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Margining in derivatives markets and the stability of the banking sector

Rajna Gibson [a,*], Carsten Murawski [b]

[a] University of Geneva and Swiss Finance Institute, Geneva Finance Research Institute, UNIMAIL, 40 Bd du Pont d'Arve, 1211 Geneva 4, Switzerland
[b] Department of Finance, The University of Melbourne, Victoria 3010, Australia

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ABSTRACT

We investigate the effects of margining, a widely-used mechanism for attaching collateral to derivatives contracts, on derivatives trading volume, default risk, and on the welfare in the banking sector. First, we develop a stylized banking sector equilibrium model to develop some basic intuition of the effects of margining. We find that a margin requirement can be privately and socially sub-optimal. Subsequently, we extend this model into a dynamic simulation model that captures some of the essential characteristics of over-the-counter derivatives markets. Contrarily to the common belief that margining always reduces default risk, we find that there exist situations in which margining increases default risk, reduces aggregate derivatives' trading volume, and has an ambiguous effect on welfare in the banking sector. The negative effects of margining are exacerbated during periods of market stress when margin rates are high and collateral is scarce. We also find that central counterparties only lift some of the inefficiencies caused by margining.

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1. Introduction

For a long time, margining, a mechanism for attaching collateral to derivatives contracts, was considered a panacea to mitigate default risk in derivatives markets (International Swaps and Derivatives Association, 2005). However, in many financial calamities during the past few decades, including the collapses of Metallgesellschaft, Long-Term Capital Management (LTCM), and more recently Bear Stearns, Lehman Brothers, and American International Group (AIG), margining played an ambivalent role. It is not unreasonable to believe that it exacerbated the recent financial crisis. At present, it is an open question as to what the overall effect of margining is in a financial system and in an economy more generally.[1]

In this article, we identify situations in which margining of derivatives, two-way contracts in which both parties are both potential creditors and potential debtors, decreases trading volume, increases default rates and default severity, and reduces welfare in the banking sector. Our analysis shows that margining presents derivatives counterparties and regulators with a delicate trade-off. On the one hand, margins reduce default severity by reducing banks' exposure to the default of their counterparties. On the other hand, margin requirements generate several types of costs, particularly when banks use derivatives for hedging purposes. First, by imposing a funding constraint on banks' trading strategies, margin requirements can limit the number of derivatives contracts traded by a bank and thus can prevent it from implementing its optimal hedging position. Second, increased margin requirements can indirectly constrain a banks hedging strategy by reducing the number of contracts outstanding of other banks. Moreover, increased margin requirements can reduce the credit quality of a bank's counterparties (that is, increased probability of default and loss-given-default) by constraining the counterparties' hedging strategy.

These considerations lead to the conclusion that margining affects market outcomes through several different direct and indirect channels that may interact in subtle ways, some of them counter-intuitive. Moreover, it may impose negative externalities, that is, negative, indirect effects on other parties within the financial system or the economy, that are not transmitted through prices.

In the remainder of this article, we address the following research question: How do the various margining mechanisms observed in current derivatives markets affect trading volume, default risk, and welfare in the banking sector, in particular, during periods of market stress?

To analyze the effectiveness of margining within the banking sector we present two models. Our first, baseline model is a simple, static equilibrium model in which we develop some basic intuition for the main channels of margining. Subsequently, we present a

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* Corresponding author. Tel.: +41 22 379 8983.
E-mail addresses: rajna.gibson@unige.ch (R. Gibson), carstenm@unimelb.edu.au (C. Murawski).

[1] In the following, we will refer to the assets used as security deposit as *collateral*. We will refer to the collateral attached to a contract or to a position of several contracts as *margin*. Thus, we will abstract from certain legal details of margining that we consider irrelevant for the following economic analysis.

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dynamic market model that extends the equilibrium model. The dynamic model captures many features of modern derivatives markets so as to analyse the various channels of margining and their interaction in a more realistic setting. However, this model cannot be solved analytically; hence, we evaluate it using simulations.

In the equilibrium analysis, our baseline model, we consider a one-period economy with an incomplete market and two (groups of) risk-averse banks. The banks have opposite endowments in a long-term, illiquid asset and a certain amount of cash. They wish to hedge the risk of their endowment by trading short-term derivatives contracts with each other. Banks maximize the expected utility of wealth by choosing the optimal number of derivatives contracts. Because markets are incomplete, we allow the banks to default.

We then introduce a margin requirement aimed at mitigating default risk associated with the trading of the derivatives contracts. Solving for the banks' optimal trading strategies, we analyze the impact of margin requirements on their welfare (as measured by their utility of wealth), their default risk, and on the volume of derivatives traded. We find that exogenously imposed margin requirements can be privately and socially sub-optimal. Indeed, using numerical analysis, we find that sometimes a margin requirement of zero is optimal. The negative effects of margining increase as the constraints imposed by the margin requirements on the banks' optimization problem tighten. More important, our results also suggest that when banks differ in key characteristics that affect the optimal level of the margin requirement, including their probability of default and risk aversion, privately and socially optimal levels of margining may not be the same, which in turn implies that the level of margining in a market will affect not only aggregate welfare but also the relative distribution of welfare.

