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Are Dominos a Good Metaphor for Systemic Risk in Banking?

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ABSTRACT

This article compares financial contagion theories relevant to systemic risk in banking, namely counterparty contagion and informational contagion, and critically reviews the literature on past "Too Big to Fail" bankruptcies. Policy proposals to limit the adverse effects of contagion are dependent on which contagion theory best describes the phenomenon. Paradoxically, while counterparty contagion theory seems to dominate through the domino metaphor, empirical and theoretical literature give~~s~~ little credence to it. In light of the literature reviewed, a better metaphor for financial contagion would be a single domino falling, prompting investors to question the solidity of similar dominos.

JEL Classifications: G01, G33

Keywords: financial contagion; systemic risk; too big to fail; bailouts

I. INTRODUCTION

The "Too Big to Fail" banking policies have been mostly motivated by fears of systemic risk. Systemic risk, as a concept, refers to the idea of chain reaction and highly correlated waves of bankruptcies that threaten the financial system and would prevent it from playing its intermediation role in the economy. Taylor (2010) defines it as a three-step event: (1) the failure of a large financial institution triggering the systemic event, (2) financial contagion and (3) transmission to so-called real economy. Financial contagion refers here to the way the bankruptcy of a financial institution spills over to another one, but a broader interpretation of financial contagion would be successive correlated price declines (or losses) on a market, regardless of the bankruptcies it might or might not entail. It does not refer to long-term systematic confidence crises characterized by growth stagnation and a dearth of investment.

This document will focus primarily on financial contagion, specifically financial contagion in the banking sector, and its implications for "Too Big to Fail" policies. But the systemic risk literature is also very much interested in the non-financial industry, where results largely differ[1].

There are two distinct types of financial contagion affecting financial institutions: counterparty contagion and informational contagion. Both have the common idea that the first failure responsible for the contagion should be a systemically important financial institution (SIFI).

TBTF banks, or SIFIs, is a qualifier often defined in terms of turnover, but the concept goes beyond to take account of its role in the market and, in the case of banks, its function in the banking system. For example, a bank that would not be of significant size but would assume the role of clearing house, correspondent bank or prime broker would be likely to endanger the system and be a candidate for the status of SIFI or TBTF, or sometimes "Too Interconnected to Fail". Of course, the size and role of banks often go together. However, there is no formal way to define systemically threatening firms in the economic literature, and authorities long refused to provide information on which institution they considered too big to fail, given the significant moral hazard problem it would entail.

Counterparty contagion theory involves direct links between financial institutions through counterparty risk. The default of the first firm on its obligations would transmit financial distress to its creditors, who would forward it to their own creditors and so on until the crisis is widespread. The dominos metaphor is often used to illustrate these scenarios.

The second type of contagion is informational contagion. According to informational contagion theory[1], contagion spreads because the financial difficulties of the initial bankrupt firm reveals information on a risk shared by both firms. Contagion occurs because the information needed to determine how similar firms, or securities, are affected by this 3rd party risk is not immediately available, requires a costly analysis, and the creditors of these subsequent firms are risk averse. This type of contagion is manifested by bank runs, panics, and confidence crisis. This type of contagion can lead to significant losses in the financial system without necessarily leading to bankruptcies. This contagion affects solvent and insolvent institutions alike.

Whether from counterparty risk or informational, financial contagion is often illustrated with metaphors: dominoes falling one after the other, the failure of an

institution that would block the plumbing of the financial system, etc. Metaphors can be useful for vulgarization, but one needs to be careful when using them as they influence the way we think about the underlying phenomenon. For example, the dominoes metaphor captures quite perfectly the narrative of counterparty contagion, but Kaufman and Scott (2003) suggest that informational contagion might better be thought of as the collapse of a single or a few dominos, pushing to question the stability of surrounding dominoes. The question of whether the dominoes are a good metaphor for the phenomenon thus refers to the question of what type of contagion makes most sense and is better validated empirically.

The following document is a review of the literature on financial contagion and attempts to answer this question. Section II will focus on the theoretical framework of counterparty contagion, and Section III on informational contagion. In Section IV, we will review the empirical evidence of 3 cases sometimes cited as examples of Too Big to Fail in banking, namely the Continental Illinois National Bank, the Bankhaus Herstatt and the events of the last quarter of 2008. In Section V we will conclude with implications for the way we think about systemically important financial institutions.

