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Financial Crises' Optimization*

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Abstract

This paper is about events where one or more banks face difficulty ruling over their short-term liabilities and perhaps fail. It is natural to think of these events as occurring where some agents have some benefits from creating the risk of these kinds of events, and perhaps do not bear all the societal costs. It is natural to think of these as inefficient outcomes, such as a straightforward way of thinking about that is coming from implicit bank guarantees, for example. What is surprising is that they may happen. This article is about challenging this view. The goal is to try to persuade the reader that there may be some, not just private values but judiciary values to set up a financial system that is subject to these kinds of events where multiple banks will fail at the same time and face difficulty ruling over their debt. In that sense, this article is not trying to convince someone that financial crises may have some efficiency problems. So, it leads very naturally to the question that has been studied already. And this article is going to try to contribute to the understanding of why individual banks per se find an optimal to finance themselves in a fragile way where they are subject to these inefficient terminations. And more generally, why might there be an optimal to have a system that is subject to these kinds of shocks? It is that kind of a question that is under discussion here in this article.

Keywords: optimal financial crises, banking system, bank solvency, information friction, Pareto improvement, renegotiation contract, optimal capital incentives

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Introduction to the Optimal Capital Structure in a Bank

The topic is motivated by an observation which is banks, and other financial institutions seem to rely very heavily on short-term debt to finance their assets. It is the debt that has to be reviewed or repaid in very short-time horizons. And very naturally this exposes them to roll over risk or possible events that resemble bankrupts, where they are officially terminated or liquidated in some way. These financial crises are pervasive. It is known from Reinhart and Rogoff, who said that that is a common occurrence in advanced economies (Reinhart, Rogoff, 2011). It is believed that there are important events in understanding that kind of large depressions in economic activity. Perhaps they played an important role in the most recent recession (Schenk, 2002).

Here is an attempt to develop a theory of the optimal capital structure of banks. And mechanically here is an idea about this as a large number of depositors who have to finance an investment project which offered by a bank. And it will be run by a bank manager or a banker. And these depositors are going to have to design compensation contracts to provide the banker with incentives. In some sense, there must be a resolution to some agency friction within this bank (Lin, Sun, Jiang, 2009). The key result of the research is that one optimal capital structure is fragile. Specifically, there will be events when banks earn low returns, and which bank will be inefficiently terminated or liquidated. This situation resembles a bank run. These depositors will be giving up future profits from a continuing operation, but they are going to

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try to find a way to commit to this kind of inefficiency (Chen, Milesi-Ferretti, Tressel, 2012).

In particular, it is shown that implementing this fragile capital structure necessarily requires contracts that resemble short-term debt. In that way, the short-term debt will be essential for a fragile capital structure. We will see the role that short-term debt will play. These first three bullet points are really in a model with a single bank, in a single group of depositors. And it is clear in this model what happens in a banking system with multiple banks. This model will imply that systemic crises are optimal, in a sense that economic agents are all better off when all banks face difficulty at the same time (Legg, Harris, 2009).

There is also a bit of a flavour of these results before getting into the model. Let us start with thinking about the mechanism with a single bank. And here is an idea by Colliners and Kon and Diamond Roger, where bank runs, or a threat of bank runs can be a useful discipline device in resolving agency frictions. When you think about these depositors designing compensation schemes for the banker, and in a world with their full commitment to long-term stay-contingent contracts providing incentives will require them to commit to ex-post inefficient liquidations. That will be optimal for them; this will be the optimal way for them to provide incentives to the banker (Dorrucci, McKay, 2011).

It introduces a natural time and consistency problem. When they get to a day where they are trying to commit to these ex-post inefficient liquidation, given the opportunity to renegotiate and reap off the contract, they would love to do so. So, in a world with limited commitment, the optimal contracts would have no ex-post inefficiencies, but, of course, they will provide worse incentives to the banker. So, there's going to be a cost of limited commitment in this environment (Gourinchas, Obstfeld, 2012).

What is argued here is when there is a limited commitment with additional private information friction, depositors are subject to private discount factor shocks. They can attain their commitment outcomes. They can effectively get around the limited commitment constraint. To replicate commitment, to get around it, they will have to use contracts that resemble short-term debt (Jordà, Schularick, Taylor, 2011).

And the idea here is they are going to create something that resembles a public goods problem. At time zero, they are going to choose contracts at such a time run when they would want to renegotiate. The renegotiation problem will be very difficult. Short-term debt and private information will make it very hard for them, even if they coordinate, renegotiate and rollover their debt. And that will let them get back to kind of the first bullet point, i.e. the commitment outcomes where they are providing optimal incentives with these ex-post inefficiencies (Lane, Milesi-Ferretti, 2011).

So, the whole game is how to obtain the commitment and how it translates to a world with multiple banks. What does it say about the financial system? There must be a consensus about the world where the returns are independent across banks. It is a one-bank model to replicate. And the banks are effectively completely separate. What can be seen is that short-term debt will no longer entail its commitment to outcomes. And a simple way to think about that is that if there is a rich bank and a poor bank, and they receive independent shocks, for commitment reasons the central bank will still like to liquidate the poor bank, the bank that earns low returns, but now the depositors of both banks can get together and kind of share the future returns in their current resources and make themselves better off by financing both of the banks. With independent returns, they are no longer going to face the same renegotiation problems in a world of limited commitment. Though there must be a way to continue both banks, that is going to worsen incentives of the banker and yield worse outcomes. How to get around this?

