

# Empirical Literature on Financial Crises: Fundamentals vs. Panic

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## INTRODUCTION

The process of financial globalization has given rise to an increase in the frequency of financial crises.<sup>1</sup> With it, there has also been a surge in research about financial crises. One of the key questions in this area is whether crises are triggered by fundamentals or come as a result of panic. Observing real-world events, many prominent researchers, including Friedman and Schwartz (1963) and Kindleberger (1978), concluded that financial crises are so strong and sudden that there must be an element of panic in them. Yet, a large empirical literature (reviewed in the next section) has been able to establish a fairly strong link between crises and fundamentals.

Theoretically, the panic-based approach to banking crises was formalized by Bryant (1980) and Diamond and Dybvig (1983). In the Diamond–Dybvig model, when investors withdraw money from a bank, they deplete the bank’s capital, reducing the amount available for investors who come in the future. This creates strategic

complementarities, such that investors wish to withdraw when they think others will do so. The result is multiplicity of equilibria. There is an equilibrium in which all the investors withdraw and an equilibrium in which none of them does. Crises are then self-fulfilling; they occur only because investors believe they will occur. In the Diamond–Dybvig model, the occurrence of a crisis cannot be linked to fundamentals. The fundamental-based (or information-based) approach has been modeled as well, for example, in Chari and Jagannathan (1988), Jacklin and Bhattacharya (1988), and Allen and Gale (1998). The basic idea is simple. Bad fundamentals (or negative information about fundamentals) lead banks’ balance sheets to deteriorate, inducing investors to run.<sup>2</sup>

The tension between the self-fulfilling approach and the fundamental approach to crises exists also in the currency-attack literature. The two classic approaches are presented by Krugman (1979) and Obstfeld (1996). According to Krugman (1979), the crisis is an inevitable result of a government that runs a fiscal policy which is

<sup>1</sup> In this chapter, financial crises include banking crises and currency crises. For evidence, see Bordo et al. (2001).

<sup>2</sup> The issues get more complicated in the information-based approach when there is asymmetric information, leading to learning, herding, etc.

inconsistent with the exchange rate regime, and hence the currency collapse is predictable by fundamentals. On the other hand, in Obstfeld (1996), the currency collapse might be self-fulfilling. If enough speculators choose to attack the currency, they will weaken the ability of the government to maintain the fixed exchange rate regime, leading to the collapse of the currency. Krugman himself later admitted that the fundamental approach is unable to explain the Asian crisis of the late 1990s, and in Krugman (1999), he proposed a model that is based on self-fulfilling beliefs and multiple equilibria.<sup>3</sup>

Differentiating between panic-based and fundamental-based crises is crucial for policy purposes. Many of the policies adopted against financial crises – such as deposit insurance, lender of last resort, and suspension of convertibility – are predicated on the idea that crises are panic-based and result from a coordination failure.<sup>4</sup> Hence, it is not surprising that many empirical papers have tried to distinguish the two types of crises in the data.

The Section ‘Empirical Evidence on the Role of Fundamentals’ of this chapter reviews some of the empirical papers on financial crises and their conclusion on whether crises result from fundamentals or panic. The traditional view in this literature is that the panic approach does not generate any testable implications (see Gorton, 1988). Hence, the focus has been on investigating whether crises can be linked to fundamentals. Indeed, by and large, the literature has found a strong link between crises and fundamentals, and this was usually interpreted as evidence in support of the fundamental-based approach and against the panic-based approach.

The Section ‘What Do We Learn from the Evidence about the Role of Panic?’ argues that, while the evidence certainly speaks of the importance of fundamentals, it does not say much about the panic-based approach. Even if crises are linked to fundamentals, it can still be the case that they would not have occurred without coordination failures or self-fulfilling beliefs. That is, it is possible that agents’ self-fulfilling beliefs about crises are triggered by low fundamentals, and so the fundamentals are linked to crises indirectly via the effect on coordination patterns. In this case, the panic amplifies the response to fundamentals and generates crises in levels of fundamentals that could support a different outcome. Indeed, the global-games approach – pioneered by Carlsson and van Damme (1993) and then extended and applied to study financial crises by Morris and Shin (1998), Goldstein and Pauzner (2005), and others – illustrates this idea. This section describes the paradigm and demonstrates that it generates self-fulfilling (or panic-based) crises that can be linked to fundamentals.

The Section ‘How Can We Test for Panic?’ asks whether there is a way to validate the panic-based approach in the data: can we identify that investors do something just because they believe others are doing the same? This is clearly a difficult problem, as, in a non-experimental environment, running a regression of the behavior of some people on the behavior of others is econometrically invalid, as it suffers from the reflection problem (Manski (1993)). This section describes two recent papers that make progress in this direction. Hertzberg et al. (2010) provide evidence on peer effects in lending by using a natural experiment in Argentina that enables them to identify the effect of one bank’s expected lending decision on other banks’ lending decisions. Chen et al. (2010) provide evidence on peer effects in redemptions among US mutual fund investors by showing the difference in behavior between funds that exhibit strong complementarities and funds that exhibit weak complementarities. Going forward, the challenge is to identify panic or self-fulfilling beliefs in the ‘classic’ crises datasets reviewed in the section ‘Empirical Evidence on the Role of Fundamentals.’

## EMPIRICAL EVIDENCE ON THE ROLE OF FUNDAMENTALS

The empirical literature on banking crises and currency crises has produced large evidence identifying fundamental variables that either determine or provide a warning sign for the occurrence of an upcoming crisis. This section reviews the main themes coming out of this literature. Note that this review is not meant to cover the whole literature, but rather to draw some of the main lessons.