II. COUNTERPARTY CONTAGION

Counterparty contagion comes from counterparty risk, when the insolvency of a firm is transmitted directly to another. A lot of the literature on correlated counterparty losses, such as Jarrow and Yu (2001), Kyle and Xiong (2001) or Giesecke and Weber (2004), is concerned with the composition of optimal portfolios without default correlation necessarily resulting in an event of systemic magnitude. Indeed, bankruptcies rarely are isolated, and many models attempt to take this correlation into consideration in the composition of an optimal portfolio, or derivative design.

In counterparty contagion, the insolvency is transmitted from one bank to another through its claims. These claims mostly take the shape of commitments on the interbank market and the derivatives market, as well as within clearing houses. There is counterparty contagion when losses related to credit risk is higher than the equity of the bank.

Counterparty contagion requires several elements:

1) That the firm responsible for the contagion is large and systemically important;
2) That there are significant losses in the first company going bankrupt ;
3) That the creditors have undiversified portfolios;
4) That the first failure is idiosyncratic.

These conditions are however hard to be met. The first condition, that the first company going bankrupt is systemically important, is necessary for its failure to have some effect on its counterparties. A bank that would not be significant in terms of its role in the payment system would be too isolated to provoke a crisis that would affect the entire economy. For example, in the counterparty risk models of Davis and Lo (2001), and Jarrow and Yu (2001), all firms must have a direct link to the first company that went bankrupt for the contagion to spread. Contagion scenarios not only require a close relationship between the first troubled bank and the subsequent banks, but also a close relationship between the following banks.

The first bankrupt firm needs to lose significant value for its insolvency to be passed on to its creditors. This may be due to the initial shock that has made the

company go bankrupt, but also to market fluctuations reacting to it, or attempts by managers to avoid bankruptcy. Helwege (2010) suggests that fire sales of assets by managers are an unlikely cause for this kind of depreciation, because it contradicts the core bankruptcy resolutions principles of maximization of the value of the distressed firm, whether driven by Chapter 11 or by special Federal Deposit Insurance Corporation regimes, as outlined by Bliss and Kaufman (2007). Diamond and Rajan (2009b) suggest that a consequence of limited liability regimes and lender of last resort policies is that distressed firms do not forego the revenues of holding on to their assets by selling them disorderly, because of their possibility to shift the risk onto creditors and/or tax payers.

The third condition concerns the diversification of the firms. The scenario of counterparty contagion leading to systemic risk also assumes that firms hold undiversified assets and have large exposures in the interbank market. Indeed, if the sole failure of one of its debtors is to push a bank into insolvency, these commitments must have been a fairly large portion of its assets. In an industry that is not only well aware of the virtues of diversification, but must meet strict quotas regulating the maximum share of capital that they can allocate to a single counterparty, this assumption is unlikely to be verified.

Jorion and Zhang (2009) support the idea that the banking industry is too diversified for counterparty contagion leading to a systemic risk to arise. The biggest claim in their sample is Citibank's in the Enron bankruptcy for 1.75 billion dollars, a relatively small number compared to its capital. Enron's assets having not dramatically lost value, Citibank's loss finally amounted to 228 million dollars, approximately 0.5% of its capital. In fact, the mean exposure of financial institutions within their sample is 0.16% of their capital, with a maximal exposure of 2.39% of its capital. If Jorion and Zhang's results are representative of the general situation among SIFI's creditors, banks never expose themselves largely enough on the interbank market for a bankruptcy to create counterparty contagion of systemic proportions.

With a method consisting of identifying flows on the interbank market, Furfine (2003) demonstrates that the exposure in the interbank markets is generally low. Using data from the interbank market from February to March 1998 revealing the net positions total 719 banks representing 70% of U.S. banking assets, it was determined that if the largest debtor in his sample was to fail, causing a negative return on investment of 40% (a figure well beyond what was witnessed during the banking failure clusters of 1930 and 1980) it would cause some bankruptcies in 2 to 6 other banks, but these failures only represent one percent of total banking assets. For an average negative return on investment of 5% on the economy, no other bank would go bankrupt (Kaufman and Scott, 2003). The 5% figure is particularly significant, since it is the rate calculated by Kaufman (1994) for the failure of Continental Illinois Bank in 1984, the bankruptcy that launched the "Too Big to Fail" idiom.

