some of the adverse effects on the broader economy that might otherwise arise from the disruptions in financial markets and to promote moderate growth over time.

The lowering of the federal funds target rate contributed to a temporary calm in ABCP markets, as shown by the decline in the AA-rated ABCP interest rate in Chart 1.

Around the time of the second crisis in ABCP markets (November 2007), the Federal Reserve decided to take additional steps to provide liquidity to financial markets. The FOMC had already lowered the federal funds target rate from 5.25 percent in August 2007 to 4.5 percent in November 2007. On November 26, the Federal Reserve Bank of New York announced it would temporarily conduct a series of repurchase agreements to provide short-term funding to financial institutions. This program, however, was not sufficient to stem the flight from the commercial paper market. As before, increased expectations of the likelihood of other investors exiting the ABCP market likely contributed to an increase in the number of investors who stopped funding ABCP. The result was that interest rates on ABCP continued to rise.

Additional action was taken by the Federal Reserve on December 12, when it announced it would establish a Term Auction Facility. Under this program, the Federal Reserve would auction funds to depository institutions for a term of approximately one month. The important aspect of this program is that these loans could be secured with a “wide variety of collateral,” including commercial paper. The first auction was held on December 17.

This provision of liquidity had an immediate effect on the AA-rated ABCP interest rate. In terms of expectations, the provision of lower-cost loans served to change incentives in the ABCP market. The action helped break the coordination of expectations on the outcome where investors expected many other investors would likely exit the market. Investors now had a greater incentive to remain in the ABCP market. For some investors, this additional incentive was strong enough to offset or even change their negative expectations regarding the likely actions of other investors. Due in part to the monetary policy action and changes

in expectations, the AA-rated ABCP interest rate fell nearly two percentage points over the next month.

Following the third crisis in the ABCP market (September 2008), which was a part of the larger crisis that affected most financial markets, the Federal Reserve decided to intervene directly. On October 7, the Federal Reserve announced that it would lend directly to nonfinancial corporations for the first time since the Great Depression. This new program, the Commercial Paper Funding Facility, allowed for the purchase of unsecured and asset-backed commercial paper (ABCP) of sufficient quality. With the Federal Reserve replacing investors as buyers of ABCP, the interest rate on AA-rated ABCP dropped sharply to levels closer to the typical margin above the federal funds target rate (Chart 1).

This policy action likely had a lesser effect on expectations than prior actions. Instead of trying to change incentives so that investors were less likely to exit the ABCP market, the action signaled that the Federal Reserve would directly replace exiting investors by providing its own funds. This action did reduce concerns that the ABCP market would collapse. As conditions stabilized, the coordination of expectations for an investor run from the ABCP market gradually lessened. Federal Reserve purchases of ABCP peaked in January 2009 at \$350 billion. Its investment in the market has fallen gradually since then to \$40 billion in October 2009.

For the *money market fund industry*, the government responded to the run on prime money market funds with the typical policy response used to avert bank runs. On September 19, 2008, three days after the money market run began, the Treasury Department announced a temporary guarantee program for the industry.⁶ The role of investors' expectations was cited in the press release "This action should enhance market confidence and alleviate investors' concerns about the ability for money market funds to absorb a loss." The program allowed eligible money market funds to purchase insurance from the Treasury Department at an established rate, similar to deposit insurance for banks. In the following weeks, the pace of withdrawals from prime money market funds waned (Chart 2). Shortly thereafter, assets began flowing back into the funds.

Housing prices

In response to the nationwide collapse of the housing market, the government has taken numerous steps to help stabilize the sector. From the perspective of the coordination game, one purpose of the actions was to break the coordination of expectations, where most people believed that others would pay less than current values for houses in the future. If these programs could persuade enough consumers to pay more for a house than they would have otherwise, others in the housing market may upwardly revise their expectations of house prices. Through a gradual realignment of the expectations of the housing valuations of other consumers, such actions may contribute to a stabilization of house prices.

One program has provided a subsidy to first-time homebuyers. The initial version was enacted in July 2008 as part of the Housing and Economic Recovery Act of 2008. This provision provided a tax credit of up to \$7,500 for qualifying first-time homebuyers who made a purchase between April 9, 2008 and July 1, 2009. This tax credit was an interest-free loan from the government that would be repaid over a 15-year period via an annual income tax surcharge. By lowering the interest rate expense for qualifying first-time homebuyers, this served to increase the price that they were willing to pay for a home.

