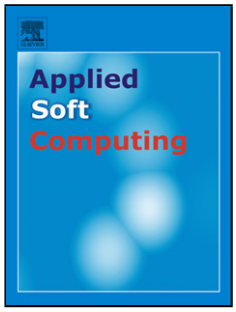

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On the Measure of Contagion in Fuzzy Financial Networks[1]

Giuseppe De Marco[a,b,2], Chiara Donnini[a], Federica Gioia[a], Francesca Perla[a]

a: Department of Management and Quantitative Sciences, University of Naples Parthenope. Via Generale Parisi 13, Napoli 80132, Italia.

b: Center for Studies in Economics and Finance, University of Naples Federico II.

Abstract

Previous literature shows that financial networks are sometimes described by fuzzy data. This paper aims to extend classical models of financial contagion to the framework of fuzzy financial networks. The *degree of default* of each bank in the network is defined. It consists in a (real valued) measure of the fuzzy default and it is computed as a fixed point for the dynamics of a modified *"fictitious default algorithm"*. Two specific models of degree of default are also introduced and investigated; namely, an optimistic model and a pessimistic one. Finally, the algorithm is implemented in Matlab and tested numerically on a real data set.

Keywords: Financial networks, fuzzy financial data, degree of default, fixed point.

1 Introduction

The mutual exposures that banks and other financial institutions assume towards each other, connect the banking system in a network. This kind of interbank exposures are recognized as a source of financial crisis: shocks, which initially affect only few institutions, propagate through the entire system by interbank exposures, producing a *contagion cascade*. In the last 15-20 years, the literature on financial contagion has grown rapidly; theoretical and empirical papers now provide insights on the relationships between the interbank exposure network and the financial stability of the banking system (see for instance Glassermann and Young (2016) or Hurd (2016) for recent surveys). However, there seems to be an issue that has not been explored in its entirety and it consists in the lack of precise information about the overall interbank exposures in the system[3]. The present paper aims to tackle this issue; in particular we study a financial network model in which interconnections are represented by fuzzy numbers and provide mathematical and computational tools in order to exploit the information arising from this model[4].

Allen and Gale (2000) is a cornerstone in the literature on financial contagion. It gives a first microeconomic analysis of this issue: banks hold claims on other banks to provide insurance against (imperfectly correlated) liquidity shocks. When there is no aggregate uncertainty, the interbank deposit market allows banks to achieve the first-best allocation of risk sharing but,

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[2]Corresponding author at demarco@uniparthenope.it

[3]Indeed, banks are constrained to show their exposures within the balance sheet only few times per year (usually balance sheets are made public quarterly).

[4]To the best of our knowledge, our present paper is the first attempt to tackle the issue of fuzzy information on interbank linkages. From a different perspective, previous literature handles the uncertainty of financial networks by taking into account random graph models (see Hurd (2016) and references therein).