If returns are correlated across banks, and one bank is doing poorly, the other bank is doing poorly as well. A client might face the same hard renegotiation problems he/she will meet with the single bank. And that is what it is argued here. What this means is an obvious strict preference to live in an economy where returns across banks are perfectly correlated. The optimal financial system will feature banks that earn perfectly correlated returns. When both banks are in high returns, the system looks fine. Everything gets ruled over. Banks continue their projects (Ostry, 2012).

When both banks are in low returns, they will end up liquidating all of their business. The systemic risk here is going to come from X-any investment choices, and it will be optimal. The value of having this financial system subject to systemic

crises comes from obtaining a commitment to provide optimal incentives to bank managers. Mechanically, it can be seen the problem is going to be solved in a mechanism-design framework. A planner subject to the same constraints is the depositor, so to speak. It will not be able to improve its outcomes, and thus, this will be a financial system with systemic crises that are going to be efficient (Lee, Rhee, 2012).

Single-bank Model of Optimal Bank Capital Structure

Let us again start with the single-bank model and a large group of depositors. And effectively, what the researchers try to show here is those few results. And in a full commitment, it is possible to liquidate the bank after low output is realized. With limited commitment, a bank will face a timing consistency problem. With a limited commitment in private information, it can somehow get around that. The key ingredients in the model include, first of all, one that must be paid attention to. It is just a repeated moral hazard environment by Alan Holmstrom. Here it should be thought of a banker who has to exert some unobservable effort. And this effort will affect the distribution of future returns to the bank (Pisani-Ferry, Sapir, 2010).

The crucial thing of all this will be a constraint on what kind of contracts that can be written down, which will be limited commitment. And there will be a version of renegotiation improvements. And then the last element which is also very important is this kind of classic moral hazard problem, something that makes this look like a Diamond–Dibbing bank.

This project will be financed by a large group of depositors, each subject to idiosyncratic and private discount factor shocks. They will affect how much they enjoy the future. And so, this friction means a kind of contracts that will have to satisfy incentive constraint which induces these depositors to report their types truthfully. These discount factor shocks are truthful. So, those are the three key ingredients in this model. The model itself is fairly compact.

Writing down contracts is where things get complicated. So, let us try to focus on what are the key things in this model, and then there will be a few words on the results. We have got A+ agents. This is the easiest way to think of this. We shall call the first N of them depositors because it is known at the end that they are going to look like short-term debt depositors and set of investors. And there will be the N+ banker. That is a three-period model, dates zero, one and two. Although it is believed the model generalizes that an arbitrary number of periods, there is production technology here. Investment in period zero is I, the one that will require a fixed scale of resources I. We can also talk afterwards about the importance of that assumption, and investment will also require an effort of the banker (Robleh, Haldane, Nahai-Williamson, 2012).

So, how do investment and effort turn into future output? All efforts denote is that we want to think of the banker just directly choosing a probability over future outcomes. It can be a low probability π_o or low probability π_h. Manager suffers, or the banker suffers disutility of effort denoted by q. So, we will set the cost so to speak of the high effort for the banker q (bar) and the cost of low effort all normalized to zero. And so, let us start in time zero. If I resources are put into this production technology, and the banker exerts effort e_0, then in period 1 the output is $i+y_1$, where y_1 is stochastic. And y_1 is high, y_h with probability e_0 and at 0 with probability $(1 — e_0)$. So, if the banker exerts high effort, he/she will likely get high output. The banker is likely to get high output. In this example, all the risk is over the net output. So, the crucial thing that is worth remembering for later here is getting lower output, whereas aggregate resources are still I. A bank under consideration has just enough funds to finance the project to gain the kind of a client wants to choose. If reinvestment is required in period 1, it is necessary to put I in again, and the manager's effort would be e_1. And when we get (i+a), this, in turn, depends on period 1, which is an output for moments to be supposed at zero. That means the result of $(i+z_2)$. So, it is exactly a repeated version of this game.

What is worth introducing here is a bit of persistence into these projects. One condition which is unseen here is high output projects that look a little bit better than conditional hidden low output. Let us introduce that persistence is not dependent on the previous effort level of the banker. This period 2 has a moral hazard problem. The only role it is playing is conditioning continuation utilities of the banker and nothing else. It could be almost ignored. All of the action is going to

depend on how the banker is to exert high effort in period 0. And the concern here is about outcomes in period 1. That is the situation focus on in this moral hazard problem. Just to finish roughly the model it is worth thinking of this as having a large number of small depositors.

What is meant by small? Each of the depositors is initially endowed with I over N resources. So, at time zero all of them will need to know that they are willing to participate in financing this project. And though they have nothing in periods 1 and 2, in terms of preferences this banker has linear preferences over consumption streams c_0, c_1, c_2. Then the disutility of effort again is indexed by q. And this banker discounts last period utility or consumption which is rated later. In terms of the depositors, they again have linear consumption. And in period 1 they will learn their discount factor shock is v_i, again in period 1 they will know how much they discount is period 2 consumption. It should be assumed this v_i-s is independent across depositors. They are distributed according to some distribution G_i which will be identical.

The support is actually critical here. They go from some range v (lower bar) to v (upper bar). The most impatient depositor v (lower bar) is critical. What also should be assumed is with all the linearity after pinned on the timing the payments between the banker and the block of depositors are to be pinned down, which means that the banker is more impatient than the most impatient depositor.

These counter shocks are private. For notational v there is just the vector of all discount factor shocks across the agents. And then there is a limited liability constraint. For the depositors, this is important. That means that each depositor is small. They cannot bring in the outside resources. For the banker, this is also important, because it is a limited liability constraint. It will even say something about continuation utility of the banker. That is the content of that assumption.