As the housing crisis worsened in 2009, the government decided to increase the incentive for first-time homebuyers. In the American Recovery and Reinvestment Act of 2009, the government increased the credit to \$8,000 for homes purchased between January 1, 2009, and November 30, 2009. In addition, the credit no longer needed to be repaid if the owner maintained this home as his or her primary residence for the first three years following the purchase. This revised version provided a much greater incentive as the government was now giving a full subsidy of up to \$8,000 for qualifying homebuyers who remained in the purchased home for three years. The goal, as before, was to stem the decline in house prices by enticing a subset of buyers to pay more than they would otherwise for homes.⁷

In late 2008, the Federal Reserve also took action to stabilize the housing market. The Federal Reserve announced on November 25, 2008, that it would begin to purchase assets of Fannie Mae, Freddie Mac, and Federal Home Loan Banks (agency debt) and mortgage-backed securities backed by Fannie Mae, Freddie Mac, and Ginnie Mae

(agency MBS). The stated goal of this action was to “... reduce the cost and increase the availability of credit for the purchase of houses, which in turn should support housing markets and foster improved conditions in financial markets more generally.” This action of the Federal Reserve was aimed at stabilizing (or increasing) house prices by lowering the interest rate costs. As the housing crisis deepened in 2009, the Federal Reserve expanded this program to its current stated goals of purchasing up to \$175 billion of agency debt and \$1.25 trillion of agency MBS.

A third program was aimed at stabilizing housing markets by limiting the number of foreclosures. The Department of the Treasury established the Making Home Affordable program in March 2009 with the goal of “... making mortgages more affordable and helping to prevent the destructive impact of foreclosures on families, communities and the national economy.” While a primary goal of the program was to help individuals avoid foreclosure, the program also was set up to help stabilize the housing market by limiting the number of foreclosed homes that were for sale and also limiting the housing value declines in neighborhoods that contained large numbers of actual and potential foreclosures. In the current crisis, one factor that has stood out as a leading coordinator of expectations regarding the price of a house has been the presence of a foreclosed home in the neighborhood. Several recent studies have found that foreclosures affect the values of nearby houses through three primary channels: increased neighborhood blight and crime, lower appraisal valuations because of discounted sales of nearby foreclosed homes, and increased supply of homes for sale (Lee).

The goal of each of these programs was to stabilize the housing market. If these programs could increase the prices that some homebuyers were willing to pay, the combined effect may be sufficient to break the coordination of expectations for a continued decline in housing prices.

Automobile warranties

In the automobile industry, the government decided to address consumer concerns by providing a guarantee.⁸ With Chrysler and General Motors facing the prospect of bankruptcy, the U.S. Treasury Department announced on March 30, 2009, the creation of a Warrantee Commitment Program in which the warranties for all newly purchased Chrysler and General Motors vehicles would be guaranteed by the gov-

ernment. The guarantee would be in effect until the two companies resolved their current financial difficulties.⁹ In providing an explanation for the guarantee program, the government said, "...the program will support and encourage the continued viability and restructuring of the auto industry by mitigating consumer uncertainty that is depressing demand for new vehicles."

The exact effect of these warranty guarantees on consumer expectations and automobile sales in general is hard to determine. Since the government announcement in March, sales of General Motors vehicles have gradually risen relative to the other large auto manufacturers. Sales of Chrysler vehicles, however, have fallen sharply relative to the rest of the industry. In this case, the role of expectations of behavior by others is likely just one part of the decision process faced by consumers when purchasing a vehicle.

V. CONCLUSION

This article has brought a particular perspective to the recent economic crisis. The framework of a coordination game focuses on the interaction between individual choices and expectations. As expectations change, individuals often alter their choices in a way that becomes self-fulfilling. In some instances, this interaction between choices and expectations can lead to dramatically different outcomes in a very short period of time.

There have been many examples of coordination games in the recent crisis. This article has focused on bank run-style panics in financial markets, rapid swings in housing prices, and consumer confidence in automakers and their warranties. These are but a few of the types of complementarities that have been highlighted in the economics literature.¹⁰ One of the fascinating aspects of these complementarities is that once you are aware of the basic coordination game structure, you can see these interactions everywhere.

Since games with complementarities often have multiple self-fulfilling outcomes, it is natural to consider the role of the policymakers. In the face of rapidly changing expectations in the marketplace, policymakers are often the only ones that can act to coordinate expectations in a way to avoid bad outcomes. This article has highlighted the role of government guarantees and changes in incentives by policymakers in

the recent crisis. However, each of these interventions contains the possibility of creating longer-term problems as the decisions of individuals and firms may change in unintended ways once the crisis is over. Therefore, these extraordinary policy actions should be enacted with extreme caution and, in most cases, only enacted for a limited period of time.

APPENDIX: A COORDINATION GAME

This appendix develops a more detailed framework for a coordination game that highlights the role of expectations in the choices of economic agents, such as households and firms. The framework is then used to study bank runs and the role of policymakers in changing incentives to prevent them.

A framework for analysis

The basic framework of analysis is a *coordination game*. An abstract example of a coordination game is shown in Table A1.