### Banking Crises

A classic reference in the empirical banking crises literature is Gorton (1988). He provides one of the first sets of evidence linking crises to fundamentals. Studying the national banking era in the United States between 1863 and 1914, he shows that crises were responses of depositors to an increase in perceived risk. He demonstrates that crises occurred whenever key variables that are linked to the probability of recession reached a critical value. The most important variable is the liabilities of failed firms. He also shows an effect of other variables, such as the production of pig iron, which he uses as a proxy for consumption. When the perceived risk of recession based on these variables becomes high,

<sup>3</sup> An interesting quote from Krugman (1999) is “I was wrong; Maury Obstfeld was right.”

<sup>4</sup> See Diamond and Dybvig (1983) and Rochet and Vives (2004).

depositors believe that their deposits in banks – which have claims in firms – become too risky, and hence they demand early withdrawal, leading, in aggregate, to mass withdrawals.

While Gorton's study focuses on crises in the United States in the nineteenth and early twentieth centuries, other papers conducted international studies trying to understand what brings down a whole banking sector. A banking crisis in this literature is manifested by large withdrawals out of the banking system, leading to bank closures, government help to banks, or suspension of convertibility. A leading paper is Demirguc-Kunt and Detragiache (1998). They conducted an international study to understand the determinants of banking crises in a sample of developing and developed economies in late twentieth century (1980–1994). They again found that a number of variables connected to the fundamental state of the economy are related to the occurrence of crises. The key predictors in their study are low Gross Domestic Product (GDP) growth (which reflects declining economic activity that reduces the value of banks' assets), high real interest rates and inflation (which both induce banks to offer higher deposit rates, while the rates on their loans are fixed, given that they are mostly long-term loans), and a high level of outstanding credit (which obviously makes the banking system fragile). They use these results to conclude that crises cannot be solely explained by self-fulfilling beliefs and that they are connected to the state of the economy. They also find that the institutional environment in a country has an effect on the likelihood of a banking crisis. Surprisingly, the presence of deposit insurance is associated with an increase in the likelihood of a banking crisis. While deposit insurance should mitigate the concerns leading to a panic-based crisis, it also exacerbates the moral hazard problem in the banking system. This latter effect is potentially the explanation for this result.<sup>5</sup> Other factors are the quality of the legal system and the structure of liabilities of the banking system.

While the aforementioned papers look at economy-wide variables, others have analyzed bank-specific variables and their relation with the withdrawals from specific banks. One example is Schumacher (2000), who is also interested in distinguishing between information-based runs, and what she calls 'random runs.' She conducts her study around the runs on Argentine banks following the devaluation of the Mexican currency in December 1994. The devaluation in Mexico was of significance to the Argentine banks because it led to speculation that Argentina would also have to devalue its currency, and hence led depositors to rush to

withdraw their deposits denominated in the domestic currency. While this had started to happen, the run quickly spread to dollar-denominated deposits, suggesting that what was going on was more than just a run on the currency, but a general concern about the strength of the financial system. Schumacher conjectures that depositors' runs were triggered by information they had about the ability of banks to survive the currency collapse, and that according to this information, they transferred money from banks they considered 'bad' to banks they considered 'good.' She finds evidence in support of this conjecture by showing that the depositors took their money out of banks that were fundamentally weaker, as such banks had less adequate capital, poorer performance, more nonperforming loans, and lower liquidity.

In similar spirit, Martinez-Peria and Schmukler (2001) analyze the behavior of depositors in Argentina, Chile, and Mexico over two decades in the late twentieth century, asking whether they provide market discipline by withdrawing money and/or demanding high interest rate from risky banks. Indeed, they generally find that depositors' behavior is affected by banks' risk characteristics. Deposits decrease and interest rates rise in banks with a low ratio of capital to assets, low return on assets, high level of nonperforming loans, and high ratio of expenditures to assets. Surprisingly, they find that the effects are quite similar among insured and uninsured depositors, suggesting lack of confidence among depositors in the deposit insurance schemes. They also find that the effect of risk characteristics on depositors' behavior increases after banking crises.

Finally, Calomiris and Mason (2003) study banking crises during the great depression. As mentioned in the introduction, the famous study by Friedman and Schwartz (1963) attributes these bank runs to panic because they were not preceded by significant deterioration in macroeconomic fundamentals. But, it is possible that Friedman and Schwartz's conclusion can be overturned if one looks at regional or bank-specific variables as determinants. That is, it does not have to be that macroeconomic weakness was at the root of the crisis, but rather microeconomic issues could be behind the failure of specific banks. Indeed, Calomiris and Mason find support for the 'fundamental' view by showing that bank-specific variables – such as leverage, asset risk, and liquidity – affect the likelihood of failure, and so do variables that capture the local or regional economic situation. At the same time, they show that there is a significant residual left when trying to explain crises. In their view, this can indicate that the model of fundamentals is incomplete or that there was some element of panic involved.

<sup>5</sup> See also Demirguc-Kunt and Detragiache (2002), who develop this result further, and show, among other things, that the effect of deposit insurance on the probability of banking crises increases when institutions are weak.

## Currency Crises and Twin Crises

In parallel to the banking crises literature, a literature has been developed to understand the determinants of currency crises. A currency crisis is marked by a speculative attack on the domestic currency. It is usually manifested by one of the following three outcomes: large depreciation (if speculators succeed in their attack), large loss of reserves (as the government is trying to defend the regime by selling its reserves at the current exchange rate), or a sharp increase in interest rate (as the government is trying to defend the regime with the interest rate tool).