So, that is the model in three periods. It is essential to think about designing optimal compensation schemes for the banker and the optimal payments between all of the depositors. The analysis should be focused on direct mechanisms. It is important to think about an investment contract. What is a long term investment contract? It is just specifying recommended effort levels of the banker, transfers out of the returning remaining resources to the banker and all of the depositors and the continuation rule. Should the project be continued in period 1? All of these functions are in real history and realisations of the stochastic shocks Y. This is simplified a bit relative to the research so that here there is no answer on notations in the model. But it should be clear that a p_t^i is a payment to depositor I. What is meant to say is they can only make payments in period 1 conditional on Y_1.

It is because they paid before they realised their discount factor shocks. It will be a result that the optimal contract has that feature. So, it is not incorrect to abstract from being able to make payments after they were included in their discount factor shocks. And then payments in period 2 the depositor again is a function of the output history, and the whole vector of the discount vector shocks is v, which says that the project must be continued.

There are, of course, payments to the banker that are similar. And then there is a continuation rule — here it depends on the discount factors, but again that is not critical in terms of the optimal long-term investment contract and recommended effort. So, it needs a work-through. The results in characterising the optimal contract are got by slowly bringing in additional friction. It should be started with full commitment and full information of the depositors' types. There is the optimal contract which is maximising X-any depositor's welfare subject to these constraints.

There are resource constraints, non-negativity constraints and the banker's incentive constraints. The goal is to show why it is optimal to liquidate this project inefficiently after a low output. This shows up in lots of optimal contracts. Optimal provision of X-any incentives requires ex-post inefficiencies. It should be governed by the intuition here. What is the idea behind all this? As in most moral hazard problems, there is a spread in the utility of the banker in period one following high and low output to provide the banker incentives to exert effort in period zero.

There are two ways to create a spread. The payment could just be changed to the banker in period one or the continuation utility to the banker could be changed in period one. As it is a dynamic model, the project continues in period one, or the mechanism calls for continuation from one to two periods. The banker has to get strictly

positive utility in continuation. That is effectively the incentive rent the banker is getting from the combination of moral hazard and limited liability (Rousseau, Wachtel, 2011).

Any continuation contract yields strictly positive continuation utility to the banker. What this means that if it is a promise, or the mechanism promises to liquidate after low outputs have been realised, the banker can be deprived of that continuation utility (The Economist, 2009). More spreads could be effectively created this way. Stricter punishments are exerted by promising or committing to liquidate the project. That could be beneficial in relaxing the incentive constraints. That means the banker could be paid less after a high output has been realised.

It should be assumed that this promise to liquidate this is costly in a sense that it is ex-post inefficient. Knowing all of the depositors' discounter factors, it could be strictly better for depositors and the banker to continue the project. This promise must be somehow committed to. One problem is that it can be optimal when this promise to liquidate relaxing incentives dominates the cost associated with foregone profits from the project. It is when the moral hazards are severe.

Optimal Renegotiation Contracts

Going forward, what happens in this state is to realise low output in the optimal contract which should be liquidated repaying out whatever is left, which is I in that state. Paying the banker nothing, I must paid out over each of the depositors. It is as if anyone starts period one exactly like in period zero. But now, they all are going to have these private discount factor shocks. They look different. What happens if a limited enforcement constraint is added? This is the constraint not to renegotiate the contract in period one. Mechanically, after they learn discount factors, let them renegotiate. So, renegotiated contracts have to satisfy some constraints.

The resource constraints, non-negativity constraints again have to provide the banker incentives to exert effort. And the investment contract is enforceable if all parties cannot gain from renegotiation. In the paper, this is a bit more saddle because there are richer sets of contracts in the market, but it must be thought of as whether there is an operating improvement or not. Not surprisingly, under an assumption that liquidations are ex-post inefficient, the commitment outcomes are not enforceable. It would just be renegotiated that away. And this is the classic time and consistency problem. Strictly speaking, this model is worse off in a world without commitment. Why does adding private information fixe this somehow? We have additional constraints. After these depositors are included in the report, their type is truthful. And here is one more important question to ask: Could anyone actually enforce a liquidation contract? There is low output.

Can anyone design a renegotiation contract that gets all to participate and roll over a debt so to speak? What do renegotiation contracts have to satisfy? There should be picked an arbitrary one: X-hat and P-hat. So, someone is going to roll over some probability X-hat. There happens a pay-out according to the reports of the type p-hat. These renegotiation contracts have to satisfy the incentive constraint of the depositors. They have to be Pareto improved, and they have to be resource-feasible. The total payments in period two have to be less than what can be earned, the net of what could be paid to the banker.

What is the incentive constraint? This top line is what a depositor gets in expectation if they report their type v_i truthfully. The bottom line is what they get if they misreport and report at different discount factor v-hat. They are taking an expectation over the other depositors' truthful reports. Now, what do they get? With probability X the depositor continues to get p_2 which he discounts at v_i. With (1-X) he gets a status quo I over N. If he lies, what does he affect? He affects the probability that the project continues, and he affects the payments he receives. What is Pareto Improvement? Itis this top line which is bigger than equal to I over N. So, there's a constraint there. The incentives have to be satisfied. These Pareto improvement constraints in the resource constraints are in any renegotiated contract.