Usage of the term “game” refers to a strategic situation in which the payoff to taking an action depends on the choices of others. The entries in Table A1 correspond to the payoffs (think of these in terms of money) for every combination of choices made by an individual and by everyone else. The individual’s choices are indicated by the two rows: high effort and low effort. Likewise, the columns correspond to the choices of high and low effort for all others. At this point, the meaning of effort is intentionally vague. One of the points of the applications in the article was to make these labels more precise.

To understand the table, suppose that an individual chooses high effort while everyone else chooses low effort. Then the individual would obtain a payoff of 0. If, instead, the individual chooses low effort and everyone else chooses low effort as well, then the individual obtains a payoff of 20.

It is assumed that everyone in the economy is identical. Of course, this is an abstraction since in reality everyone is different in some way. But the goal here is to use the model to highlight the essential interactions between people, leaving aside differences that do not modify the central point of investigation. Given this assumption, the payoffs in the table apply to each of the participants in the game. You can think of each of them as having a chance to choose between high and low effort, given the choices of all others. Since everyone is the same, we only have to study this choice once.

What can we say about the outcome (equilibrium) of this game? Each individual acts independently, taking the choices of everyone else as given. Economists think that individuals make choices to maximize their payoffs. But in this game, payoffs depend on what others do. Or, more precisely, they depend on *expectations* of what others will do.

Table A1

AN ABSTRACT COORDINATION GAME

Others / You	Others choose HIGH effort	Others choose LOW effort
You choose HIGH effort	100	0
You choose LOW effort	80	20

To see how this works, what will the individual choose to do if he or she believes that all others will choose high effort? Since $100 > 80$, the individual will choose high effort in response to others choosing high effort. So, if the individual expects others to put forth high effort, the best (payoff maximizing) choice of the individual is to choose high effort as well. By the same logic, if the individual expects others to choose low effort, then the best choice for the individual is also low effort ($20 > 0$).

Thus, expectations by one individual about others will influence the choice of that individual. In other words, *expectations matter*.

But then, what determines these expectations and thus the choices of what an individual chooses to do? Suppose that an individual expects everyone else to choose high effort and thus, by the argument above, chooses high effort—but, in fact everyone else chooses low effort. The outcome would be very unsatisfactory to the individual since expectations differed from reality. It is natural then for the individual to modify expectations so that they are in accord with the choices of others. That is, in fact, the answer to the question: Expectations are required to be in accord with the choices of others.

These two ingredients, the choice of an individual of a payoff-maximizing action and the requirement that expectations match actual choices, are used to make predictions about the outcome of the coordination game. One outcome, which is called the pessimistic outcome, has all individuals in the economy choosing low effort. It was shown earlier that if an individual expects everyone else to put forth low effort, the individual will also choose low effort. And since this is true for everyone (since all individuals are the same), the expectation of low effort is consistent with the choice of low effort by all individuals. In this way, expectations of low effort are self-fulfilling.

There is another outcome, which is called the optimistic outcome. In this case, all individuals choose high effort. Looking at a single individual, if all others choose high effort, the individual will as well.

So, in this game two outcomes satisfy the requirement that: 1) individuals make choices that maximize their payoff given expectations of others, and 2) the expectations about others conform to what others actually choose to do. This means that to make a prediction of an actual outcome, as opposed to a set of possible outcomes, something must fix expectations in this game.

Of the two possible outcomes, the one in which everyone chooses high effort is better for everyone than everyone choosing low effort. But, if everyone has pessimistic expectations and thinks that all others will choose low effort, it is in their self-interest to do so as well. Because of the possibility of getting stuck in an outcome that delivers lower payoffs for everyone, this is an example of a coordination game.

There is an essential ingredient in this game: As others choose higher effort, an individual has an incentive to do so as well. You can think of this as a type of complementarity between the return to effort by one individual and the level of effort chosen by others. That is, the gain to higher effort is increasing in the effort put forth by others. In our example the gain to high effort is 20 (100-80) when others choose high effort, and this gain is actually a loss of 20 when others choose low effort.

The bank runs game

The example of a bank run can be formalized using the framework of a coordination game. Table A2 displays the choices and payoffs for individuals in an environment in which there is no deposit insurance. The two rows correspond to the choices of “don’t withdraw” and “withdraw.” At the same time, all of the other depositors at the bank are making the same choices, as depicted in the two columns.¹⁵ As in the previous example, it is important to note that an individual’s payoff is affected by the choices of others.

The game has explicit payoffs that are consistent with the story described in Section I. In this case, think of yourself as a depositor who puts \$100 in the bank. You do not have liquidity needs, and the bank pays interest of 10 percent per year.