Eichengreen et al. (1995) study the determinants of currency crises and speculative attacks. They are able to find a set of determinants for several types of events but not for others. In particular, devaluations are preceded by political instability, fast growth of money, inflation, and budget and current account deficits. But, at the same time, they find no early warning signs for changes in exchange rate regimes (e.g., floatation) that may follow a speculative attack. Hence, they conclude that there is a great deal of self-fulfilling element in these events.

While in the past, banking crises and currency crises were treated as separate phenomena, an important aspect of financial globalization is that they became interdependent. This phenomenon has been documented by Kaminsky and Reinhart (1999) and is often referred to as the 'twin crises.' Kaminsky and Reinhart observe a vicious circle between the two types of crises; each one amplifies the prevalence of the other.

Theoretically, the 'twin crises' phenomenon has been the focus of several models, including Chang and Velasco (2000) and Goldstein (2005). In a developing country that opened its doors to foreign capital, we often observe that banks suffer from a mismatch between liabilities that are denominated in foreign currency and assets that are denominated in domestic currency.<sup>6</sup> Then, a run on the bank weakens the currency because it leads to an outflow of foreign reserves. At the same time, an attack on the currency weakens the bank, as depreciation leads to an increase in the value of the liabilities relative to the value of the assets of the bank. Hence, a vicious circle between the two crises ensues, amplifying the likelihood of both.

Indeed, after studying a sample of 20 countries over the period between 1970 and 1995, Kaminsky and Reinhart find that, following the increase in liberalization of financial markets across the world, the 1980s saw a huge increase in the link between banking crises and currency crises. In most cases, the beginning of a banking crisis led to weakening of the currency and then to a currency crisis. The currency crisis, in turn, tends to

deepen the problems in the banking sector, and hence the vicious circle arises. Aside from exposing the link between banking and currency crises, Kaminsky and Reinhart provide important evidence on the causes of the two, and hence inform the debate between the fundamental-based approach and the panic-based approach to crises. They show that both crises are preceded by deteriorating economic circumstances: below-normal economic growth, declining stock prices, worsening terms of trade, overvalued exchange rates, and the rising cost of credit. These fundamentals tend to be worse before a twin crisis than before an episode where only one of these crises occurs. Also, a twin crisis causes more damage than either a banking crisis or a currency crisis alone. They also document the role of financial liberalization in the emergence of crises. Prior to crises, there is usually a process of reduction in reserve requirements and an increase in credit.

Bordo et al. (2001) provide a historical perspective on international financial crises demonstrating that they have increased in frequency since 1973 to a level that is comparable only to the 1920s and 1930s, but at the same time they have not increased in severity or duration. Their explanation for the increase in crisis frequency is the increase in capital mobility due to the liberalization in capital accounts worldwide in the 1970s. Another factor is the apparent safety nets provided by governments, in the form of exchange rate pegs or deposit insurance, which encourage risk taking and eventually lead to crises.

Reinhart and Rogoff (2008) also provide a historical perspective going even further back than the Bordo et al. study. They also document the same increase in frequency of banking crises since 1973. They show a high correlation between the liberalization of capital accounts and the incidence of banking crises. Interestingly, they show that banking crises are evenly spread between developed and developing economies. If anything, financial centers are very susceptible to banking crises. In terms of variables that lead to banking crises, they find the following results: A sustained surge in capital inflows is a common characteristic that leads to a banking crisis. Another factor preceding a banking crisis is a bubble in equity and housing markets, a bubble that starts to burst before the crisis.

## Contagion

Some of the discussions about fundamental-based versus panic-based crises are mirrored in the vast literature on contagion. The forceful transmission of crises across countries and regions sometimes appears to be

<sup>6</sup> Even if a bank's loans to domestic firms are denominated in foreign currency, the firms will often have assets in domestic currency, and hence they will suffer from the mismatch, which will indirectly affect the bank (as firms will have to default on their loans).

pure panic that results from self-fulfilling beliefs. Yet, at the same time, theories and evidence have emerged to suggest that a lot of what we observe can be explained with fundamental reasons.

Kaminsky et al. (2003) provide a nice review of the theories behind financial contagion.<sup>7</sup> They define contagion as an immediate reaction in one country to a crisis in another country. There are several theories that link such contagion to fundamental explanations. The clearest one would be that there is common information about the different countries, and so the collapse in one country leads investors to withdraw from other countries. Calvo and Mendoza (2000) present a model where contagion is a result of learning from the events in one country about the fundamentals in another country. They argue that such learning is likely to occur when there is a vast diversification of portfolios, as then the cost of gathering information about each country in the portfolio becomes prohibitively large, encouraging investors to herd.

Another explanation is based on trade links (see e.g., Gerlach and Smets, 1995). If two countries compete in export markets, the devaluation of one currency hurts the competitiveness of the other, leading it to devalue its currency as well. A third explanation is the presence of financial links between the countries. In Kodres and Pritsker (2002), investors optimize their portfolio allocation. A decrease in the share of their portfolio held in one country due to a crisis leads them to rebalance by reducing their holding in another country, and hence causes a comovement in prices. In Allen and Gale (2000), different regions insure one another against excessive liquidity shocks, but this implies that a shock in one region is transmitted to the other region via the insurance linkage.

