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Leverage bubble

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ABSTRACT

Leverage is strongly related to liquidity in a market and lack of liquidity is considered a cause and/or consequence of the recent financial crisis. A repurchase agreement is a financial instrument where a security is sold simultaneously with an agreement to buy it back at a later date. Repurchase agreement (repo) market size is a very important element in calculating the overall leverage in a financial market. Therefore, studying the behavior of repo market size can help to understand a process that can contribute to the birth of a financial crisis. We hypothesize that herding behavior among large investors led to massive over-leveraging through the use of repos, resulting in a bubble (built up over the previous years) and subsequent crash in this market in early 2008. We use the Johansen–Ledoit–Sornette (JLS) model of rational expectation bubbles and behavioral finance to study the dynamics of the repo market that led to the crash. The JLS model qualifies a bubble by the presence of characteristic patterns in the price dynamics, called log-periodic power law (LPPL) behavior. We show that there was significant LPPL behavior in the market before that crash and that the predicted range of times predicted by the model for the end of the bubble is consistent with the observations.

1. Introduction

Financial bubbles play a huge role in the global economy, affecting hundreds of millions of people yet, until recently, the existence of such bubbles, much less their effects, have been ignored at the policy level. Finally, only after this most recent historical global financial crisis (which is still ongoing), officials at the highest level of government and academic finance have acknowledged the existence and importance of identifying and understanding bubbles. No less than the President of the Federal Reserve Bank of New York, Dudley, stated just a few months ago [1]:

> …what I am proposing is that we try—try to identify bubbles in real time, try to develop tools to address those bubbles, try to use those tools when appropriate to limit the size of those bubbles and, therefore, try to limit the damage when those bubbles burst.

Such a statement from the New York Fed – representing, essentially, the monetary policy of the United States governmental banking system – would have been, and, in some circles, still is, unheard of. This, in short, is a bombshell and a wake-up call to academics and practitioners. Dudley proposes to "try to develop tools to address…bubbles". Before discussing tools that could address bubbles, we must know what a bubble is.

A financial bubble is a curious beast: its meaning is accepted as beyond obvious by average people yet its very existence is loudly debated in angry terms among experts. Arguably, almost any given adult met on the street in, say Asia, Europe or

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North America (and, of course, elsewhere), would know exactly what one is and could cite examples in recent and distant history. The dot.com bubble ending in 2000 and the housing bubble recently ended would most likely be the most common examples given. More well-read – but still non-expert – people could cite the Dutch tulip mania in the 1600's and the South Sea Company of the 1700's. After that, the examples are less well-known but not because of their scarcity but just because most people are not interested in financial history and debates. This is changing.

While the general population accepts bubbles, academics and policy-makers have a decades-old tradition of arguing about whether bubbles even exist. This single fact could very well be the most striking and unbelievable statement ever transmitted from the Ivory Tower. In spite of the lack of academic consensus on a definition, we can give qualitative ideas of bubbles and apply our quantitative approach in the next sections. Following Ref. [2], the term "bubble" refers to a situation in which excessive public expectations of future price increases cause prices to be temporarily elevated. For instance, during a housing price bubble, homebuyers think that a home that they would normally consider too expensive for them is now an acceptable purchase because they will be compensated by significant further price increases. They will not need to save as much as they otherwise might, because they expect the increased value of their home to do the saving for them. First-time homebuyers may also worry during a housing bubble that if they do not buy now, they will not be able to afford a home later. Furthermore, the expectation of large price increases may have a strong impact on demand if people think that home prices are very unlikely to fall, and certainly not likely to fall for long, so that there is little perceived risk associated with an investment in a home.

In this paper, instead of emphasizing the case for the presence of a housing bubble (which was indubitably present, see Refs. [3,4]), we argue that there was *in addition* a leverage bubble that peaked and crashed in early 2008 after building up for the years beforehand. As we explain below, the leverage bubble formed and grew for the same reasons as described in the housing bubble example above: investors were afraid that if they did not extend their leverage (buy a house) then they would lose money later. Further, we argue that the size of the market in *repurchase agreements* (or repos, for short) is an observable proxy of leverage in the financial system. We will elaborate on repos below, but, briefly, a repo is simply a cash transaction for an asset combined with a forward contract to buy the asset back at a later time (hence 're-purchase'). By measuring the size of the repo market and applying an appropriate bubble model, we can see that the leverage crash in early 2008 was potentially a forecastable event.

The paper is constructed as follows. In Section 2, we discuss the relationship between repo market size and the overall leverage of the market. In Section 3, we briefly introduce the Johansen–Ledoit–Sornette model [5,6] of bubbles and apply it to total repo market size to make an ex-post forecast of the crash in early 2008. We conclude in Section 4.

2. Repo market size represents the leverage of the market

A repurchase agreement (repo) is the sale of securities together with an agreement for the seller to buy back the securities at a later date.[1] In other words, it is a contract obliging the seller of an asset to buy back the asset at a specified price on a given date. Therefore, a repo is equivalent to a cash transaction combined with a forward contract. The cash transaction results in transfer of money to the borrower in exchange for legal transfer of the security to the lender, while the forward contract ensures repayment of the loan to the lender and return of the collateral of the borrower.

To understand the possible role of repos in the generation of a bubble, we first discuss the relationship between leverage and balance sheet size. We start with a very simple case, taken from Section 2 of Ref. [7]. Assume that an investment bank has 100 USD in securities while its shareholder equity is 20 USD and its debt is 80 USD. Then the balance sheet of this bank looks like:

Assets	Liabilities
Securities, 100	Equity, 20
	Debt, 80

Now the leverage of the bank is

$$\frac{\text{assets}}{\text{equity}} = \frac{100}{20} = 5. \tag{1}$$

Suppose that the debts of this bank are all long term debts and, therefore, we can assume that the debt remains the same in the balance sheet over the short period of time considered in the argument. Now assume that the prices of the securities increase by 10%, so that the new balance sheet is

Assets	Liabilities
Securities, 110	Equity, 30
	Debt, 80

[1] http://en.wikipedia.org/wiki/Repurchase_agreement.