Resolution procedures in a system of financially linked institutions

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Abstract

In a system of institutions holding liabilities on each other, their capacities to reimburse these liabilities are intertwined, thereby potentially generating coordination issues and defaults that could be avoided. These linkages call for an orderly resolution, as implemented by a regulatory authority assigning how much each institution within a financial system reimburses to its creditors. The paper studies such resolution procedures, assuming their main goal is to avoid the bankruptcy of the institutions within the system without external bail-outs if possible. Bankruptcy is triggered by a default on outside creditors, say, for a bank, a default on its depositors. By not requiring the full reimbursement of its net liabilities to the system, latter, bankruptcy can be avoided in some situations. The paper analyzes resolution procedures in these situations, taking into account various institutional, informational, and fairness constraints.

Keywords resolution, bankruptcy, entropy, limited liability, defaults, central counter-party

JEL classification D71, G33

1 Introduction

In a system of institutions holding liabilities on each other, their reimbursement capacities are intertwined, thereby generating coordination issues and, possibly, defaults that could be avoided. This paper studies orderly resolutions of these linkages, as arises in troubled times when a regulator takes control and assigns how much each entity within the system reimburses to its creditors. Orderly resolutions arise in practice under discretionary or systematic ways. In the risk of the bankruptcy of LTCM, the Federal Reserve Bank of New York organized a bailout by the major creditors. More systematically, a central counter-party (CCP) organizes the liquidation of the liabilities of a defaulting member and allocates the possible losses among the other members. This role for CCPs is due to grow: The fast and orderly resolution of the positions of Lehman Brothers that were cleared by central counter-parties\textsuperscript{2} was one of the motives for the regulators to require the use of CCPs for a

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\textsuperscript{2}See Fleming and Sarkar (2014).
large class of derivatives.\textsuperscript{3} The paper studies the design of resolution procedures, assuming their main goal is to avoid the bankruptcy of the institutions within the system without external bailouts if possible. An entity is bankrupt when it fails to reimburse fully its outside creditors, say its depositors for a bank. Default on liabilities within the system does not trigger bankruptcy, although default is controlled due to various restrictions such as creditors’ priority over stockholders.

The analysis is based on a stylized model of cross-liabilities within a set of institutions, all with equal priorities. At the resolution date, the cross-liabilities are determined by the previous engagements -standard loans, derivatives- and the current market conditions. Each institution has also outside assets and liabilities -investment, deposits- resulting in a net value -called net outside value in the sequel- which can be positive or negative. The institution is distressed if its net outside value is less than its net liabilities to the system. By not requiring the full reimbursement of the latter, bankruptcy can be avoided. To illustrate, consider a simple claims problem where a single firm in the system is indebted. If its liabilities to other institutions are larger than its net outside value, several questions arise: Is it possible to allocate the limited firm’s resources so as to avoid its own bankruptcy as well as that of its creditors? If this is indeed possible, on what principle should the partial reimbursements be chosen? The paper addresses the same questions in the more complex situation with cross-liabilities between the institutions. Cross-liabilities add two features: the multiplicity of debtors and the dual position as a debtor and a creditor. In the absence of the second feature, the structure of the linkages is bipartite, with creditors on one side (long institutions) and debtors on the other side (short institutions). Duality occurs when institutions are on both sides of the liability structure, simultaneously with positive claims and liabilities. The dual structure opens up various possibilities of treating the claims and liabilities. One treatment is the netting of positions either at a bilateral level between two entities or at an aggregate level, as is performed by a CCP.

An important feature of the analysis is the focus on resolution procedures that are defined for a range of problems, without knowledge of the exact data that will be realized: a procedure specifies an allocation of cash between the institutions, for each data that can be realized. Procedures contrast with either a discretionary or a disorderly liquidation of conflicting claims. They correspond to the perspective of a regulator or an exchange organizer, who clarifies how conflicting claims will be solved in case a default arises. To fix the terminology, the designer of the procedure is hereafter called regulator. A procedure can be evaluated not only through the properties of the assigned allocation given a situation but also through its coherence when the situation varies. In particular considering procedures allows one to address questions such as: Can an institution be penalized for earning more from outside, or for having lended more? Negative answers to these questions impose some coherence in the assigned allocations.

The information on the institutions available at the time of liquidation conditions its resolution. We always assume that the regulator knows the net outside value of each institution as well as its total liabilities and claims within the system. In particular, the regulator knows whether a firm is distressed. In a normal situation, no firm is distressed; in that case, requiring each one to

\textsuperscript{3}See the Dodd-Frank Act (2010) for the USA and the European Market Infrastructure Regulation (EMIR 2012) for the EU.
fully reimburse its liabilities (creditor’s priorities) avoids coordination issues potentially leading to bankruptcies. When there is a distressed firm, requiring full reimbursement of the nominal liabilities within the system would make any distressed firm bankrupt except if it is bailed out through external resources. We exclude the latter possibility and consider situations where bankruptcy is avoided only though appropriate reimbursements within the system. The information on the cross-liabilities then matters to define the constraints on these reimbursements. Two main settings are investigated. In the first setting, referred to as \textit{full information}, the regulator knows all the bilateral values of the liabilities and uses this knowledge: an allocation specifies the reimbursement of each bank to each other on the basis of the bilateral values and banks’ resources. In the second setting, referred to as \textit{coarse information}, the regulator uses only the information on the total values of the claims and liabilities per institution. This situation naturally arises if the regulator does not know the bilateral values. It also holds when the regulator has access to this information but voluntarily dismisses it, as is the case for a CCP, which aggregates the positions of each of its members. In that case, an allocation specifies the total amount paid and received by each bank on the basis of the claims and liabilities’ totals. These amounts can be thought as sent to and dispatched by the regulator.