Empirical evidence has followed the aforementioned theories of contagion. The common information explanation has vast support in the data. Several of the clearest examples of contagion involve countries that appear very similar. Examples include the contagion that spread across East Asia in the late 1990s and the one in Latin America in the early 1980s. A vast empirical literature provides evidence that trade links can account for contagion to some extent. These include Eichengreen et al. (1996) and Glick and Rose (1999). Others have shown that financial linkages are also empirically important in explaining contagion. For example, Kaminsky et al. (2004) have shown that US-based mutual funds contribute to contagion by selling shares in one country when

prices of shares decrease in another country. Caramazza et al. (2004), Kaminsky and Reinhart (2000), and Van Rijckeghem and Weder (2003) show similar results for common commercial banks.

### WHAT DO WE LEARN FROM THE EVIDENCE ABOUT THE ROLE OF PANIC?

While the evidence reviewed in the previous section provides a strong case that fundamentals matter and crises, in general, do not happen out of the blue, it does not resolve the question about whether there is also panic involved. To be precise, the word 'panic' here means that crises are not justified solely on the basis of fundamentals, as the fundamentals could have supported a noncrisis outcome, but rather there is a crucial self-fulfilling element behind the crisis. It should be clarified that finding correlation (even if it is very strong) between fundamentals and crises is not a proof against the 'panic' hypothesis. It is possible that the self-fulfilling expectations are triggered by fundamentals, in which case fundamentals are associated with crises, but crises would not have occurred without the coordination failure.<sup>8</sup>

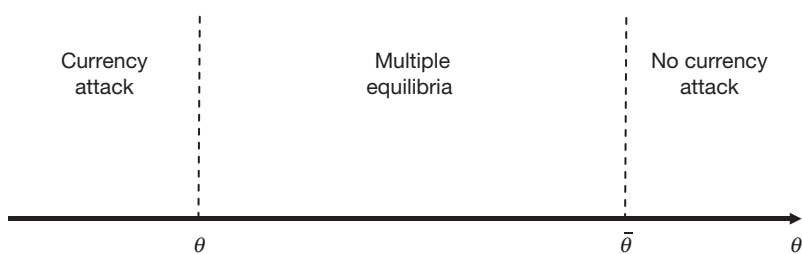
The global-games literature helps making these arguments more precise. This can be illustrated with the currency-attack model by Morris and Shin (1998).<sup>9</sup> In this model, the government maintains a fixed exchange rate regime at an overappreciated level. Speculators may choose to attack the regime by selling the local currency to the government. There is a variable  $\theta$  that captures how strong the fundamentals of the economy are (a higher  $\theta$  represents stronger fundamentals, and hence implies that the currency is fixed at a level closer to its fundamental value). Speculators have to pay a transaction cost to attack the regime. They make a capital gain if the government abandons the regime, in which case their gain decreases in the fundamentals of the currency. The government abandons the regime if the cost of maintaining it is higher than the benefit, where the cost is decreasing in the fundamental and increasing in the number of speculators who attack.

In a framework with common knowledge about the fundamental  $\theta$ , the possible equilibrium outcomes depend on which one of the three regions the fundamental  $\theta$  is in. This is depicted in Figure 36.1. Below a threshold  $\theta$ , there is a unique equilibrium where speculators attack the currency and the government abandons the regime. Here,

<sup>7</sup> For a broader review, see the collection of chapters in Claessens and Forbes (2001).

<sup>8</sup> Similarly, not finding evidence that fundamentals are associated with crises is also not proof that there is panic, as it could just be that the econometricians were not able to identify all the relevant fundamental variables.

<sup>9</sup> Goldstein and Pauzner (2005) analyze a global-games model of bank runs. Their model is more involved because the bank-run problem violates one of the central assumptions in the global-games literature – that agents' incentive to take a certain action monotonically increases in the proportion of other agents who take this action – and hence they develop a new proof technique.



**FIGURE 36.1** Currency attacks with common knowledge: tripartite classification of the fundamentals. *Reproduced from Morris, S., Shin, H.S., 1998. Unique equilibrium in a model of self-fulfilling currency attacks. American Economic Review 88, 587–597.*

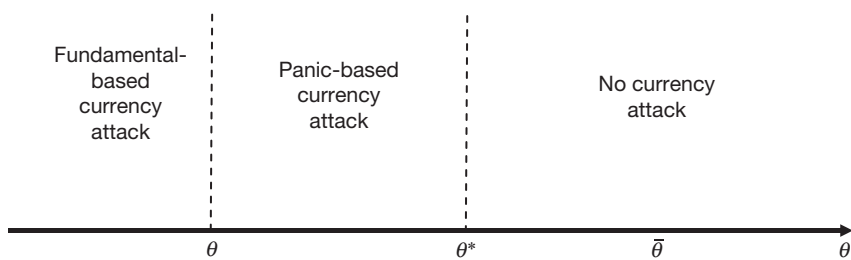
the fundamentals are so low that the government will abandon the regime no matter what speculators do (as the cost of maintaining the regime is high due to the low fundamentals), and hence each speculator undoubtedly finds it profitable to attack. Above a threshold  $\bar{\theta}$  ( $>\underline{\theta}$ ), there is a unique equilibrium where speculators do not attack the currency and the government maintains the regime. Here, the fundamentals are so high that speculators make a net loss from the attack even if the government abandons the regime (since the capital gain is lower than the transaction cost). Hence, they choose not to attack. Between  $\underline{\theta}$  and  $\bar{\theta}$ , there are multiple equilibria. Either everyone attacks and the government abandons the regime or no one attacks and the government maintains the regime. There are strategic complementarities, as speculators benefit from the attack if, and only if, other speculators attack, and hence there are two possible equilibria.