So, now, it is the heart of the paper in terms of the single-bank model. The time can be resolved and consistency problem as well in this setting. For example, suppose a depositor of the most impatient type is sufficiently impatient affectively. Then for N there is sufficiently large incentive feasible renegotiation contracts. The set of all possible renegotiation contracts is considered to converge to the set with the probability of continuations going to zero. What it is saying is when

N is large, it is difficult to construct mechanisms which satisfy the constraints which get ever into agreed and put them I over N back in this project and role over the bank. Mechanically one is applying the results that came out of a theory on the literature on public goods provision from Robin, Mailath and Postlewaite. So, this debt role over a problem is looking like a public goods problem.

It is not a rule over the problem. They are allowed to coordinate and design the best renegotiation contract, and the outcome is they do not roll over anything as N gets large. The consequence of this is that they resolve the time and consistency. This is all said of renegotiation contracts that do not have to be rolled over the project. So, the project can effectively be committed to liquidation. How does this result work mechanically? What is the economics behind all this? It is assumed that the most impatient type would not want to participate, given a Pareto share. Suppose, the returns to the bank are just split up in period two evenly. What is assumed here again is that the most impatient type would not put up their I over N for just a Pareto share? But this most impatient type should be motivated to participate. How is it done? There is a larger share of future returns than ever and anything else. But now, concerning the incentives of patient types, by misreporting or underreporting their type, they can get a larger share of the future returns. There is also a private benefit which is really their incentive rent. What is the cost? They might lower the probability the banks rollover. If they stay all impatient, the mechanism is going to run all over again, because it would be inefficient in that state. So, there is a trade-off for a fixed N.

A larger share of future returns can also be generated, but there might be a lower probability of the roll-over. Now, as N gets large, the probability or pivotal are converging to zero, the effect on the probability of roll-over is disappearing. But this positive gain can always be captured off-line, and this is going to misreport the type. So, because their benefits do not go to zero, the renegotiation contracts cannot be constructed. In that sense, when N is sufficiently large, liquidation is actually time consistent. But of course, it is ex-post inefficient by assumption. Under full information, this is known to be a bad outcome. And that is why it must be said that these events resemble runs or panics.

A planner looking at this world or a government will say, "I know I can make you all better off if we can just roll over." It looks kind of crazy the way a sun's bet type banker does. But it is much more severe in terms of a coordination problem. It is worth introducing these ex-post public goods problems, actually resolving the time and consistency problem that is faced under full information. This optimal contract does resemble short-term debt. These depositors put I over N (I/N) in period 0. They get a right to effectively withdraw I/N in period 1. And if not enough of them agree the bank is liquidated. Now, in this talk, it is quite good to consider a much richer contract base where there is a choice when to give out of these rates, and when not to give out these rates. And it must be shown that contracts that do not give depositors the right to demand I/N in period 1, they do not commit to liquidate the bank.

Effectively, if there are more slack participation constraints in the renegotiation problem, the liquidation is renegotiated right away. These contracts provide worse incentives than short-term debt does, and it is sensible to argue these contracts resemble long-term debt. That is the result of the model. It is worth thinking of them as just saying the depositors are going to leave all the money in the firm, knowing that it is the individual right to withdraw something which is promised to liquidate, but when someone gets there, they know they can all be made better off. And it is possible to design better contracts and do so. This is the sense in which short-term debt is not only sufficient but also possibly necessary. Release contracts will give out the same rights in short-term debt or if that is necessary (Kose, Prasad, Rogoff, Wie, 2009).

The Multi-bank Model of Optimal Capital Structure

So far, that is all about one bank. And these claims have been made that crises are efficient. And crises or in a model, there are all the values of how the commitment has been gotten to provide optimal incentives. So, let us see how it works in a model with multiple banks. What should be done here is compare two stark economies. The first is going to be a replica of all that was just seen. Think about 2N banks and two N depositors. And they are completely independent. Income across banks is uncorrelated, and

individual banker's effort only affects a return at their own bank. And if that kind of an economy is considered for a minute, it is as if there are two separable problems. In all the commitment outcomes, any bank to be liquidated when they earn low output, or they are going to be the same. And it is necessary to compare that to an outcome where returns have perfectly correlated the risk in returns increases. Two things are going to be changed here: correlated risk across banks and risk in the returns. And they both play an important role. Formerly what was done, when there were correlated risk and effort, banks might be worried about moral hazard in terms of type problems. And actually, it is worth abstracting away from all that with the production structure.

What needs to be assumed is the probability that both banks realise the same income in one of these two economies. Either both banks get higher, both banks get low. It has been said that there is an increase in risk. What should be kept in mind is low output for a single bank in a perfectly correlated economy that will now be negative instead of zero. And the high output will be higher than it was in the replica economy. And then what is the probability of either bank that has a high output, it is good to assume it is the minimum of the efforts of the two bankers.

This production structure so to speak means a banker has to provide the same incentives, or a planner has to provide the same incentives to an individual banker, to both of them, because they have to make something to exert effort. What that means is under full commitment a planner would be completely indifferent between these two cases. There are no incentive benefits from using a correlation structure in the production structure, in the production function to get the advantage of the incentive constraints. What should be argued is the limited commitment economy which implies that there is a strict preference for the correlated risky return economy.

