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Leverage-induced systemic risk under Basle II and other credit risk policies

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ABSTRACT

We use a simple agent based model of value investors in financial markets to test three credit regulation policies. The first is the unregulated case, which only imposes limits on maximum leverage. The second is Basle II and the third is a hypothetical alternative in which banks perfectly hedge all of their leverage-induced risk with options. When compared to the unregulated case both Basle II and the perfect hedge policy reduce the risk of default when leverage is low but increase it when leverage is high. This is because both regulation policies increase the amount of synchronized buying and selling needed to achieve deleveraging, which can destabilize the market. None of these policies are optimal for everyone: risk neutral investors prefer the unregulated case with low maximum leverage, banks prefer the perfect hedge policy, and fund managers prefer the unregulated case with high maximum leverage. No one prefers Basle II.

1. Introduction

The recent crash in home and mortgage prices, and the ensuing global recession, has brought forth numerous proposals for the regulation of leverage. The trouble is that many of these proposals ignore the mechanism of the leverage cycle, and thus might unwittingly do more harm than good.

Leverage is defined as the ratio of assets held to wealth. A homeowner who buys a house for $100 by putting down $20 of cash and borrowing the rest is leveraged 5 to 1. One reason leverage is important is that it measures how sensitive the investor is to a change in asset prices. In the case of the homeowner, a $1 or 1% decline in the house price represents a 5% loss in his wealth, since after he sells the house and repays the $80 loan he will only have $19 out of his original $20 of capital. Limiting leverage therefore seems to protect investors from themselves, by limiting how much they can all lose from a 1% fall in asset prices. Basle II[1] effectively puts leverage limits, *through rules for eligible financial collateral*, on loans banks can give to investors, and furthermore it ties the leverage restriction to the volatility of asset prices: if asset prices become more likely to change by 2% instead of 1%, then Basle II curtails leverage even more. At first glance this seems like good common sense.

The leverage cycle, however, does not arise from a once and for all exogenous shock to asset prices, whose damages to investors can be limited by curtailing leverage. On the contrary, the leverage cycle is a process crucially depending on the heterogeneity of investors. Some investors are more optimistic than others, or more willing to leverage and buy than others. When the market is doing well these investors will do well and via their increased relative wealth and their superior adventurousness, a relatively small group of them will come to hold a disproportionate share of the assets. When the market is controlled by a smaller group of agents who are more homogeneous than the market as a whole, their commonality of outlook will tend to reduce the volatility of asset prices. But this will enable them, according to the Basle II rules, to leverage more, which will give them a still more disproportionate share of the assets, and reduce volatility still further. Despite the leverage restrictions intended from Basle II, the extremely low volatility still gives room for very high leverage.

At this point some exogenous bad luck that directly reduces asset prices will have a disproportionate effect on the wealth of the most adventurous buyers. Of course they will regard the situation

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[1] Note that we do not refer here to the minimum leverage ratio introduced in Basle III.

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as an even greater buying opportunity, but in order to maintain even their prior leverage levels they will be forced to sell instead of buying. At this point volatility will rise and the Basle II lending rules will force them to reduce leverage and sell more. The next class of buyers will also not be able to buy much because their access to leverage will also suddenly be curtailed. The assets will cascade down to a less and less willing group of buyers. In the end, the price of the assets will fall not so much because of the exogenous shock, but because the marginal buyer will be so different from what he had been before the shock. Thus we shall show that in some conditions, Basle II not only would fail to stop the leverage build up, but it would make the deleveraging crash much worse by curtailing all the willing buyers simultaneously. The policy itself creates systemic risk.

We shall also see that another apparently sensible regulation can lead to disaster. Common sense suggests it would be safer if the banks required funds to hedge their positions enough to guarantee they can pay their debts before they could get loans. The trouble with this idea is that when things are going well, the most adventurous leveragers will again grow, thereby lowering volatility. This lower volatility will reduce their hedging costs, and enable them to grow still faster and dominate the market, reducing volatility and hedging costs still more. Bad luck will then disproportionately reduce the wealth of the most enthusiastic buyers. But more importantly, it will increase volatility and thus hedging costs. This will force further selling by the most enthusiastic buyers, and limit the buying power of the next classes of potential owners. In just the same way as Basle II, the effort to impose common sense regulation of leverage can create bigger crashes.

In recent years a variety of studies including Fostel and Geanakoplos (2008), Geanakoplos (2010), Adrian and Shin (2008), Brunnermeier and Pedersen (2009), Thurner et al. (2012) and Caccioli et al. (2012) have made it clear that deleveraging can cause systemic financial instabilities leading to market failure, as originally discussed by Minsky (1992). The specific problem is that regulatory action can cause synchronized selling, thereby amplifying or even creating large downward price movements. In order to stabilize markets a variety of new regulatory measures have been proposed to suppress such behavior. But do these measures really address the problem?