The intermediate range between  $\underline{\theta}$  and  $\bar{\theta}$  captures the traditional view of panic-based crises. Here, whether there is a currency crisis cannot be determined by fundamentals and is left entirely to self-fulfilling beliefs. At every level of the fundamental in this range, a crisis can either occur or not occur solely on the basis of self-fulfilling beliefs. A usual statement is that the occurrence of a crisis is left to a sunspot – a nonfundamental event – that coordinates agents' expectations on this outcome.<sup>10</sup>

However, introducing noise in speculators' information about the fundamental  $\theta$  dramatically changes the

predictions of the model even if the noise is very small. The new predictions are depicted in Figure 36.2. Now, the intermediate region between  $\underline{\theta}$  and  $\bar{\theta}$  is split into two subregions: below  $\theta^*$ , an attack occurs and the regime is abandoned, while above it, there is no attack and the regime is maintained.<sup>11</sup>

This result can be best understood by applying the logic of a backward induction. Owing to the slight noise in agents' information about  $\theta$ , agents' decisions about whether to attack no longer depend only on the information conveyed by the signal about the fundamental, but also depend on what the signal conveys about other agents' signals. Hence, between  $\underline{\theta}$  and  $\bar{\theta}$ , agents can no longer perfectly coordinate on any of the outcomes (attack or not attack), as their actions now depend on what they think other agents will do at other signals. Hence, a speculator observing a signal slightly below  $\bar{\theta}$  knows that other speculators may have observed signals above  $\bar{\theta}$  and chose not to attack. Taking this into account, he chooses not to attack. Then, knowing that speculators with signals just below  $\bar{\theta}$  are not attacking, and applying the same logic, speculators with even lower signals will also choose not to attack. This logic can be repeated again and again, establishing a boundary well below  $\bar{\theta}$ , above which speculators do not attack. The same logic can then be repeated from the other direction, establishing a boundary well above  $\underline{\theta}$ , below which speculators do attack. The mathematical proof shows that the two



**FIGURE 36.2** Equilibrium outcomes in a currency-attack model with noncommon knowledge. *Reproduced from Morris, S., Shin, H.S., 1998. Unique equilibrium in a model of self-fulfilling currency attacks. American Economic Review 88, 587–597.*

<sup>10</sup> It should be noted that even in Figure 36.1, there is some association between the fundamentals and panics, as panics occur only when the fundamentals are in an intermediate range. Introducing noise makes this much stronger.

<sup>11</sup> This sharp outcome is obtained when the noise in the signal approaches zero. For larger noise, the transition from attack to no-attack will not be so abrupt, but rather there will be a range of partial attack. This does not matter for the qualitative message of the theory.

boundaries coincide at  $\theta^*$ , such that all speculators attack below  $\theta^*$  and do not attack above  $\theta^*$ .

As Figure 36.2 shows, in the range between  $\underline{\theta}$  and  $\bar{\theta}$ , the level of the fundamental now perfectly predicts whether or not a crisis occurs. In particular, a crisis surely occurs below  $\theta^*$ . Crises in this range can be referred to as ‘panic-based’ because a crisis in this range is not necessitated by the fundamentals; it occurs because agents think it will occur, and in that sense, it is self-fulfilling. However, the occurrence of a self-fulfilling crisis here is uniquely pinned down by the fundamentals. So, in this sense, the ‘panic-based’ approach and the ‘fundamental-based’ approach are not contradictory. The occurrence of a crisis is pinned down by fundamentals, but crises are self-fulfilling as they would not have occurred if agents did not expect them to occur. The key is that the fundamentals uniquely determine agents’ expectations about whether a crisis will occur, and in that, they indirectly determine whether a crisis occurs. Agents’ self-fulfilling beliefs amplify the effect of fundamentals on the economy.

The discussion in the preceding paragraphs demonstrates why the evidence reviewed in section ‘Empirical Evidence on the Role of Fundamentals’ that fundamentals matter for crises does not speak against the validity of the panic-based approach to financial crises. Consistent with evidence, the global-games approach predicts that crises will occur at low fundamentals and will not occur at high fundamentals, but crises are still self-fulfilling (or panic-based). Hence, to detect the panic-based mechanism in the data, one needs to resort to other strategies.<sup>12</sup> Such strategies are discussed in the next section.

Before turning to the next section, it might be useful to go back briefly to the issue of contagion that was reviewed at the end of the section ‘Empirical Evidence on the Role of Fundamentals.’ The fact that contagion can be attributed to fundamental factors, again, does not imply that there is no panic element in it. For example, consider the model in Goldstein and Pauzner (2004). Contagion happens in this model due to a fundamental factor – diversification of investment portfolios. Yet, crises are still self-fulfilling and would not occur if agents do not believe they are going to occur.<sup>13</sup> In the model, there are two countries that have independent fundamentals, but share the same group of investors. A crisis might erupt in each country because of self-fulfilling beliefs. That is, there are strategic complementarities that imply that investors are better off keeping their money

in a country only if they believe that other investors are going to do so. Using the global-games technique, one can uniquely determine whether a crisis is going to occur in each country as a function of the fundamentals in that country. Contagion then occurs as a result of a wealth effect. The occurrence of a crisis in one country makes investors poorer and hence more risk-averse. Then, they are more averse to the strategic risk involved in keeping their money in the other country and being dependent on what others do, so they are more likely to run. Hence, a crisis in the other country becomes more likely, and the contagion ensues. In summary, a fundamental cause – financial link – creates contagion, but contagion is still self-fulfilling. In fact, the crisis in one country makes investors more risk-averse and hence more likely to ‘panic’ in the other country.

