The Leverage Cycle

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Over the last dozen years or so John Geanakoplos has developed an important theory of asset pricing, leverage and collateral (Geanakoplos 1997, 2003, and Fostel and Geanakoplos 2008a, b). This paper provides an accessible exposition of this theory using illuminating numerical examples and relates it to the current crisis.

It is perhaps helpful to start by providing some context to John's contribution. Conventional models of asset pricing typically use a risk sharing framework. Classic examples are the Capital Asset Pricing Modal (CAPM), the consumption CAPM and their successors (for an excellent account, see Cochrane 2005). Most theories of asset pricing have been primarily tested using CRSP data for the U.S. that starts in 1926. This data set contains one extreme episode of a financial crisis in the 1920's and 1930's, namely the Crash of 1929, the subsequent banking problems of the early 1930's and the Great Depression. This series of events did not run its natural course as it was cut short by the Second World War. This involved the ultimate fiscal stimulus of fighting a major war that required expenditures of the order of 30-40 percent of GDP. In this case it was not necessary to worry about the long run effects of such massive expenditures because without them there would have been no long run.

During the 1930's and during the war itself the U.S. and most other countries put in place regulatory and other measures to prevent the occurrence of financial crises. These measures were extraordinarily successful in this respect. From the end of the Second World War in 1945 until the abandonment of the Bretton Woods agreement for fixed exchange rates in 1971 there was only one banking crisis in the entire world. That was in Brazil in 1962 and occurred together with a currency crisis (Bordo et al. 2001). However, this elimination of banking crises did not come without a cost. The measures adopted prevented the financial system from doing

its job of allocating resources. This led to financial liberalization and the relaxation of regulations in many countries. However, it also led to the return of banking crises.

The U.S. suffered relatively mild episodes such as the S&L crisis of the 1980's. Other parts of the world were less fortunate and many banking crises occurred (see, e.g., Kaminsky and Reinhart 1999). As the contributions of Kindleberger (1989, 1993), Bordo et al. (2001) and most recently Reinhart and Rogoff (2008a, 2008b, 2009) have shown, this was a return to normalcy. These works document that crises typically involve an expansion in credit that leads to a boom in asset prices, particularly real estate prices. Eventually boom turns to bust and prices collapse leading to extensive problems in the banking system. As Herring and Wachter (2003) recount, it is collapses in real estate prices that are so often the trigger for banking crises. Since the early 1970's many crises were in emerging economies but there were also many in developed countries such as Norway, Sweden and Finland in the early 1990's and Japan through the 1990's. Up until the current crisis, the example of Japan was perhaps the most extreme example of a crisis in a large country. The Nikkei index of stock prices peaked at just under 40,000 at the end of 1989. Almost 20 years later the index is trading in the range 7,000-10,000. Real estate prices fell from their peak in 1991 for about 15 years and ended up about 70-75 percent down from that peak.

It can be argued that U.S. CRSP stock price data are quite special because of the relative absence of crises and the feature that the Great Depression was cut short by the war. The fact that real estate prices did not fall in aggregate in the U.S. since the Great Depression is also rather unusual. Modern versions of conventional asset pricing theories do reasonably well explaining this data (Cochrane 2005). However, such risk sharing theories do not do a good job

of explaining boom and bust cycles or bubble episodes. The current crisis is an extreme financial and economic crisis and forces us to reassess our theories and produce new ones such as John's.

Standard risk sharing models assume people invest their own money, but this hasn't been realistic in most countries for many years. In practice financial institutions invest people's money. For example in most countries 70-80 percent is invested by institutions. In the U.S. the figure is slightly lower but has been rising in recent years. Risk sharing theories view these institutions as veils. Other theories, like John's, focus on the fact that much invested money is borrowed (see, e.g., Allen and Gorton 1993, Bernanke, Gertler and Gilchrist 1996, Kiyotaki and Moore 1997, Allen 2000, Allen and Gale 2000, 2007, Caballero and Krishnamurthy 2001, Morris and Shin 2004, and Adrian and Shin 2009). Many of these theories, such as Kiyotaki and Moore (1997), take the loan to value ratio or the "haircut" as given. One of the key contributions of John's work is that this is endogenous. In the current crisis the magnitude of changes in haircuts has been large. For example, Table 1 shows the typical haircut or initial margin before the crisis from January to May 2007 and in April 2008. These dramatic changes underline that it is of first order importance to understand what determines these ratios.

John's starting point is the idea that assets have *natural buyers* who value them more than other people. Some reasons for this preference are the following.