The analysis builds on two approaches. The first one is the axiomatic approach, which starts by defining the fundamental properties a procedure should satisfy, and seeks for the ones satisfying them.\textsuperscript{4} The second one is the optimization approach, which starts by defining an objective function, reflecting, say, a measure of fairness, and seeks for the allocations optimizing the objective for each set of data. Procedures can be characterized by both. To illustrate, consider again the simple claims problem, with a single indebted firm whose resources are less than its liabilities. The proportional procedure allocates the indebted firm’s resources to each of its creditors in proportion of their claims. Proportionality satisfies what can be considered as a fundamental property, which should be satisfied whenever possible. The proportional procedure also solves the optimization of an index, used to measure fairness in a large number of areas, to measure segregation, inequality and so on (see the related literature). However, a creditor may end up bankrupt with the proportional procedure if its outside net value is negative. One goal of the analysis is to extend the proportional procedure to the more complex environment where firms’ outside net value may be negative and they own cross-liabilities between each other.

Concerning the axiomatic approach, one may distinguish two types of properties: those bearing on the allocations specified by a procedure for a given data profile and those bearing on the behavior of the procedure when data varies, i.e. on how the assigned allocation varies with the data. Here are a few representative examples of properties that bear on allocations for a given data profile: the net worth of each firm is non-negative (no bankruptcy), creditors’ priority over stockholders, which requires a full repayment of the liabilities if the net worth is positive, bounded reimbursements meaning that no institution reimburses more than its liabilities, bounded repayments meaning that no institution receives more than its claims, contagion-freeness, which requires each non-distressed

\textsuperscript{4}The approach has been developed by social choice theory, initiated by Arrow (1951) on voting procedures. It has been used for analyzing the simple claims problem (see the related literature).
firm to reimburse fully its liabilities.\footnote{Contagion-freeness is imposed in some but not all legislations. For the Lehman Brothers’ resolution, creditors who lost on their claims on the US branch had nevertheless to reimburse their liabilities to the firm, but compensation was possible in the UK.} The three last properties can be required on the totals per firm or on each bilateral liability. The main properties on the behavior of a procedure with respect to the data are related to monotony. We will mainly consider the monotony of the net worth levels with respect to the net outside value; alternative -and stronger- monotony properties require the reimbursements made to be non-decreasing or the payments received to be non-increasing with the the net outside value.

As for the optimization approach, the objective is the entropy function, which has been shown to reflect fairness in a wide range of areas.

**Related literature.** The paper is related to several strands of literature.

A first strand addresses the adjudication of conflicting claims, as introduced by O’Neill (1982), referred to as ‘simple claims’ problem. The problem amounts to divide an estate among creditors, each one having claims, whose total is more than the estate. The problem arises in a large number of situations, ranging from bankruptcy of a single firm, inheritance, tax allocation (Young 1987). The proportional allocation is feasible (there is no minimal requirement) and is a widely used procedure. There are also other rules depending on the context, some suggested by texts in the Talmud. Aumann and Maschler (1985) rationalize these suggestions by defining a rule they call the Talmud rule, and provide an axiomatization. Since then, the works have been numerous, surveyed by Thomson (2003).

A simple claims problem arises in our framework when there is a single indebted firm, as described previously. Our setting is much more general by dealing with minimum reimbursements to avoid bankruptcy and by considering not only multiple debtors but also cross-liabilities and claims.

A different but related strand evaluates allocations through the computation of a measure (often called index) meant to reflect a kind of ideal. This leads to the optimization approach, where the procedure assigns the allocation that optimizes the measure over the feasible allocations defined by the constraints. There are a variety of similar measures aimed at comparing the fairness of different distributions of resources, the distribution of bads as in taxation, or the segregation of assignments to school: the Gini index, the family of Atkinson’s indices, and the Mutual Information index (see e.g. Frankel and Volij (2011). We consider one such measure, related to the entropy measure.

A second strand of literature studies the effect of cross-liabilities among a group of institutions on the contagion of defaults. This domain of research has been an active since the 2008 financial crisis and the bankruptcy of Lehman Brothers, which made clear the complexity of the liability structure. As the reimbursements are interrelated, there is a variety of ways to model them in case of default (see the survey of Upper (2011), which reports simulations works). One class of models specifies a sequential process, meant to describe domino effects, and studies the long run outcome. The other class relies on the liquidation procedure defined by Eisenberg and Noe (2001), which is much related to our analysis. The procedure assigns reimbursements characterized by three properties: proportional reimbursements, meaning that each institution in default pays the same fraction of its liability
to each of its creditors, limited liability and creditors’ priority. Csoka and Herings (2017) proposes an axiomatization of the proportionality requirement (2001). The procedure is well defined when firms have no outside creditors (their net outside value is composed of their ‘operating cash flow’) or more generally when net outside values are all positive. When some outside values are negative, a clearing ratio may not exist because any ratio triggers bankruptcy, even though bankruptcy could be avoided. The procedures introduced here do not assume proportional reimbursements. One reason is to avoid bankruptcy, the other one is that there are several dimensions in proportionality. For example, proportionality in the reimbursements does not imply proportionality in the received payments (except in the unrealistic case where banks have the same composition in their claims). In practice, the proportionality in reimbursements is not satisfied (for example, in 2011, private creditors accepted a 50 percent loss on their Greek bonds). Stutzer (2018) also challenges the assumption of proportional reimbursements.

Finally the paper is also related to works that study how to define proportionality in two-dimensional setting with various constraints, as in Balinski and Demange (1989) and Moulin (2016) (see more references in the latter paper).
References