The fourth condition is definitional; that what made the first bank fail did not influence, or at least is not the major influence, to subsequent bank failures. It is necessary to differentiate counterparty contagion from the effects of macroeconomic conditions and other adverse trends. Rochet and Tirole (1996) implicitly use an idiosyncratic shock, i.e. an error of assessment of risk, but other examples of idiosyncratic shocks could be mismanagement or fraudulent management. While many counterparty contagion models (Allen and Gale, 2000; Giesecke and Weber, 2004;

Jarrow and Yu, 2001) incorporate the effects of macroeconomic fluctuations, they specify how much of the effect is due to macroeconomic fluctuations. In both cases, tests are performed in the absence of systematic influences.

III. INFORMATIONAL CONTAGION

Informational contagion is triggered when an exogenous shock prompts creditors of financial institutions to review their expectations. While the length of the queue at the cashier was central in bank run models derived from Diamond and Dybvig (1983), particularly visible in Chari and Jagannathan (1988), an event triggering informational contagion could be the failure of a similar bank or its fall in credit ratings, or adverse news about a type of asset. At that time, information on the cause and intensity of the initial shock, as information on each bank's exposure, is not known very precisely. Risk-averse agents will then try to reduce their stakes until they learn more about their debtor's exposure.

While information about the financial health of the firm in face of an unforeseen shock is difficult to find, expensive, not perfect, not perfectly transmissible, and market stakeholders are not perfectly vigilant, the theory of informational contagion assumes that they can identify the banks that will survive the shock on the basis of information.

During this period of reassessment, creditors and shareholders of firms with portfolios similar to that of the firm in difficulty will question the soundness of the institution. In a manner reminiscent of bank runs, counterparties will try to reduce their exposure to the institution they interpret as dubious. The contagion will affect firms that are actually affected by the initial shock, but also other firms that will in due time prove they were not in danger.

A wide range of models seeks to recreate these events with different types of asymmetry of information and different levels of 'beauty contest' behaviors such as King and Wadhani (1990), Genottes and Leland (1990), Calvo & Mendoza (2000), Barlevy and Veronesi (2003), Kodres and Pritsker (2002), and Pasquariello (2002).

Whether contagion remains contained to institutions that have similarities with the troubled institution or whether it spills over to institutions that are not perceived as being exposed to the shock (sometimes referred to as non-informational contagion, or "irrational contagion") is an empirical question. Kaufman (1994) reviews this literature and finds that contagion is firm-specific (as opposed to industry-wide). Subsequent studies such as Aharony and Swary (1996) or Jordan et al. (2000) offer a similar response. Investors direct their doubts quite effectively toward the institutions that have links, real or perceived, with the triggering shock.

During this reassessment process, some counterparties will reduce their exposure through various means. Bank runs are one example of such process, even though the existence of deposit insurance has altogether eliminated bank runs and depositors' incentives to monitor banks. Likely, in an informational contagion setting thought of as broader than simply depositors to include other kinds of creditors, and shareholders, better informed agents can reap a premium by either reducing their exposure early, facing a smaller haircut, or by not reducing their exposure when their analysis suggests that the bank is not at risk. It is the opportunity cost of this early bird premium that creates incentives to monitor banks and gives rise to a wealth of institutions analyzing, auditing and publishing financial institutions. In turn, this heterogeneity in investors'

knowledge will create profit opportunities that steer the bank's value towards equilibrium.

Another way to discover the needed information, specific to bank runs and informational contagion, is a by-product of creditors and shareholder flights. During these flights, investors run on short term claims or sell their shares or bonds. On the derivative market, Duffie (2010) suggests that counterparties may do so by borrowing to offset exposure, by entering new derivative contracts, or through novation requests by which they transfer their claims on a third party. In this sense, these flights can be interpreted as a means of controlling the banks; the stress on the bank's liquidity forces them to take the actions that ultimately demonstrate their exposure and resilience to the initial shock through price and non-price signals. They might make announcements or release information, but much more valuable information might come from actions taken to ease their liquidity, or simply from withstanding the test of time. Banks that are actually at risk, or with structurally unsustainable balance sheets or liquidity management, might reveal their situation by, for example, refusing to provide two-sided market quotations, offering unattractive quotations or refusing novation requests in an attempt to stop the outflow of liquidities. Ultimately, they might do so through default and/or bankruptcy.

