A dynamic model of investor sentiments and leverage

Master Thesis

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1 Introduction

In 2008 the world was shattered by the worst financial crisis since the *Great Depression.* The financial turmoil was followed by a global recession which took a high toll on many economies. It was only due to the various institutions in place that prevented the financial system from a complete meltdown like in the thirties of the last century. Even though the world was spared from a disastrous depression like in the thirties the aftermath of the crisis is still felt today roughly seven years after the onset of the financial crisis. The cause for the crisis, the bubble in the real estate market, was quickly identified. However, the drivers behind the bubble do not point to a single factor. It was multitude of factors that interacted in a complex way that led to the financial crisis. Some explanations focus on growing global imbalances like saving gluts (Bernanke, 2005). Other focus on complex financial products like *Collateralized Mortgage Obligations* (CMOs) which bundled a multitude of mortgages and divided it into several tranches according to the risk attached to these tranches. Another factor, which played an important role in the buildup of the real estate bubble and which contributed to the severity of the financial crisis, was leverage. Already Fisher (1933) recognized that investment using leverage is highly treacherous:

> *"Thus over-investment and over-speculation are often important; but they would have far less serious results were they not conducted with borrowed money. That is, over-indebtedness may lend importance to over-investment or to over-speculation. The same is true as to over-confidence. I fancy that over-confidence seldom does any great harm except when, as, and if, it beguiles its victims into debt." - Irving Fisher (1933)*

The reason why leverage is a double-edged sword is that it allows to increase returns but if speculation goes wrong one can lose more than just his own equity. Moreover, if the debtor is unable to repay his debt the creditor will also find himself in trouble. If the creditor is a debtor himself like a bank things can get quickly out of control. Prior to the crisis an unprecedented buildup of debt took place. It were not only the homeowners that took on huge debts in form of mortgages. Investment banks like *Lehman Brothers* or *Bear Stearns* were leveraged $30:1$ while being extremely exposed to the real estate market at the peak of the bubble. It is tempting to run such high leverage ratios if things are calm because it allows to increase the return on investment. However, if there is only a small drop in the worth of assets owned by

the bank it will be unable to honor all its obligations as there is not enough equity to cover the losses. In particular, a leverage ratio of 30 : 1 implies that a depreciation of the assets by 3.3 % will lead to a default of the bank. But leverage was not limited to the private sector. State related entities like *Fannie Mae* and *Freddie Mac* were reported to run leverage ratios far above 30 : 1 while multiple countries ran huge deficits prior to the financial crisis due to the favorable financial conditions what resulted in a huge buildup of debt. As the bubble bursted everybody struggled to fix his balance sheet instead of spending and investing what deflated asset prices and put more downwards pressure on the economy. Debt-to-GDP ratios climbed further during the financial crisis as the public sector bailed out various institutions and financed huge programs to revive the economy.

Even though complex financial products and debt can explain the severity of the financial crisis in 2008, the question remains why did homeowners, investors and financial institutions took on such high debts? One explanation is that they took on too high risk because they were incentivized by the institutional framework they were facing. Another explanation for excessive risk taking is that they were not aware of the risk that they were taking. This would point to overoptimism or severely biased investor sentiments meaning that they expected a more prosperous and calm future than they were heading at.

In the following I will develop a model that builds on two factors; namely, *Collateral* based *Leverage* and *Investor Sentiments*. In the model there exists a risky asset that delivers a previously unknown payoff at the beginning of every period. Moreover, the risky asset might default at the beginning of every period before it delivers the previously unknown payoff. If the asset defaults it does not deliver any further payoffs. Nevertheless, there exists the possibility that the asset delivers a final previously known foreclosure payoff in case of a default. Overall, there are three fundamentals that drive the value of the risky asset. Namely, the previously unknown payoff of the asset, the probability of default and the probability to obtain the foreclosure payoff. Additionally, I assume that there exists a range of heterogeneous investors which differ in regards to their beliefs about the fundamentals. Some investors are more optimistic about the fundamentals while others are pessimistic about the fundamentals. After having formed their beliefs about the value of the asset, the investors trade the asset. This transaction process splits the investors into two groups: The optimistic investors will buy the asset while the pessimistic investors sell the asset. In a next setup I allow the investors to borrow money from each other in order to buy more units of the risky asset. In particular, I assume that the investors can trade a loan that promises the lender fixed payments over

a certain amount of periods. However, if the risky asset defaults the borrowers are unable to honor their debt. Therefore, I assume that every loan contract has to be backed by one unit of the risky asset. In this way a part of the loan can be repaid if the asset delivers a foreclosure payoff in case of a default. All in all, the investors are separated into three groups during the transaction process: The most optimistic investors buy the asset and take on loans to buy as much assets as they can. The moderate investors sell their assets and lend to the buyers. And the most pessimistic investors sell their assets and hold cash. Another important aspect of the model is how the leverage ratio behaves if changes in the fundamentals occur. In particular, I found that there is a negative relationship between the probability that the asset does not default and the leverage ratio as well as the expected payoff of the risky asset and the leverage ratio. The reason is that an increase in these two variables is more valuable for the buyers of the asset than for the lenders. As a result, the buyers bid up the asset price more than the creditors are willing to lend more per unit of collateral. Moreover, I found that there is a positive relationship between the probability that the asset delivers a foreclosure payoff and the leverage ratio. The reason is that an increase in that probability is more valuable for the lenders than for the buyers of the asset because it positively affects the quality of the collateral. As a result, the creditors are willing to lend more to the buyers per unit of collateral. Another aspect of the model is that the asset price is not much affected by leverage if there is only disagreement about the probabilities of cash flows among the investors, i.e. the probability of default and the probability of a foreclosure payoff. However, if the investors disagree about the cash flows, i.e. about the magnitude of the previously unknown payoff the asset delivers, the asset price is positively affected by leverage. In another section I will analyze how the asset price behaves if the investors overreact and are too optimistic as a group. It will be shown that overreaction leads to bigger swings in the asset price and that overoptimism can increase the asset price to a great extent.

2 Literature

2.1 Leverage

Geanakoplos and the Leverage Cycle

Leverage and lending in general has been investigated from different perspectives in economics. For example, collateral based lending in context of moral hazard issues has been studied in many papers. The logic is that lenders require borrowers to provide them with collateral