Agents are all the better off when they live in a perfectly correlated world versus the independent world. And in that sense that will imply the optimality of crises. What is the basic idea behind all this? Here is an example of an independent case. And there are really two problems here. There must be an enforced liquidation for either bank when they earn low returns. The first problem is simple. Suppose both banks get low outputs. That means both banks are to be liquidated. What are the aggregate resources when both banks earn low output? They have 2I resources. And what should be claimed here is it is possible to make at least N depositors better off by continuing one of the banks. What should be done effectively is take the N most patient depositors and, say, give enough resources to roll over one bank. So, depositors should be coordinated in one of the banks. When can that be done? As long as the medium depositor is happy to take a Pareto share for one bank, then N is sufficiently large to just call out Vilfredo Pareto shares that the banks will get N people to sign them (Kiyotaki, Wright, 1989). If there is a banker who contemplates whether he/she shall exert high or low effort, if they exert low effort, they are likely to get low output. And the other banker is assumed to exert high effort to get high output. But if they both get low output, that is okay with the probability of a half they are going to coordinate and rollover. So, the incentives are stricter there. Increasing the riskiness of returns can fix that. Suppose when they both are in low output, there is only I-resources left. The only I-resources that are needed to all 2N depositors to finance even a single bank, and then a public goods problem shows up again. So, it is impossible to roll over even a single bank if there is an increase in risk. It is, of course, a preliminary result. What happens when there are high and low outputs? So, say, bank A earns high returns and bank B earns low returns. It is argued now that 2N depositors, all of the depositors can be made better off with the private information by continuing both banks. And the idea now is they both have more resources because they got the high amount of resources from bank A that did well, although you have low resources from bank B. So, you can combine all of those, but you can also share the future returns. It is as if these two banks can aggregated.

And if there is enough surplus, and in some sense, the average depositors are very different from the most patient one, that will Pareto improve. So, even with these constraints if there are independent returns, this commitment to liquidate can be renegotiated away. Correlation can result in that time consistency. Those states of the world should just be eliminated by having them taken any correlated risk. And this is a

proposition when returns are perfectly correlated and sufficiently risky. Commitment outcomes can once again be attained with short-term debt. While there are strictly higher and perfectly correlated banks, this happens because obviously there is no real insurance motive here. So, it suggests it is robust, introducing some insurance motive. And just to be clear, there must be kind of the equilibrium outcome in that world of the optimal contracts as when all banks earn low returns they are all liquidated.

So, this optimal financial system features *'systemic crises'*. In conclusion, it must be said that there is a model which was developed in conditions under which a fragile capital structure of debts is not only privately but socially optimal. Along the equilibrium path, bank runs do actually occur, along with the equilibrium path of the optimal contract. The short-term debt is essential to allowing a commitment to these exposed inefficient runs as they are called in the model. And that long-term debt or equity may not attain that same level. And lastly, the same limited commitment frictions imply correlated risky outcomes in the financial sector or the financial sector is going to be subject to systemic crises and may be efficient.

It must be argued, though, that there is a little bit bias in the idea that these things are of a commitment device. It was never thought of that systemic crises could be a good thing before this model was developed. However, there are a lot of questions to be asked here. So, financial crises are part of the ex-ante optimum. It is just like Franklin Allen and Douglas Gale who have a paper that argues something like this. This goes a little bit further. A short-debt commitment device is on board for that one. And through a slightly different mechanism, it must be said about the different staff. It is a totally new part of the paper.

The systemic, the system-wide, systemic crises are important to implement under efficient allocation. The highly correlated risks lead to systemic-wide crises which are a good thing ex-ante. It must be taken a while, taken till the very end of the discussion to talk about exactly how that gets into the model because it must be understood what is going on along the way first. These are all of the good things. This is why short-term debt is used here, and things like that. And so, this is a model where the only role that the short-term debt and financial crises have is that this commitment device provides the punishment. And there is nothing really too bad about them. They just provide an efficient punishment, and financial crises are nothing, they are ex-post inefficient, but they are not that bad. So, there is long-term debt or equity because there is no unanimous consent about what happens simultaneously. There should be some time for renegotiation. They are prone to do ex-post efficient things which people in the banking industry do not like.

Once it is clear that there is a world where things are exposed in an efficient way, that takes commitment away, and the time consistency of the punishment goes away. And then, effort incentives are reduced. So, this is obviously related to the staff that is done on runs as a commitment device. But it also strikes one that it is really close to a paper that essentially makes the same point in a different setting. It is the paper by Chari and Kehoe *Bail-outs, time consistency and optimal regulation*. It is not exactly the same model. They have a model there where there are right private contracts. It is like towns and crosses stated for a vacation that can be essentially committed to having the court inefficiently intervene and verify the state and then give essentially a zero continuation to the agent. And that private contract which does not have to be short-term in their model is what short-term debt is here. And then they have this thing called the government who likes to do bail-outs. And they cannot stand things that are ex-post inefficient, so they step because of limited commitment at the government level. They step in and provide the bailout. And so, this model is almost the same model, but it has a different name.

It is worth thinking about the possibility that there might be a government in this model that could cause some problems for this story. The basic idea of the model is a very nice job presenting it. It is worth going through it again, just so that there can be a focus on the part that is quite important here. There is a standard moral hazard effort problem, and the optimal contract imposes a zero pay-off after a poor performance in a two-state three-day model. There must be inefficient liquidation after a poor performance in its middle state because it is good to keep the agent around for incentive purposes. The agent should be given a rent in that continuation. So,

even though the agent is kept ex-post around, if it is known he/she is going to get there rent, punishment is like not so bad because they keep getting profits. They do not get a ten million dollar bonus, but they get a five million dollar bonus. So, early liquidation again at the middle date is not in the ex-post interest of the principles. The lenders require some commitment. So, how does this mechanism work?