## HOW CAN WE TEST FOR PANIC?

To fix ideas, one might speculate on what would be the ideal way to capture ‘panic’ in the data. Ideally, one would like to show that investors withdraw capital because they believe that other investors are going to withdraw capital. So, in a laboratory, we could tell subjects about the upcoming behavior of others and see how they change their own behavior (making sure that they do not infer anything about the fundamentals from the behavior of others). Clearly, the real world is not a laboratory, and it is quite difficult to find a situation that is close to this experiment. Outside a controlled experiment, running a regression where the behavior of some investors is explained by the behavior of others is not a valid econometric approach, as it suffers from the reflection problem (see Manski, 1993). That is, finding that investors are more likely to run when others run is not a proof for panic or strategic complementarities, as it is very possible that they do the same thing because they all observed some fundamental variable that led them to run.

In a recent paper, Hertzberg et al. (2010) use a natural experiment that comes very close to the desired controlled environment mentioned earlier. Their natural experiment is based on the expansion of the Public Credit Registry in Argentina in 1998. The role of the registry is to aggregate information about borrowers and to make it available to potential lenders. The information includes assessments by current lenders of the creditworthiness of the borrower. Prior to 1998, the registry only provided

<sup>12</sup> The issue of panic versus fundamental crisis is parallel to the question of illiquidity versus insolvency. A panic-based run is said to occur when a bank is solvent, but illiquid. That is, when the fundamentals are good enough that the bank would survive had investors not run, but if they ran they can bring the bank down. The problem is that illiquidity and insolvency are intertwined. The fact that fundamentals decrease might bring the bank closer to insolvency, but this may also trigger the illiquidity risk. This point is illustrated particularly well by Morris and Shin (2010). They show that investors are more likely to coordinate on a self-fulfilling attack when the risk of insolvency is high.

<sup>13</sup> See also Dasgupta (2004) for a model of contagion of self-fulfilling crises due to interbank connections.

information about borrowers whose total debt was above \$200,000. This is due to the cost of distributing information for a large number of small borrowers. In 1998, following the adoption of CD-ROMs, the need for the threshold was eliminated, leading to the disclosure of information about 540,000 borrowers, for which credit assessments were previously only known privately.

The reform was announced in April 1998 and implemented in July of that year. Hence, the experiment gives rise to three distinct periods. The first is the period before the announcement, during which lenders provided loans to borrowers who owe less than the threshold, expecting that their information will not be observed by anyone else. The second period is the interim period between the announcement and the implementation, during which the information was still available only to the lender, but it was already known that it would become available to other lenders soon. Finally, the third period is after the announcement, when the information about the creditors became available publicly.

Hertzberg, Liberti, and Paravisini identify the presence of complementarities in lending by studying the difference in lenders' behavior between the first period and the intermediate period. Consider a lender who had negative information about a borrower, for whom the information was not initially disclosed (since the borrower owed less than \$200,000 in total). From the point of view of this lender, no new information has arrived between the two periods. The only difference is that in the intermediate period, he realizes that the information will become available publicly. The authors show that for these borrowers, the amount of credit has decreased between the first and intermediate period. This is supposedly because the lenders realized that making this information public will make other lenders reduce credit. Hence, since they care about what other lenders do, they reduced credit as well. To further support their case, they use a differences-in-differences approach and show that the decrease in debt in the interim period is not observed for firms that were slightly above the threshold (for whom the information was always available) and for those who borrow from only one lender (for whom there is no coordination problem). Their results are demonstrated in Figure 36.3.

The paper by Hertzberg, Liberti, and Paravisini speaks of an important aspect of coordination problems, which is the public information multiplier. That is, because of coordination motives, information disclosed publicly ends up having a larger effect than private information. This aspect has been the subject of a large literature starting from Morris and Shin (2002). It suggests that public information may have adverse effects, and