This process is more than a screening process, in the sense that the vocable of "screening" implies that managers detain the information, but do not want to disclose it, or might not be able to do so credibly. But had there not been informational contagion, this information would not have existed or might have been tacit knowledge impossible to communicate.

In cases where banks subject to these flights turn out to have been capable of sustaining the shock, the result of the episodes of informational contagion is that investors have acquired more knowledge about the exposure of their debtors. When information gaps are somewhat bridged, most of the bank runs and hedging taking place in banks that have turned out to be solvent will be "rolled back" and business will resume.

The question that arises and that is especially relevant to Too Big to Fail policies is whether the contagion is a phenomenon that can cause the insolvency of a solvent institution which has sustained no shock, or a shock of insufficient intensity to make it insolvent. In other words, do agents revise their beliefs before they push the solvent institutions to insolvency?

In Diamond and Dybvig's the bank runs are self-fulfilling prophecies because the agents are insensitive to new information, and once set in motion nothing can stop the movement. This type of contagion may therefore make financially sound institutions insolvent. Even though real-world agents do learn and update their beliefs there are no reasons to think that this process will be fast enough, that interpretation of price and non-price signals will be effective enough, or for that matter of fact that convincing signaled information will necessarily emerge. And in fact, overwhelming evidence from, among others, Jorion and Zang (2007, 2009) based on CDS spreads, Lang and Stulz (1992) on value-weighted portfolios and Collin-Dufresne et al. (2010) through credit spreads and flights-to-quality is that contagion can incur significant losses across concerned firms.

IV. PAST 'TOO BIG TO FAIL' BANKRUPTCIES

Past large bank failures might help us understand the nature of the systemic risk threat on the financial sector. However, banking supervision and regulation today is such that the only Too Big to Fail bank that was allowed to go bankrupt with no Federal protection of its uninsured creditors is Lehman Brothers in September of 2008. We will review literature on the failures of the Continental Illinois National Bank and the German Herstatt Bank. These banks were systemically important both through their size and their role on the financial markets. Reviewing empirical literature, we will be questioning whether they posed a systemic threat of a counterparty contagion and/or informational contagion. We will finally comment the events that took place during the fall of 2008 in the light of financial contagion theory.

A. Continental Illinois Bank

The failure of the Continental Illinois National Bank and Trust Company of Chicago (CINB) in May 1984 is an important case in the study of systemic risk. It is also the bank for which the expression "Too Big to Fail" was given an official use, when then Comptroller of the Currency C.T. Conover acknowledged that some banks were too important to let fail in a September 1984 congressional hearing. Upon news that it was in financial distress, the FDIC acted beyond its mandate to protect all uninsured creditors, together with the Fed, while maintaining the institution open and not completely wiping out its shareholders.

CINB was the seventh largest bank and largest correspondent bank in the country with 42.1 billion dollars in assets. According to the FDIC (1997, 1998) its losses were mostly a result of its engagement in poorly written oil and gas loans through Penn Square Bank, which failed in 1982, and loans to less-developed countries including the Mexico defaults of 1982, but also because 75% of its portfolio was financed by rate-sensitive debt. Prior to its bankruptcy in 1984, it had reported 2.3 billion in nonperforming loans, mostly attributable to its foreign loans.

Because it was primarily a commerce and industry lender, the largest in the country, it relied relatively little on deposits for funding but a lot on Federal funds and certificates of deposits, 16% of such large deposits were domestic and 40% were foreign according to Swary (1986). Congressional hearings revealed that 2,299 banks held deposits or had lent to CINB. Only 3 billion of its liabilities were insured. As such, it was particularly vulnerable to liquidity risk. A foreign depositor run, eventually withdrawing more than 6 billion dollars by the time the bankruptcy was initiated, prompted the Chicago Board of Trade Clearing Corporation to withdraw 50 million and led to a domestic depositor run. From January to May 1984, its total deposits decreased by 10.8 billion dollars. The day before the FDIC started negotiating for a resolution, the CINB had put together a funding package of 5 billion dollars from America's 16 largest banks.

