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Systemic Risk and Optimal Fee for Central Clearing Counterparty under Partial Netting

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Abstract

We propose a novel central clearing counterparty (CCP) design for a financial network, in which the participation of banks in the CCP depends on the proportional clearing fee. We obtain the optimal fee that maximizes the CCP's net worth. We show that partial participation of banks in the CCP at the optimal fee rate reduces banks' aggregate shortfall and also reduces the overall systemic risk. We also carry out numerical examples to verify the theoretical results.

Keywords: Clearing Fee, Systemic Risk, Financial Network, Optimization, Shortfall

1. Introduction

In the aftermath of the 2007-2009 financial crisis, central to the new regulatory approach for financial stability is the implementation of central clearing for the over-the-counter (OTC) derivatives. A central clearing counterparty (CCP hereafter) stands as an intermediary between OTC derivatives counterparties (see [1]). There is an emerging field of academic literature studying the impact of a CCP or multiple CCPs on systemic risk, c.f., [1], [2], [3], [4], [5], [6], [7], [8], [9], etc.

In this paper, we incorporate a *for-profit* CCP into the financial network. We explicitly take into account the trade-off between the *profitability* of the CCP as a central bank, and the *responsibility* of the CCP as a regulator. Instead of assuming a fixed fee rate as in [4], we treat the fee rate charged by the CCP as a decision variable. Another practical feature of our model is that banks are not obligated to participate *fully* in the central clearing process, but rather can choose the proportion of their interbank liabilities to be centrally cleared through the CCP. The banks' participation rates in the CCP are given by a decreasing demand function of the clearing fee. In the gaming between the CCP and the banks, we study the case in which the banks' participation in the CCP is observable or known to, but cannot be controlled by the CCP.

We seek the optimal fee rate that maximizes the net worth of the CCP, and find that the optimal fee always exists and is unique under some technical conditions. We show that partial multilateral clearance under the optimal clearing fee always increases the clearing payment and reduces the shortfall for all participating banks and the systemic risk. Our results are clearly in favor of the introduction of a CCP, and we allow the practical assumptions that on one hand, the CCP is profit seeking, and on the other hand, the CCP is serving as a regulator aiming to reduce the overall systemic risk. Thus the two aspects of the CCP, the *incentive/profitability* and the *acceptability/responsibility*, have aligned interests under our CCP design.

The key contributions of our paper are three-fold. (1) We set up a general framework for a financial network with partial clearance through the CCP, which incorporates the classical network model (no CCP), as in [10], and some recent models with full participation in the CCP, see [4]. (2) We propose a novel CCP design where the banks can choose the proportion of their interbank liabilities to be cleared through the CCP, and where the CCP *optimally* chooses the clearing fee after observing banks' participation. (3) We prove that the aggregate shortfall of the financial system is always reduced when the CCP charges at the optimal fee rate.

The rest of the paper is organized as follows. Section 2 presents the two-step partial clearance mechanism in our setting. The optimal clearing fee is derived in Section 3 for a general demand function and explicitly calculated for a quadratic demand function. We study the impact of partial clearance on the clearing payment and the shortfall of banks in Section 4 and on systemic risk in Section 5, respectively. We conduct numerical studies in Section 6.

2. Financial Network and Clearance Mechanism

We consider a financial network that consists of m interlinked banks ("bank" here refers to a broad collection of financial institutions, e.g., banks, credit unions, insurance companies, pension funds, etc.) in a single period setting, and label those banks as $1, 2, \cdots, m$. Denote by $\mathcal{M} := \{1, 2, \cdots, m\}$ the set of all banks. At $t = 0$, the nominal interbank liabilities are represented by a matrix $(L_{ij})_{i,j\in\mathcal{M}}$, where $L_{ij} \geq 0$ denotes the nominal liabilities that bank i owes to bank j. We assume $L_{ii} = 0$ for all $i \in \mathcal{M}$, i.e., bank i does not owe to itself. At $t = 1$, these interbank liabilities have to be all settled in cash.

The total nominal liabilities of bank i sum up to $L_i = \sum_{j=1}^{m} L_{ij}$, and the total liabilities that all other banks owe to bank

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