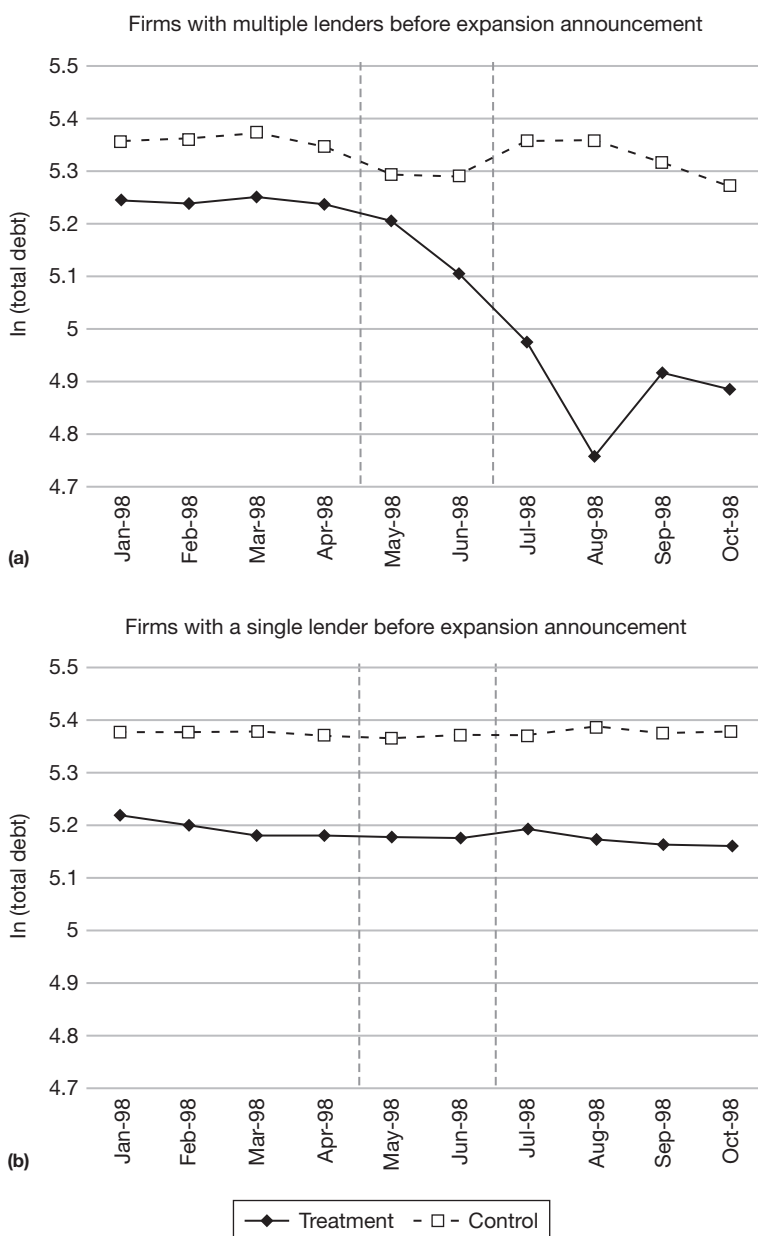
hence there may be a welfare gain in reducing disclosure. In the context studied by Hertzberg, Liberti, and Paravisini, lenders act on their information only when they realize it is going to become public. Hence, the disclosure of public information seems to play an important role in triggering a coordination failure among lenders.

While the paper by Hertzberg, Liberti, and Paravisini provides a very clean experiment that enables direct identification of complementarities in lending, its limitation is that it identifies a very local effect. That is, it tells us about the behavior of lenders to borrowers who borrow around \$200,000. Finding more general evidence for complementarities requires one to look outside the narrow framework of a natural experiment. In another recent paper, Chen et al. (2010) provide an empirical test for the effect of strategic complementarities among US mutual fund investors and show how they create financial fragility. They attempt to identify the effect of strategic complementarities by investigating whether the response of investors to fundamentals is stronger in cases where complementarities are expected to be stronger. That is, they study whether the strategic complementarities amplify the effect of fundamentals on outflows, and hence create financial fragility. Finding such evidence is an indication of the presence of panic, as it implies that investors act more forcefully just because of the expected action of others.

The study is motivated by the institutional background of the open-end mutual fund industry. Investors in open-end mutual funds have the right to redeem their shares at net asset value every business day. Their redemptions are costly to the mutual fund because the mutual fund needs to sell assets to accommodate the withdrawals or otherwise deviate from the planned portfolio holdings. The key feature is that this cost is mostly transferred to investors who stay in the fund rather than being borne by those who redeem. The reason is that funds conduct transactions after the day of withdrawal, and so the net asset value as of the day of withdrawal does not reflect the full damage of the withdrawal. This creates strategic complementarities: the expectation that other investors are going to redeem increases the incentive to redeem and avoid the damage from staying in the fund and bearing the cost of redemption. Crucially, this mechanism is strong in funds with illiquid assets (for which transaction costs are high) rather than in those with liquid assets. Hence, if strategic complementarities matter, one should observe a stronger response of outflows to bad performance in illiquid than in liquid funds. Chen, Goldstein, and Jiang find this result. It is demonstrated in Figure 36.4.<sup>14</sup>

<sup>14</sup> The graph shows results from a semiparametric analysis that does not assume linearity. Hence, the confidence intervals are wide. In the paper, the regression analysis establishes highly significant results.





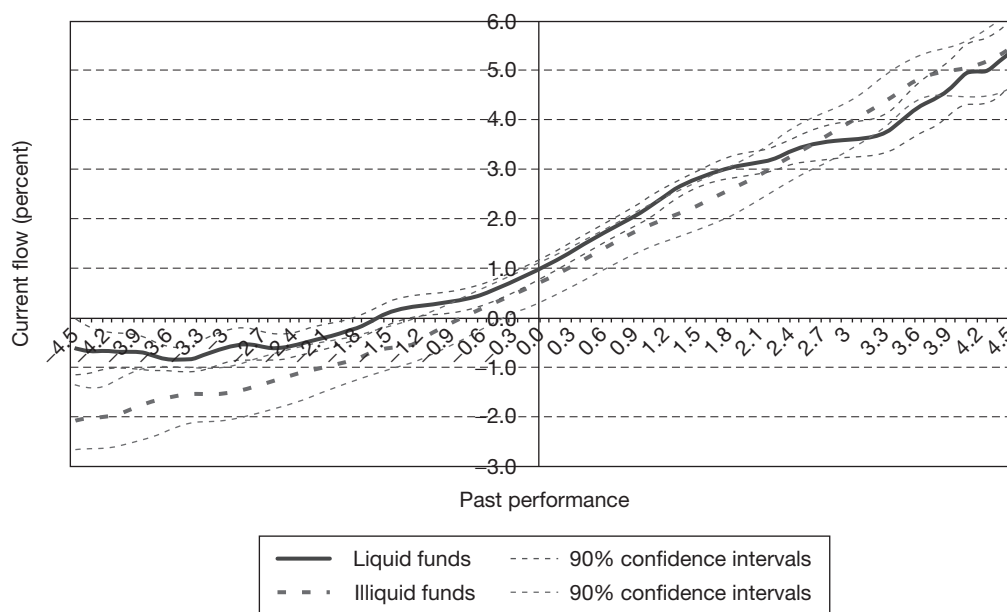
**FIGURE 36.3** Debt levels of firms around the credit registry expansion in Argentina; treatment firms have debt levels between \$150,000 and \$200,000 and control firms have debt levels between \$200,000 and \$250,000. Reproduced from Hertzberg, A., Jose, M.L., Daniel, P., 2010. Public information and coordination: evidence from a credit registry expansion. *Journal of Finance*.