What can be seen here is a contract that requires the unanimous consent of all of the lenders. In the US, there is a law on bonds called the Federal Trust Indenture Act that says if the issuer is going to change principle interest to maturity in a bond, they do need unanimous consent. It is not a crazy thing. And the lenders are ex-post heterogeneous in their impatience. So, some people get preference shocks; some do not. And they vary in their intensity. The ability to misreport that they are highly impatient, and launch their money today is the way they get the commitment in here. And the way it actually works here is through something that can be called an aggregate liquidity shortage. There is nobody around that that has funds to inject to the outside of the original set of the depositors. There is no specificity of assets or relationship. There must be somebody to inject the money to implement a supplement that is ex-post efficient. They would be able to do it, and the whole goal of designing a contract is to make sure there is nobody out there on the outside who is sufficiently patient, who can inject this money. That is the particular reason that systemic financial crises are good because everybody will be broken in the end. So, they are to be liquidated.

Unanimous consent in this assumption that impatience is private information leads to a problem that is very standard in sort of the bank work-out of bankruptcy, work-out of debt-default outside the bankruptcy; the thing called the hold-out problem that the people who hold out sometimes do better than the people who make concessions. If someone of punishes them, if someone rewards the people for holding out, then they will hold out. Holding out here is essentially misreporting the impatience as high. And it is important; there are actually no runs in this research. This is just simultaneous, the people report about their impatience, and then if enough people report that they are impatient, the government goes ahead and liquidates. So, there are people who implement runs or implement the commitment of short-term debt which is done through something where there is either some lottery simulation or no simulation, either a lottery or literal real-time first come, first served, which rewards the people who report that they want to get paid. There are multiple equilibria, things like that, all kinds of bad stuff happens sometimes. Here nothing really bad happens. There is nearly no rollover risk. There is something which is like rollover risk, and it is worth thinking this has the good but not the bad side of commitment here.

The Outcomes of Debt Contracts Providing Optimal Capital Incentives

Whatever one says something is optimal, it does not really matter since nobody knows when a bank is supposed to be closed down. It is a similar kind of wanting to commit to close the bank down. Nobody knows. It is not verifiable, but if someone sets up first a runnable deposit, when the time comes to close the bank, people will run to the bank, and then it can be found out it is time to close them down. This story can be believed. But there is still something good about these runs, these crises, and if something bad happens to the bank, and the people need to know something, they learn something that they would not learn otherwise.

The basics of the model here is that debt contracts provide optimal incentives. This is a non-robust part of the model, because there are two realizations to the state or nature. It can be seen if there are more than two realizations; there is nobody to get debt contracts. And there is a lot of evidence in that model in the paper comparing the capital structure of firms with banks. Firms do not issue much; corporations do not issue much short-term debt; banks do. It is still needed to see whether this model can explain that. The results are interesting. There are several papers on the subject. In one of them effectively, loans are hard to collect financial assets. There is an ex-post hold-up problem because only the banker can collect the asset. So, people need to commit the banker not to renegotiate down the loan. If then there is the threat of a run, they ask first come, first served, but it could be done exactly the way they did it, committing the banker not to do that (Financial Times, 2011). The other paper published

in 2004, which takes that mechanism to a corporate setting. And then there is no liquidation, but there is a commitment device called a court, that if someone goes to court and says, they defaulted on one's contract, now they the right to liquidate. The court is a commitment device.

The commitment problem is getting the depositors to report to the court that now is the time they want liquidation. And the first come first served element of this thing basically builds in commitment to do that. So, in this sense, neither of these things explicitly do this as a mechanism design problem. There is built in this institutional thing called court here or called first come, first served which present both of them. And that becomes a little bit messy here. It is as if there are very clean and no distracting details. Standard effort problem under the staff of the bank means loan specificity. It can be seen on a very clean basis that this is really what the stuff is about. It is trying to commit to preventing something here from happening. Here it is shocking, followed by renegotiation continuation. It is an interesting and different take on this kind of stuff.

There are two points of view. One, from the financial intermediation banking literature point of view, the banking set of ideas, and second, from corporate finance. From the point of view of banking, there is really under the banking model, because there are no firms in this. That is the last thing people think it is hard to be a banker and easier to be an entrepreneur. There is an effort problem here. That this does not much explain the difference between them. In fact, this should be treated as saying if someone looked at this evidence that that does not seem to apply to firms unless they would think well, the banks would diversify. They are the only ones which could have just systematic or systemic risk in them. They could say they should better have conglomerates then or something like that. So, really, what is missing in this — if someone is really going to take this seriously about banks, about systems like financial crises is thinking about the difference between firms and banks, and then from just as a minor little detail, from the corporate finance point of view, debt contracts are not the optimal way to provide an incentive to a risk-neutral agent.

Basically, what is the general point? The regulators want to punish low outcomes and reward high outcomes. But that is not debt contracts. They give everything to the principle for low outcomes, and they give everything to the agent for high outcomes, and that has a jump in it. And then it makes the principle's contract not monitor, and because of the jump. So, that is not a big deal. But in any case in some sense, the way this is set up to deliver short-term debt as opposed to short-term weird staff requires two outcomes.

Let us get back to the key thing here. What is giving the people the commitment here? It is the key element of the model. So, again, it is what is called the aggregate liquidity shortage. The inability for any outsider to inject funds to buy assets of the banker or deposit in the bank to remove the need for unanimous consent to continue in the bad state. It, in a certain sense, requires that there is the only bank in the world, or this is the whole financial system. That is sort of a reason that this thing pushes to start thinking about system-wide crises. If there is one particular bank failing, one tiny little bank failing, probably there would be plenty of patient people out there who would be willing to pick up these assets at, below, utter below their fair market value, if it is efficient to continue them, they will continue them here. So, whether this sort of aggregate budget constraint is the right way to motivate the stuff is very suspicious.