It is still to this day one of the largest bankruptcy is US history. It is the perfect example of a SIFI failure. The "domino" theory was used as a justification by the FDIC for overstepping their statutes and effectively bailing out all creditors. But in the absence of the bailout, would there have been counterparty contagion?

Table 1
Banks with exposures to Continental Illinois National Bank greater than 50% of their capital

Amount of exposure relative to their capital	Number of banks					
	Expo-sure	Uninsured exposure	Banks with Federal funds exposures only	Recovery rate of 40%	Recovery rate of 70%	Recovery rate of 90%
>100%	66	65	21	27	6	0
Between 50% and 99%	113	101	31	56	22	2
Total	179	166	52	83	28	2

Source: US Congress, 1984.

Simulation runs on CINB's case were carried out in a report by the House Committee on Banking, Finance and Urban Affairs in 1984. The question was then to consider what would have happened if the FDIC had been restricted to its official mission of insuring deposits of $ 100 000 and less, about 1,325 of its 2,299 creditor banks.

The report first carried out the simulation of a negative return on investment of 60%, losses not only disproportionate to what is usually seen in cases of bank failures, but more than tenfold the actual losses suffered by Continental. According to these parameters, only 27 banks (or 1%) would have suffered losses greater than their capital, and 56 would have suffered losses greater than half of their capital. There is a small contagion effect, but stemmed from a rather unrealistic assumption.

The report then proceeds to a simulation assuming that the rate of loss of Continental was 10%, more than twice the actual rate, but already a much more realistic hypothesis. It follows that no bank would have gone immediately insolvent as a result of these losses, and only two banks would have suffered losses in excess of 50 percent of their capital. Since the actual losses to the creditors were less than 5%, no counterparty contagion would have prevailed.

On the other hand, we do have evidence of informational contagion. Swary (1986) studies the events following the CINB bankruptcy through abnormal returns and abnormal volumes of trading. His findings are such that the sub-sample of his study group exposed to risks similar to CINB (Latin-American debt) and in a state of questionable solvency did suffer higher abnormal losses and largely higher trade volumes. Since this reaction occurred after the announcement that all CINB creditors would be protected, and that this announcement was credible, the findings are consistent with the informational contagion theory. The failure of CINB likely revealed information on risks that CINB and Swary's sub-sample shared in common. Wall and Peterson (1990) study the same events, with increased attention to detailed time-line of announcements on Latin-American debt, and confirms that movements are better explained by other risks than counterparty losses from CINB's bankruptcy.

The empirical literature on CINB's failure provides evidence that there was no risk of counterparty contagion, but that some level of informational contagion has been involved. In any case, this informational effect does not seem to have been of such intensity as to alone spark a failure in the banking sector.

B. Bankhaus Herstatt

The case of bankruptcy of the German bank Herstatt in 1974 is so often cited as an example that it lent its name to describe the risk associated with foreign banking, and sometimes erroneously cited as an example of contagion. Indeed, Herring (2003) describes that following its initiation of bankruptcy by the German banking authorities many banks suffered losses. Beyond the fact that no other bank went insolvent as a result of this failure, and despite the similarity of this phenomenon with that of credit risk, most of the losses were caused not because the creditor banks was insolvent. They were rather attributable to how German authorities closed the bank and instated an automatic stay before the German bank fulfilled its part of foreign exchange transactions (for which the Herstatt Bank had the necessary liquidity), planned for New York's market closing time as reported by Eisenbeis (1995). Had German authorities waited for Herstatt to fulfill its part of the deal as programmed, the losses would have been borne by a different set of creditor, as a more traditional credit risk. Nowadays, this risk is centralized through international clearing houses. It would be wrong to describe this event as "financial contagion" of either sort because their causes were clearly attributable to the actions of the regulators, and probably not of deeper significance to the relation between banks.

C. Lehman Brothers

After the collapse of Lehman Brothers in 2008, many bank failures followed, which are generally thought to be the result of financial. Indeed, following Lehman Brothers' demise bank runs occurred, interbank lending froze and only resumed after intensive intervention by the Federal Reserve as described in Diamond and Rajan (2009a). Still, a brief reflection on the basis of simple evidence suggests that counterparty contagion is not responsible for the events of the last quarter on 2008.