Subsequently, we extend our baseline model to create a more realistic simulation model of derivatives trading in the banking sector. More precisely, we analyze a market consisting of several heterogeneous banks that face a similar optimization problem as before while assuming that the banking sector is experiencing severely adverse market and credit risk conditions. The latter assumption is made in order to determine how margin requirements affect this banking economy during market crises which are often deemed to represent the market conditions during which collateral is most valuable. In order to make the model more realistic, we calibrate its parameters with actual derivatives market data. We use this model to study the effects of initial margin, variation margin, and a central counterparty on market outcomes.

We find that the introduction of margining, both in the form of initial and variation margin, significantly deteriorates derivatives market liquidity while it increases banks' default rates and ambiguously affects their welfare when assuming a mean–variance utility function. These results are more pronounced when initial margin levels are strengthened. The simulation results thus support the results obtained with our baseline model regarding the impact of margining on banks' welfare and derivatives trading liquidity. They further show that, under stress scenarios, tighter margin requirements will even exacerbate banks' default risk. In all our analyses, initial margin levels are set *ex ante* and remain constant; that is, we exclude pro-cyclical adverse effects of margining due to increases in margin rates during periods of stress.

Our results are reminiscent of the theory of 'second best', according to which the elimination of a market imperfection does not necessarily make an economy better off in the sense that it can exacerbate the negative effects of other market imperfections. We believe that our results explain some of the existing empirical research in this field. Hartzmark (1986) and Hardouvelis and Kim (1995) found that increases in margin rates at major derivatives exchanges led to a decrease in trading volume and open interest. We also believe that our results explain, at least in part, current events in financial markets such as the collapse of AIG.[2] Hence, our results for both the baseline equilibrium and the extended simulation models presented in this article are of interest to public policy makers, especially in light of the recently increased use of margining in over-the-counter (OTC) derivatives markets and its ambiguous effects on welfare in the banking sector. Indeed, we find that almost perfect coverage of counterparty default risk exposure by margining is sub-optimal during periods of market stress.

This finding is relevant to the role of derivatives trading, including credit derivatives trading, in the recent liquidity and credit crisis in the global banking sector.[3] Our results also emphasize the significance of the interdependence between different types of risk, such as credit and liquidity risk, suggesting that these risks should ideally be analyzed and managed jointly rather than separately. Therefore, any change in margining policies in financial markets, such as the introduction of a central counterparty, should be considered carefully. At the same time, margining should become a key issue in the design and implementation of financial market policies, as suggested in Turner (2009).

We proceed as follows. In Section 2, we briefly review the literature relevant to this study. In Section 3, we develop our baseline model, a simple equilibrium model to shape the intuition for the various channels of margining. In Section 4, we extend this baseline model to create a more realistic, dynamic simulation model. Finally, Section 5 concludes the study.

2. Literature review

This article focuses mainly on the analysis of the trade-off between the benefits of collateral as a risk mitigation mechanism and its costs. Several strands of the literature have addressed issues related to this topic.

The measurement of default risk in derivatives contracts is inherently more complex than in most other financial contracts. Standard measurement approaches to credit risk often fail in case of derivatives. Duffee (1996) suggests two main reasons for this complexity. First, credit exposure fluctuates with the price of the underlying security. Second, exposures on derivatives contracts are correlated with the probabilities of default. The incorporation of default risk into the valuation of derivatives contracts was first considered by Hull and White (1995) and has since been re-examined by Collin-Dufresne and Hugonnier (2007) and others for a rather broad class of instruments.

Equally challenging as the measurement of default risk is its mitigation. As Swan (2000) reports, market participants have been preoccupied with the development of mechanisms to mitigate default risk in derivatives contracts ever since the inception of modern derivatives markets. Among the first means employed by market participants were appraisals of counterparties and collateral. Over time, rather sophisticated mechanisms evolved,

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[2] On September 16, 2008, the *New York Times* reported that as a result of adverse market movements and a ratings downgrade, the derivatives counterparties of AIG could ask for up to $10.5 billion in additional collateral in relation to swaps contracts. Because AIG was unable to raise sufficient funds to meet these margin calls and to meet its other counterparty-related obligations, the United States government provided a loan to AIG in exchange for a controlling stake in the company on the grounds that a default of AIG would probably have caused a systemic crisis in derivatives markets and the wider financial system. At the same time, because of rising margin requirements, market liquidity in derivatives markets was drying up, as reported in *The Economist* on September 20, 2008 (*Wall Street's bad dream*). Other recent examples of such (near-)credit events include the cases of Metallgesellschaft in 1993, LTCM in 1998, Amaranth in 2007, as well as ACA in 2008.

[3] Although default risk in derivatives contracts has mainly been discussed in relation to credit derivatives, a similar issue exists in most other derivatives markets. The greatest exposures are, so it seems, in the interest-rate swaps market, as reported in *The Economist* on September 20, 2008 (*A nuclear winter?*).

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