The way this thing works like again all banks are in trouble, and the losses are huge, that is an important thing, their end losses are huge, the people see how that is coming in. There is nobody else to lend to any bank, and this provides commitment. Perfectly correlated risks are good because it makes it more likely to get into this sort of circumstance where they cannot afford to say even one bank. Then if the regulators can commit banks to take actions that are either all good or all like this, that will prevent from shocking. If only a few banks were in trouble, obviously this would not happen.

What about the details of how it gets modelled? So, what is the case that all of the banks in the world that everybody is in deep trouble, that is exactly the time they would think the government is going to step in. So, there is no president in this model because there is nothing particularly bad that everybody is in trouble versus one bank in trouble. They are just doing this. Everybody is risk-neutral here. They are just doing this inefficient liquidation several times over. And it is all linear

utility, so it is done once, but they do it twice. It is like twice as bad if someone does it two times.

So, if someone believes that maybe it is actually not great to liquidate the entire financial system as a whole and there might be bigger costs, in that sense if there is no financial system at all, then it is not even obvious that if everything else were right, that if there is a government, the banks could commit to doing this because there is going to be exactly one government that would come in.

What can be done to commit the government to not intervene in this case? Things might play differently. And lender of last resort is a very bad idea because systemic crises are exactly what the central bank wants to make sure that other banks have (Sachs, 1995). But nobody thinks like this. This is like there are people who say while the only reason they have so many financial crises is because of anticipated bailouts. And the reason that Lehman did these things because they knew that they are going to get bailed out. Well, clearly they did not get bailed out. They somewhat made a mistake there. But this would be a micro-foundation for this view that financial crises and bad stuff are caused by anticipated bail-outs. And if they just knew the punishment would be so bad, the banks would work hard, and this would not happen very often.

There is the last comment to make here. It is definitely worth thinking. It is definitely empirically possible, possibly true, and it is a really interesting idea. But the way that the result that systemic crises are good in this model, there are complications with this. What is the basic idea? Suppose there are one or two projects that are doing well, then the banks are randomly going to continue one of them. That is not good. And when they both do poorly in the original set-up in the model, then if both do poorly that is fine. They continue one of them. But if losses were bigger, then depositors are let both fail. It is not when they are going to more correlated risks and less correlated risks; they do not just change in the correlation, they are saying, if they choose the more correlated risk, the loss per project is bigger.

Then if the banks can get it so, the maximum loss per project is so big that they cannot afford to continue even one of them, then they get this commitment to let the stuff go on. There are situations when that is true, and when it is not true. It is not positive if the model can be changed a little bit, just having lots of projects that would otherwise be of the same scale of losses if the banks just made them all good down at the same time. It can be believed it could be very hard to refinance them all. So, this is needed. So, this paper, all of a sudden, gets way less general than everything else.

The other thing is one can just think about this in terms of implementation. The banks would each prefer to have independent projects. So, if they happen to do poorly, they get refinanced and do not get punished. This is exactly the opposite of the stuff that is an interest rate, illiquidity interest rate policy paper (People's Bank of China, 2014). In both of those papers if a lot of people get in trouble, then they get bailed out. Therefore they want to take correlated risks. This is sort of the opposite because if everybody gets in trouble, you are not going to get bailed out, then they want to take independent risks. If there is also in addition an effort choice, they could privately choose the correlation. This would not decentralise because the last thing they want to do is be in trouble when they get punished for getting in trouble. This is the point that could be addressed, as well. So, overall, a bunch of very interesting and new ideas are in here. Without further development or thinking about the type of data to look at or to see if these were relevant or not. They can be trustworthy. They are very creative.

The main point of the systemic crisis issue is understanding if it is really a response to a lot of people who view this all as a result of bad government policy, who think if people could just somehow commit the government not to act, they would not see these outcomes, which even just thinking about banking history it seems it is hard to think many earlier episodes, they are all predicting implicit bail-outs to the national government, and people still see systemic crises. There are efficiency properties here. They can be taken seriously in the same way as saying, it is hard to say that because there are no external costs to these crises, nothing else is going on. There are still losses. They are giving up future values. It is not like everything is free to shut down these banks, and those costs can be significant. People still choose them as long as these events are rare enough. It is hesitant to say the losses are peanuts, but it also suggests there are forces pushing these banks to do this independent, which

is a bad policy in the view of some people. And that is relevant here.

Understanding that at least the banking system's incentives go in this direction, what would they do in an equilibrium gain if they choose their projects? It is absolutely right. It is quite clear which mechanism is better. And there is an agreement depending on how the modelling goes. It is fairly certain that there could be a model where they also choose correlated risks. It is not obvious, but they can privately choose these projects and knew then all that is better off. But there is sure this project selection — correlated or not correlated. They are observable; then the banks can write down a standard game form and equilibrium as they choose a correlated risk outcome. It is positive that can be expanded on, but it is right that some of these results are coming in, and they can be figured out.

In terms of debt being sensitive to just two states, it is absolutely right. That is a point taken. As can be seen, the model is a complicated mess already. And so, the idea is that maybe literally debt is probably too severe. And as might be said, the idea is to allocate the right to ensure commitment. How is it done that is going to be sensitive to the environment, this can be trustworthy in terms of the aggregate liquidity shortage (Sales, Barroso, 2012). In some sense, it was the whole purpose of writing a model with multiple banks. And that led to these ideas. It is the first path to think of that as just having Warren Buffett in the model in period one. There is someone with deep pockets. And this comes back to the assumption of a fixed scale in terms of the project.