The paper goes on to provide further tests. Another cut at the data is obtained by considering the type of investors in the mutual fund. As we learn from the paper by Corsetti et al. (2004), large investors are less likely to fall into a coordination failure, as they internalize some of the externalities by being large. This then injects stability to the fund. Hence, taking this insight into the current context, one would expect that the effect of illiquidity on the sensitivity of outflows to bad performance will be weaker among funds that are held mainly by large/institutional investors. This is indeed confirmed in the data.

Finally, since the identification relies on the idea that differences in liquidity proxy for differences in the strength of complementarities across funds, it is important to make sure that differences in liquidity do not

capture other important differences across funds. Two alternative stories come to mind. First, in the spirit of the fundamental-based approach reviewed earlier, maybe investors in illiquid funds are more responsive to bad performance because in these funds bad performance is more indicative of future performance, that is, it is fundamentally justified to be more sensitive to bad performance in these funds. Chen, Goldstein, and Jiang mitigate this concern by showing in different ways that the returns in illiquid funds do not show more persistence than in liquid funds.

Second, maybe investors in illiquid funds are more responsive to bad performance than in liquid funds because the two types of funds simply have different types of investors. This would make sense, for example, if illiquid



**FIGURE 36.4** Flow-performance sensitivity in illiquid versus liquid mutual funds. *Reproduced from Chen, Q., Itay, G., Wei, J., 2010. Payoff complementarities and financial fragility: evidence from mutual fund outflows. Journal of Financial Economics 97, 239–262.*

funds had institutional investors who are more tuned to financial markets and hurry to withdraw at the first sign of trouble, while liquid funds had retail investors. The paper mitigates this concern by focusing on one type of investors, that is, institutional investors. It shows that institutional investors are more likely to redeem upon bad performance in illiquid than in liquid funds. Per the discussion earlier, they do so when surrounded by retail investors. Hence, institutional investors seem to care who their fellow investors are and they ‘panic’ only when surrounded by retail investors who are expected to panic.

In summary, the two papers described in this section use two identification strategies that enable making an inference about the validity of the panic-based approach. One paper uses a natural experiment that can identify the effect of the expected action of lenders on the action of other lenders. The other paper identifies the effect by contrasting the reaction in funds with different degrees of strategic complementarities.<sup>15</sup>

## CONCLUSION

A central question in the research of financial crises is whether crises are driven by bad fundamentals or result from panic. While evidence provides links between fundamentals and crises, it does not go against the panic hypothesis. As theory shows, fundamentals may trigger panic, and so panic acts to amplify the effect of fundamentals on the economy. Hence, the fundamental-based

approach and panic-based approach are not inconsistent with each other.

Assessing the extent of panic in real-world crises is important for policy purposes, as many policy tools against crises – deposit insurance, lender of last resort, suspension of convertibility – are based on the premise that crises result from coordination failures. Hence, it is important to try and identify in various contexts the contribution of panic and coordination failures to observed crises.

Two recent papers described in the section ‘How Can We Test for Panic?’ make progress in documenting the role of coordination in lenders’ and investors’ behavior. There is ample room for future research to use these (or other) identification techniques in some of the ‘classic’ crises data that were discussed in section ‘Empirical Evidence on the Role of Fundamentals.’ Also, such techniques may be used to improve our understanding of the contribution of panic and coordination failures to the events in the crisis of 2007–2009, including the run on Northern Rock, the run on money-market funds, and the collapse of financial institutions such as Bear Stearns and Lehman Brothers.

## SEE ALSO

Financial Globalization and Crises: Overview; Crises: Models of Currency Crises; Predictive Indicators of

<sup>15</sup> There is also a large experimental literature studying coordination problems in the laboratory. For example, see Heinemann et al. (2004).

Financial Crises; Definitions and Types of Financial Contagion; East-Asian Crisis of 1997.

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## Glossary

**Banking crisis** The failure of banks due to runs by creditors, a deterioration in banks' asset values, or a combination of both.

**Contagion** A scenario in which crises spread across banks, regions, or economies.

**Currency crisis** A speculative attack on a currency regime, leading to a large depreciation, loss of reserves, or a sharp interest-rate increase.

**Global games** In economics and game theory, global games are games where agents receive noisy information about the state. These games often overturn the multiplicity of equilibria result in games of complete information.

**Self-fulfilling beliefs** In economics and game theory, self-fulfilling beliefs are equilibrium outcomes that occur only because agents believe they will occur.

**Strategic complementarities** In economics and game theory, strategic complementarities exist when agents want to take similar actions to other agents.

**Twin crisis** A combination of a banking crisis and a currency crisis.

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