Table A2

COORDINATION GAME: A BANK RUN

Others / You	Others don't withdraw	Others withdraw
You don't withdraw	110	0
You withdraw	100	30

If you choose “don't withdraw” and the other depositors choose “don't withdraw,” then you will have \$110 in the bank next year. If others “don't withdraw” but you do, then you can take your \$100 out of the bank but you forgo the interest. So, clearly if you expect everyone else to choose “don't withdraw,” then your best choice is “don't withdraw” as well since \$110 is greater than \$100.

But what if you expect others to choose “withdraw”? In that case, if you leave your money in the bank, then you will earn \$0 since the bank will dissolve during the run. If you follow others and try to take your money out, then you will only receive a fraction of your initial deposit because the bank will be forced to quickly liquidate its long-term assets, likely at a loss. If the bank can only redeem 30 percent of deposits, then you would get back \$30. In this situation, if you expect that the others will choose to “withdraw,” then you should do so as well.

In this game, the gains to leaving money in the bank depend on what others do. The gain to leaving the money in the bank (that is, choosing “don't withdraw”) is \$10 if everyone else chooses “don't withdraw.” But this gain is -\$30 (therefore a loss) if you choose “don't withdraw” when everyone else is running.

There are two outcomes where everyone is doing the best they can for themselves, given expectations of others. One such outcome is that everyone leaves their money in the bank. In this case, everyone has \$110 and the bank does not have to liquidate any of its long-term investments.

The other outcome is the case when there is a bank run and everyone attempts to take their money out. Both of these outcomes are cases where expectations are consistent with the actions taken by others. If the outcome is a bank run, everyone's payoff is much lower than in the alternative outcome. Still, this is an equilibrium outcome since each individual, acting alone, is doing the best they can for themselves. The possibility of getting stuck in a bad outcome is what motivates the label *coordination game* for these types of interactions.

Table A3

A COORDINATION GAME WITH A GOVERNMENT GUARANTEE

Others / You	Others choose HIGH effort	Others choose LOW effort
You choose HIGH effort	100	30
You choose LOW effort	80	20

A key feature of coordination games is that it is in your interest to do what you expect others to do. As a result, expectations are critical to the survival of a bank.

The coordination game with guarantees added

Is there any way to avoid the pessimistic outcome from Table A1? As a reminder, this outcome is possible because the best action for an individual is low effort when others are expected to choose low effort. However, suppose that the government offers a guarantee that anyone choosing high effort would get a payoff of at least 30. Then it would look like Table A3.

This game is just like the original table except that an individual gets 30 by choosing high effort even when everyone else chooses low effort. The game now contains a very powerful policy, which in the end has *zero* cost to the government, in this simple environment. Based on the payoffs in Table A3, each individual will choose high effort regardless of what everyone else does. So the unique outcome will be for everyone to choose high effort. The use of guarantees here highlights the role that can be played by policymakers in the midst of a coordination failure, but they also must be aware that their policies may change incentives in a way that can have adverse effects on the actions of individuals and businesses in the longer term.

ENDNOTES

¹The appendix provides a formal presentation of this game.

²This presentation draws on Diamond and Dybvig and the many extensions of their analysis that followed. The appendix provides a formal presentation of this game.

³See Covitz and others for an empirical analysis of the ABCP market that finds evidence of extensive runs.

⁴Bubbles are a relatively open and exciting area of research in economics. A key challenge is seeing if they are consistent with rational agents (Tirole).

⁵This discussion draws on Bigelow and others.

⁶This temporary program was initially scheduled to end on April 30, 2009. The end date was later extended to September 18, 2009.

⁷In terms of the housing price formulation shown in equation (1), the tax credit implicitly lowered the interest rate expense for a first-time homebuyer because the financing of the purchase included a \$8,000 tax credit that does not have to be repaid.

⁸Similar arguments, presented in Cooper and Ross, pertain to government-provided pension benefit insurance.

⁹Ron Bloom, senior adviser at the U.S. Treasury Department, announced the end of the Warranty Commitment Program on July 21, 2009.

¹⁰The book *Macroeconomic Complementarities* by Cooper is organized around economic examples of complementarities and provides an extensive set of references to the earlier literature on these interactions.

¹¹This discussion is purely suggestive. There is a growing literature on the role of government provision of information in strategic settings. See, for example, Angeletos and Pavan; and Morris and Shin; and the references therein.

¹²The appendix contains a formal discussion of the effects of guarantee funds, such as deposit insurance, in coordination games.

¹³However, this insurance has come with a cost. When depositors are fully insured, they have no incentive to monitor the investment activities of their bank. Part of the savings and loan crisis in the 1980s can be attributed to the lack of incentives depositors had for monitoring bank activity (Shoven and others).

¹⁴See Shin for a more in-depth analysis of Northern Rock.

¹⁵For simplicity, we are just showing what happens if all the others choose “don’t withdraw” or “withdraw.”

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