The question is, how many people can be brought in, and how patient are they? If there is an approximation of this fixed scale with a come's back production function, then it is a horse race between how fast the returns are going up, and how many impatient types there are to pull in. In that sense, there is the model it that way. The results would go through. It is just different assumptions in terms of having the most impatient person not to value it or the medium person. It is meant by saying to get into the order statistics of it, and as a theoretical point it is robust in that case, but it becomes messier (People's Bank of China, 2012b). It would not be interesting to take this data on how patient people are, and what is their wealth in these different events. It can be thought of as helping people think about what is driving these crises. Can it be really believed that there is a loss in wealth in those states? That is a useful suggestion on those margins. Dealing with internalising effects of policy what happens in the private sector, and clearly, there is no role for policy here (People's Bank of China, 2012a). Almost in some sense, this is because that is the point that can be made very strongly that deposit insurance may be a bad idea, and these models were committed to disciple. But the point is that in earlier versions of this paper what is largely missing is this difference between financial and non-financial firms — it is one of those striking facts in the data of how different they are. And there is some more work to be done to try to tease out because just looking at short-term versus long-term is a bit crude because there are worries about deposit insurance, and how much is uninsured long-term, but these differences still exist. And this is absolutely right that this model of face value just does not speak to those differences. Except on one margin really which is N, how many people there are to finance a project. Clearly, none of this is going to work if there is a small firm that one person can always finance.

So, at a minimum, it is going to tell something that these effects are important for large-sized firms. Those banks are firms; that is an interesting question. Earlier versions of this paper try to take attack similar to other works. Is the moral hazard problem different for banks versus firms? Is there a sense that one should think of it as being more severe for banks and less severe for firms? And there are ways to write that in a model, and it comes right out that there is something to commit to these costly liquidations ex-post. It depends on how much the firms are saving on the incentive rent, and how much the ex-post losses are. Maybe that points away from data to think about that of as a way to try to tease that out. There are earlier versions of that model, and there are people who modelled it but cannot be convincing so that it can be scrapped because that is not what this model is going to help understand. But there is a lot of challenges for a lot of this literature because they are so different on these margins. There is not the same variation in maturity that is seen for corporate firms. That is like two starkly different sets of firms that are in very different businesses, and it is kind of an avenue for the future to try to

figure that out because it is important to understand whether these moral hazard problems are more severe if this story can be believed.

There are still the questions what is going on here? Are banks investing in the housing stock? Or they are investing in corporate equity? Right, that is observable what they are invested in, where they can see their assets are holding. The idea is if depositors can get a niche in their loans on the kind of assets the banks are holding, then they can provide incentives in a way in terms of the loans, the kind of rate on the loans that will actually be different. They will get better terms. Even if there is an outcome they are getting driven down from outside options where they could change exactly which point on parade often tiers are selecting.

There is no need in changing the feature of a contract. To some extent, their assets are observable. But it can be seen in the lens of a model that if that is observable and the types of investments they are doing, then there is conjecture. It can be understood as being able to get them in a condition of their loans on that. It is the same thing here. The simplest way of modelling it, which is in a paper on short-term debt, and when there is a decentralisation, it is non-contingent short-term debt implements the optimal contract, where it is just the banker issuing short-term debt claims. Here effectively, a way can be assumed of some sun-spot-like events. And if there is the discretionary model here, these sun-spots are still in existence. So, there again can be added some kind of escrow accounts where an account sits in escrow until enough people put in, then it goes, just like a kick-starter campaign (Jeanne, Subramanian, Williamson, 2012). So, that is what is said here which can be written down in a game form, that is going to yield some of these outcomes. It will all work if there is an assumption that these investments are observable if they are private, all that is off. That is an interesting problem to think about.

When there is a worry about these ex-post incentives plus their private incentives to choose a different margin of moral hazard, that is a calling, but it is interesting. And in terms of countries, in terms of the details of how the law should apply or not, it still remains an interesting question. So, finally, there is a question of whether it is possible to use variation in maturities either in terms of aggregates or across countries. It is worth thinking about in a future research paper.

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Оптимизация финансовых кризисов

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Аннотация. Статья посвящена анализу событий, в рамках которых банки сталкиваются с проблемами урегулирования краткосрочных обязательств и потенциального банкротства. Эти события происходят в случае образования выгод в результате создания рисков наступления того или иного страхового случая, с учетом того, что не все подобные события предполагают социальные издержки. Поэтому достаточно представлять эти события в качестве неэффективных или неоптимальных результатов, последствий некачественного управления ликвидными средствами без подкрепления гарантиями коммерческого банка. Данная статья выдвигает противоположную точку зрения и ставит перед собой цель — убедить читателя в том, что в процессе функционирования банка учитываются не только частные интересы, но и правовые аспекты, связанные с формированием финансовой системы, в которой могут существовать несколько банков, подверженных негативному влиянию крупных долгов. В этом отношении автор не пытается убедить читателя в том, что финансовый кризис затрагивает проблемы экономической эффективности или рациональности. Напротив, результаты статьи исходят из предыдущих исследований по данной проблематике, не основе чего сделан вывод, что конкретный банк должен найти такой оптимум, который позволял бы ему продолжать работать в условиях финансового кризиса. Также в статье выявлены особенности существования подобного оптимума в условиях финансовых шоков. Именно этим вопросам и посвящена данная статья.
Ключевые слова: оптимальный финансовый кризис; банковская система; платежеспособность банков, информационно-фрикционные издержки; Парето-эффективность; переговорный контракт; оптимальная структура капитала банка

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