In this paper we focus on the systemic risk component of overlapping portfolios. By systemic risk here we mean the default of financial institutions generated by the internal dynamics of the financial system. Such defaults are typically synchronized and in more serious cases involve the default of a substantial number of agents. Our example here is simple, as there is only one risky asset. Contagion is transmitted between agents when they buy or sell the asset, and as we will see, the use of leverage can lead to market crises. A key point in this study is that crises emerge endogenously, under normal operation of the model – there are long periods where the market is relatively quiet, but due to the build up of leverage, the market becomes more sensitive to small fluctuations (which would at other times have negligible effect).

Of particular interest here are leverage constraints, which are a significant part of financial regulation. These constraints are implemented in numerous ways, most influential in the form of capital adequacy rules in the Basle II framework and as margin requirements and debt limits in the regulations T, U, and X of the Federal Reserve System. Margin requirements were established in the wake of the 1929 stock market crash with the belief that margin loans led to risky investments resulting in losses for lenders (Fortune, 2000). Fortune (2001) discusses the regulation, historical background, accounting mechanics and economic principles of margin lending according to regulations T, U, and X.

In comparison to straightforward leverage constraints, the Basle II capital adequacy rules classify and weight assets of banks according to credit risk. Banks regulated under the Basle II framework are required to hold capital equal to 8% of risk-weighted assets. A recent case study of the Bank of Canada discusses unweighted leverage constraints as a supplement to existing risk-weighted capital requirements (Bordeleau et al., 2009). The second of the Basle II Accords (Basle II) capital adequacy regulations added a significant amount of complexity and sophistication to the calculation of risk-weighted assets. In particular, banks are encouraged to use internal models, such as value-at-risk (VaR), to determine the value of risk-weighted assets according to internal estimations. In a nontechnical analyses of the Basle II rules, Balin (2008) provides an easy accessible analysis of both the Basle I and II framework.

Lo and Brennan (2012) provide an extensive overview of leverage constraints, pointing out that regulatory constraints on leverage are generally fixed limits that do not vary over time or with changing market conditions, and suggest that from a microprudential perspective fixed leverage constraints result in large variations in the level of risk. Recent studies of central banks also conclude that current regulatory leverage constraints are inadequate (Bhattacharya et al., 2011; Christensen et al., 2011). From a macroprudential perspective internal estimations of banks appear to be cyclically biased in determining the value of risk-weighted assets, contributing to a procyclical increase in global leverage (Bordeleau et al., 2009). Keating et al. (2001) and Daníelsson (2002) have also argued that the Basle II regulations fail to consider the endogenous component of risk, and that the internal models of banks can have destabilizing effects, inducing crashes that would otherwise not occur.

Computational agent-based models have gained popularity in economic modeling over the last decades and are able to reproduce some empirical features of financial markets that traditional approaches cannot replicate (LeBaron, 2008). An advantage of this approach is the ability to implement institutional features accurately and to be able to simulate any model setup, without the constraints of analytic tractability. An extensive review of financial multi-agent models can be found in LeBaron (2006) and Hommes (2006). LeBaron (2006) has focused more on models with many types of agents and Hommes (2006) concentrating more on models with a few types of agents and the effects of heterogeneous strategies.

In this paper we use an agent-based financial market model introduced by Thurner et al. (2012) to test the performance of several credit regulation policies. The model introduced by Thurner et al. (2012) will be used as a baseline. In this work, the model is extended to allow short selling and to incorporate different regulation policies. The use of this simulation model allows us to explicitly implement and test any given regulatory policy. We test three different cases: (1) an unregulated market, (2) the Basle II framework and (3) a hypothetical regulatory policy in which banks completely hedge against possible losses from providing leverage (while charging their clients the hedging costs). We find that when leverage is high both of the regulatory schemes fail to guard against systemic financial instabilities, and in fact result in even higher rates of default than no regulation at all. The reason for this is that both regulatory policies compel investors to deleverage just when this is destabilizing, triggering failures when they would otherwise not occur.

Agent-based models have often been criticized for making arbitrary assumptions, particularly concerning agent decision making. We address this problem here by keeping the model simple and making a minimum of behavioral assumptions. There are four types of investors:

1. *Fund managers* are perfectly informed value investors that all see the same perfect valuation signal. They buy when the market is underpriced and sell when it is overpriced. Fund managers are risk-neutral.