1. Less risk aversion.

2. Access to better hedging technologies.

3. More utility from assets.

4. Special information.

5. More optimism.

Much of the exposition in the paper focuses on the last of these for ease of exposition. There is a whole range of optimism about the arrival of good news with the most optimistic having probability h = 1 and the most pessimistic having h = 0. The optimistic are natural buyers while the pessimists are sellers. The level h* shown in Figure 1 is the level of optimism that leads to indifference between buying and selling. The price of the asset is determined by cash-in-the-market pricing. The optimists use their own funds and what they can borrow to buy while pessimists sell and lend their funds against the borrowers' collateral. The price is just the ratio of the total funds available to buyers to the amount sold by the pessimists. The more credit that is available the higher are asset prices.

The way that the haircut is determined in John's theory, is that there is a whole schedule of pairs (promised interest rate, collateral). If a borrower can't repay then he has to hand over the collateral. As would be expected, less secure loans with more risky collateral have higher interest rates. One of the key results is that with one dimension of risk and one dimension of disagreement, only one contract out of the whole possible schedule is actually traded. This is the one that maximizes the amount borrowed while at the same time being safe. The intuition behind this result is that the pessimists don't want to make risky loans because they attach a high probability to default. Optimists don't want to borrow with risky loans because this means they have to pay more in good states, which they attach higher probabilities to.

The paper develops very nice dynamics of what happens when new information comes in. John postulates the idea of "scary news". This is news that leads to lower expectations, while at the same time increasing uncertainty and disagreement. He shows that this kind of information can lead to dramatic changes in prices and collateral requirements. Good news gives rise to booms, while bad news leads to a bust that bankrupts the optimists. Price movements are amplified relative to the news that comes in.

One of the nice features of John's theory is that it can be applied to both the housing market and to the mortgage-backed securities market. He shows that the two interact in such a way that the effects are magnified. A bust in the housing market causes a drop in mortgage-backed securities. This increases haircuts, which in turn feeds back into the housing market.

The theory has a number of important implications for understanding the current crisis and why it has been so severe. Leverage became higher than ever before in the lead-up to the current crisis. One explanation of this is the huge increase in the reserves of many Asian central banks. John suggests that one of the reasons that the bust has also been so dramatic is that the introduction of credit default swaps (CDSs) near the peak of the market has allowed pessimists to push prices lower. The timing of their introduction, however, meant that they were unable to prevent prices going so high on the way up. As discussed, the combination of the two leverage cycles in housing and mortgage-backed securities reinforced the negative effects of each. The empirical fact that when loans are greater than collateral, there are typically large losses in collateral values has severely exacerbated the foreclosure losses from the bust. Finally, the leverage cycle has a dramatic effect on real economic activity. In the boom, there is a large incentive to build. However, in the bust this is reversed and construction ceases.

Overall, John's theory is very good at explaining what happened in countries like the U.S. and Spain, where real estate has played a primary role. However, it does not explain why countries such as Germany and Japan that did not have a real estate bubble and whose banks were not devastated did so badly. What is perhaps missing in the theory is that price discovery is very slow in some markets such as that for real estate. As mentioned above, it took 15 years for prices to adjust in Japan. In the U.S. real estate prices are still falling three years after the peak in July 2006. It is not at all clear when the bottom will be reached. However, it is not just real estate prices that are so uncertain in the current crisis. Other ones such as the price of oil have been very uncertain too. It was only in the summer of 2008 that oil prices peaked at $147 a barrel. Within a few weeks they had plummeted to around $40 a barrel. They then rose again to $70 a barrel and have been fluctuating since then. Other commodities and exchange rates have also been very volatile. This price uncertainty chills economic activity particularly the purchase of consumer durables such as automobiles and investment goods (Allen and Carletti 2009). It is unclear whether buyers should purchase fuel efficient designs because the price of oil will be high going forward or cheaper designs that are less fuel efficient. The optimal response is to wait and see. Unfortunately, many of these goods are traded. This is why countries like Germany and Japan that specialize in the production of automobiles and investment goods such as machine tools have done so badly even though they had no property bubble in recent years and their financial systems are in reasonable shape.

To conclude, John's work is extremely important in understanding many elements of the current crisis. This paper is an excellent summary of that work.

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Table 1

Typical "Haircut" or Initial Margin

(in percent)

	January-May 2007	April 2008
U.S. Treasuries	0.25	3
Investment-grade bonds	0-3	8-12
High-yield bonds	10-15	25-40

Sources: Citigroup; and IMF staff estimates – from International Monetary Fund (2008), Table 1.2, p. 23.

Figure 1

Natural Buyers and Sellers