The information revealed by the disclosure of Lehmann Brothers's 30 largest creditors as part of its Chapter 11 initiation of resolution suggests that banks did not expose themselves to Lehman Brothers for a large part of their capital. As outlined in Helwege (2010), of the 600 billion dollars in debt the largest creditor was Japanese bank Aozora for $ 463 million, a sum insufficient to threaten its capital by 7.4 billion.[4] It is unlikely that counterparty losses from the Lehman Brothers bankruptcy's very low recovery rates[5], or that cumulative losses due to Lehman and other financial bankruptcies, were the major culprit for the troubles of the last quarter of 2008 rather than losses related to the mortgage backed instruments.

Yet, after the collapse of Lehman Brothers in 2008 the market clearly became unstable. Brunnermeier (2009) offers a comprehensive overview of the financial crisis from the point of view of the liquidity problems. It does not rule out informational contagion, as a consequence of a reassessment crisis would definitely be tough borrowing conditions. It could very well be said that the Lehman Bankruptcy revealed information about the severity of the Subprime mortgage crisis that provoked a reassessment crisis. This scenario, however, would be difficult to test given that at the same time much else was going on. Not the least, AIG announced that it was in financial distress, followed by Washington Mutual, and later Citibank.

Another source of informational contagion could very well be that investors' expectations were shattered when it became apparent that Lehmann would not be saved from bankruptcy, while it had been the de facto rule up to that point. This could imply that the decline in market confidence is not so much due to the bankruptcy of Lehman, but to the expectation of bailout that the Fed and the FDIC had been building for years, and that finally did not materialize. Such a shock could very well trigger a reassessment crisis.

Nevertheless, both hypotheses are consistent with the theory of informational contagion. If it is the Lehman bankruptcy that influenced the market adversely, it is likely that it not only revealed information about the intensity of the subprime mortgage risks to which banks were exposed, but also some uncertainty about how bank failures would be dealt with.

V. CONCLUSION

Financial contagion is at the heart of the phenomenon known as systemic risk because it is through these mechanisms that a local shock is communicated to a larger number of firms and can threaten the proper functioning of the financial system. This dysfunction then influences the economy by reducing the influx of liquidity.

However, given the theoretical and empirical evidence, the overwhelming conclusion is that counterparty contagion is an unlikely threat. At its core is the assumption that banks are undiversified, a postulate so unlikely to be verified that it would be tempting to dismiss counterparty contagion altogether. Perhaps the threat of sovereign defaults in Europe, given the preferential treatment given to government securities by prudential regulation, will rehabilitate counterparty contagion theory. In the current state of theoretical and empirical advances, financial contagion from the failure of systemically important financial institutions should not be described by the dominos metaphor. Better metaphors for financial contagion would be illustrations of flights to security; an unexpected event surprised the market, and until market participants see more clearly they reduce their exposures. Metaphors based on "clogged plumbing", however, can still be considered valid because it focuses on liquidity problems excluded from the literature on financial contagion.

A policy implication of this research is that bailouts that seek to protect the creditors from counterparty losses do not prevent financial contagion, as it travels through information and not losses. Research bridging the gap between informational financial contagion and liquidity crises will be needed to provide significant operational and regulatory recommendations to financial contagion theories.

ENDNOTES

1. Results differ in the sense that while counterparty contagion is somewhat ~~been~~ ruled out in banking, it is still a likely scenario for non-financial large firms, especially in industries where firms are poorly diversified and where commercial credit can amount to a substantial amount of the counterparty's annual turnover. See Boissay (2006).
2. Other channels of financial contagion include common causes, liquidity shocks and fire sales. Common cause contagion encompasses everything from local shocks

from a subset of an industry (sometimes referred to as their 'fundamentals') to systematic shocks.

3. Other creditors' identities are masked behind trustees with larger claims, but since it is common to sell your claim to specialized funds in the advent of a bankruptcy, their numbers are thought to be greatly inflated.
4. The Chapter 11 modification filed by the debtors and trustees in January 2011 now aims at recovery rates varying between 11% and 22% for different categories of creditors.

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